

FOSTERING GENERAL COMPETENCIES THROUGH INTERDISCIPLINARY TRAINING: TEACHERS' PERCEPTIONS OF INTEGRATING HOME ECONOMICS AND STEAM

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Abstract

This study evaluates an in-service teachers' professional development initiative designed to integrate Home Economics (HE) with STEAM disciplines. Utilizing a mixed-methods case study ($N = 14$) at the Tallinn University Science Kitchen, the research assessed teacher perceptions of competence and implementation barriers following a five-day intervention. Findings reveal a significant shift in teacher identity; while only 21% reported prior STEAM competency, post-training engagement was exceptionally high, with a 100% immediate classroom application rate ($M = 5.43$). The specialized "makerspace" environment received a unanimous perfect score ($M = 6.0$), facilitating the development of integrated "knowledge-in-practice". However, a "transfer paradox" emerged: despite near-perfect teacher readiness to implement STEAM ($M = 5.93$), systemic constraints – specifically lack of shared planning time ($M = 4.57$) and disciplinary isolation – hinder school-wide integration. The study concludes that while HE is a vital "proto-STEAM" discipline, fulfilling national strategic goals requires moving beyond individual teacher training toward structural reforms that support interdisciplinary collaboration.

Keywords: *Home economics, STEAM, teacher professional development, science kitchen.*

1. Introduction

In the face of 21st-century societal challenges, educational systems are increasingly tasked with fostering transdisciplinary competencies that bridge the gap between abstract theory and sustainable everyday practice. While Science, Technology, Engineering, and Mathematics (STEM) have long been at the forefront of innovation, the contemporary shift toward STEAM (incorporating the Arts) introduces creativity, design thinking, and a human-centric focus into the technical disciplines (Paas et al., 2025). Within this landscape, Home Economics (HE) emerges as a vital, yet often underutilized, contextual bridge. By integrating the rigorous principles of STEAM approach with the practical, life-essential skills of HE, educators can create a "living laboratory" where scientific inquiry meets responsible daily living (IFHE, 2008).

1.1. The Context of home economics in estonia

In the Estonian educational system, HE is a compulsory subject within the "Technology" domain of the national curriculum for basic education (grades 4-9). While the subject is delivered by highly qualified specialists – typically holding Master's-level degrees – its pedagogical execution has historically faced a "dual-identity" challenge. Although the curriculum officially focuses on preparing learners for sustainable and healthy lifestyles (Paas et al., 2025), HE has frequently been marginalized as cooking. However, beyond food preparation, HE contains vast scientific potential as it encompasses a wide range of daily life skills, such as household maintenance, the safe use of chemicals, and textile care – all of which serve as practical applications of Chemistry and Physics. Despite this, a narrow focus on cooking skills over scientific inquiry often isolates the subject from the rest of the curriculum. This fragmentation makes it difficult for students to see how theoretical science applies to their everyday lives. Consequently, the subject's inherent potential as a cornerstone for transdisciplinary learning remains largely untapped.

1.2. Strategic drivers: The HANO initiative and education 2035

The gap between potential and practice is a central target of the *Education and Youth Sector Development Plan 2021–2035*. This strategic document prioritizes the “consistent succession of qualified personnel” capable of delivering integrated, competence-based education (Ministry of Education and Research, 2021). To put into practice these national objectives, the HANO program (*Initial and Continuing Education and Succession of Personnel in the Education and Youth Sector*) was established.

HANO aims to replace traditional, fragmented teaching with a more connected approach. Within this broader initiative, the five-day course “Supporting General Competencies: Integrating STEAM Disciplines and Home Economics in Practical Education” designed for in-service teachers serves as a specialized intervention. By repositioning HE at the intersection of Science and Technology, this course demonstrates how the subject can transition from a secondary elective into a vital contributor to the national “integrated education” paradigm.

1.3. Theoretical framework and the role of the science kitchen

The pedagogical architecture of the HANO training is anchored in Situated Learning (Brown et al., 1989) and Experiential Learning (Kolb, 2014) theories, which ground abstract STEAM concepts in “familiar, real-life household tasks”. This framework facilitates the development of teachers’ Technological Pedagogical Content Knowledge (TPACK) (Mishra & Koehler, 2006), ensuring that the integration of science and Home Economics is transformative rather than merely additive.

