ISSN: 2181-3337 | SCIENTISTS.UZ VOLUME 5 ISSUE 7 JULY 2026

PROBLEM-SOLVING COMPETENCY AS A DIMENSION OF CREATIVE COMPETENCY AMONG PRE-SERVICE TECHNOLOGY TEACHERS IN UZBEKISTAN: A DESCRIPTIVE SURVEY

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DOI: 10.67620/sai.57b0020

ABSTRACT
Creative competency is increasingly emphasized in teacher preparation and includes several related dimensions. This study examined problem-solving competency as one dimension of creative competency among pre-service technology teachers in Uzbekistan. A quantitative descriptive design was used with 130 participants purposively recruited from three higher education institutions: the National Pedagogical University of Uzbekistan named after Nizami, Termez State Pedagogical Institute, and Bukhara State University. Data were collected through a 15-item online, scenario-based assessment that underwent expert content review. Percentage scores were summarized using three descriptive bands defined for this study: low (0%-40%), medium (41%-70%), and high (71%-100%). Half of the participants were classified in the medium band (n = 65, 50.0%), 32 were in the low band (24.6%), and 33 were in the high band (25.4%). The distribution shows substantial variation in problem-solving performance across the sample. Because the score bands were not externally validated and no reliability coefficient is reported, the results should be interpreted descriptively rather than diagnostically. Design Thinking is discussed as a pedagogical framework that may inform future intervention research; it was not tested in this study. The findings provide a baseline for further instrument validation and research on problem-solving development in technology teacher education in Uzbekistan.

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10.08.26

Keywords: *creative competency, problem solving, pre-service teachers, technology education, Design Thinking, Uzbekistan.*

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Introduction

Rapid technological change has expanded the professional demands placed on teachers who prepare learners to work with tools, systems, design processes, and emerging technologies. International competency frameworks increasingly position creativity, critical thinking, and