To operationalize these theories, the program utilizes The Science Kitchen (Teadusköök) at Tallinn University. As a social-constructivist makerspace and European innovation hub, this environment allows culinary technology and scientific equipment to converge, deconstructing daily activities as scientific phenomena. By solving “wicked problems” related to sustainability and health within this specialized space, the training aligns with the Council Recommendation on Key Competences for Lifelong Learning (European Union, 2018). Ultimately, this synergy between theory and environment aims for a “cascading impact” (Guskey, 2002), equipping teachers to enhance students’ scientific literacy and essential “learning-to-learn” skills.

1.4. The current study: Problem and knowledge gap

Despite the strategic mandate within the Estonian Education Strategy 2035 to foster interdisciplinary competence, a significant problem remains: HE has traditionally been confined to the instruction of basic culinary skills, treated as a siloed practical skill set rather than a scientific discipline. This isolation prevents students from synthesizing theoretical STEAM knowledge with practical, everyday applications. By treating the kitchen and the household as a laboratory, these activities become ideal vehicles for connecting HE with the STEAM framework. While general STEAM research is abundant, a specific knowledge gap exists regarding how HE teachers – who manage unique “kitchen-laboratory” environments – perceive their role within this framework and what specific challenges they face during the pedagogical transition.

This study seeks to address this gap by evaluating the HANO training initiative, with the primary objective of investigating the potential of HE as a cornerstone for STEAM education. Specifically, the research aims to assess how in-service teachers perceive their evolving competence and the relevance of STEAM integration following specialized training, while also identifying the pedagogical, environmental, and institutional barriers they face when implementing this integrated model in their respective schools.

2. Methodology

To evaluate the impact of the HANO training, a group case study was conducted using a mixed-methods approach. The five-day course took place between September 10 and December 10, 2025, utilizing a multifaceted pedagogical approach that combined theoretical frameworks with collaborative group work, discussions, inquiry-based investigations, and practical activities incorporating technological tools. Through active participation, the course aimed to demonstrate the conceptual and practical integration of HE and STEAM.

Data collection was administered immediately following the training. The study involved 16 teachers specializing in Handicraft and Home Economics, with 14 providing complete responses for analysis. The quantitative sections utilized a 6-point Likert scale (1 = “Strongly Disagree”; 6 = “Strongly Agree”), while open-ended questions provided qualitative depth (Creswell & Creswell, 2017). The evaluation followed Guskey’s (2002) framework for professional development, specifically focusing on Level 1 (Participants’ Reactions) and Level 2 (Participants’ Learning).

The questionnaire was divided into seven thematic sections designed to capture the transition from individual attitudes to professional practice: 1. Attitudes and Competence: Assessing baseline views on innovation and prior STEAM exposure (e.g., *“I maintain a positive attitude toward implementing innovative topics in my teaching”*); 2. Course Content: Evaluating the scientific rigor and relevance of the curriculum (e.g., *“The topics and methods used were clearly science-based and reliable”*); 3. Learning Process: Focusing on the efficacy of inquiry-based activities (e.g., *“Activities provided an opportunity to apply scientific inquiry methods”*); 4. Instructional Materials: Assessing the clarity and visual utility of resources; 5. Instructor Efficacy: Evaluating the pedagogical expertise of the trainers; 6. Physical Environment: Analyzing the role of the Science Kitchen as a makerspace (e.g., *“The environment encourages teamwork and discussion”*); 7. Implementation: Identifying future intentions and barriers (e.g., *“Time constraints are the primary inhibitor to applying what I have learned”*).

3. Results

The quantitative analysis of the valid responses indicates a high level of professional engagement and pedagogical satisfaction among the participants. The cohort demonstrated a strong baseline commitment to professional growth, as evidenced by high mean scores for the importance of self-development ($M = 5.71$) and a positive disposition toward educational innovation ($M = 5.79$). Despite this motivation, a notable “competency gap” was identified regarding the STEAM framework; prior to the intervention, 43% of participants had only superficial exposure to the concept, and 36% had applied it only partially, with only a small minority (21%) reporting prior competency in interdisciplinary integration. Following the training, satisfaction with the scientific depth and reliability of the course’s curriculum was high ($M = 5.58$), and instructor performance was rated near the scale’s ceiling ($M = 5.97$). Notably, the Science Kitchen’s physical facilities as a specialized learning environment received a unanimous perfect score ($M = 6.0$). The course demonstrated immediate practical utility, with 100% of participants already implementing the methods in their classrooms ($M = 5.43$). Notably, 57% reported the maximum score for immediate application, with no neutral or negative responses. Participants rated these initial efforts as highly successful ($M = 5.21$), reflecting their strong intrinsic commitment to future HE-STEAM projects ($M = 5.93$).

Qualitative feedback from open-ended responses corroborated these metrics, revealing three primary thematic clusters: Transformative Perspective, Practical Utility, and Structural Concern. Participants frequently noted that the training “opened their eyes” to scientific connections they were already performing but could not previously articulate or label as STEAM. The Science Kitchen environment was repeatedly described as “inspiring” and “safe”, which lowered the barrier for experimentation. However, the qualitative data also illuminated the practical transition gap; while teachers expressed a near-perfect readiness to invest personal energy into implementation ($M = 5.93$), their comments highlighted a “systemic trap”. Implementation barriers were cited as being out of the individual teacher’s control, specifically the lack of shared planning time ($M = 4.57$) and the difficulty of finding cross-disciplinary partners ($M = 4.0$) within rigid school schedules.

4. Analysis

The results reveal tension between high individual teacher agency and rigid institutional frameworks. The unanimous appraisal of the Science Kitchen’s environment ($M = 6.0$) suggests that for HE teachers, physical space is not merely a background but a “pedagogical participant”. By transforming a domestic setting into a scientific makerspace, the training facilitated situated learning (Brown et al., 1989), allowing teachers to reconstruct their professional identity. This is evidenced by the high rating for deepened scientific understanding ($M = 5.86$); the training did not just provide new facts but provided a new “academic lens” through which teachers could view their existing practice. This shift is essential for TPACK development, as it moves the teacher from possessing isolated subject knowledge to possessing integrated “knowledge-in-practice”.

The 100% immediate classroom application rate ($M = 5.43$) further suggests that the training successfully bridged the “theory-practice gap” by providing practical, “low-floor” entry points for change. According to Guskey’s (2002) framework, this rapid adoption of new practices is a critical indicator of success, as positive initial experiences ($M = 5.21$) are the strongest predictors of long-term pedagogical shift and teacher retention in innovative programs.

However, the analysis highlights a significant “transfer paradox”. While participants reported a near-perfect readiness to invest personal energy into STEAM implementation ($M = 5.93$), the perceived ease of integration in their home schools was notably lower ($M = 4.71$). This discrepancy indicates that the cascading effect – where teacher training directly benefits pupil outcomes – is currently being throttled by the “siloed” organizational structure of schools. The identified barriers of time ($M = 4.57$) and a lack of collaborative partners ($M = 4.0$) suggest that HE teachers often continue to operate as “disciplinary islands”.

When teachers noted that the training “opened their eyes” to connections they were already making, it reinforces the concept that HE has always been “proto-STEAM” but lacked the formal recognition and collaborative infrastructure to be treated as such. Therefore, the analysis suggests that the success of STEAM in the Estonian context depends less on further teacher motivation – which is already at a ceiling – and more on structural reform. Specifically, the results point to a need for “shared pedagogical spaces” and joint planning time between HE and natural science departments to turn individual teacher competence into a sustainable, school-wide interdisciplinary practice.

4.1. Limitations of the study and further suggestions

The primary limitation of this study is the small sample size, which precludes broad generalization or advanced statistical modeling. As data were collected immediately following the training, the results may be influenced by “social desirability bias” (Fisher, 1993) or the “recency effect” (Baddeley & Hitch, 1993). Furthermore, while 100% of participants reported immediate classroom application, this study lacks a longitudinal component to evaluate long-term pedagogical shifts or impact on student learning outcomes (Guskey’s Level 5). Finally, the perfect scores for the Science Kitchen environment suggest that replicating these results in standard, less-equipped school kitchens may present additional challenges.

To sustain the momentum of the HANO initiative, future professional development should adopt an interdisciplinary pair-training model, where HE and Science teachers from the same institution attend together. This would directly mitigate the “lack of partners” barrier. Additionally, research should focus on developing a “Low-Tech HE-STEAM Toolkit” to provide methods for applying scientific principles in standard school environments without laboratory-grade equipment. Future studies should also establish integrated assessment rubrics to measure the development of students’ general competencies in combined HE-STEAM settings.

5. Summary

The HANO training successfully empowered Estonian Home Economics teachers to reclaim their subject as a vital, “proto-STEAM” discipline. The study’s most significant finding is the 100% immediate classroom application rate, which proves that the “theory-practice gap” can be bridged through situated, hands-on professional development. However, while individual teacher motivation is at a ceiling, the sustainable transfer of this knowledge remains challenged by systemic time constraints and disciplinary isolation. To fulfill the strategic goals of the Estonian Education Strategy 2035, the focus must now shift from individual teacher training toward structural reforms that foster interdisciplinary collaboration and shared pedagogical spaces.

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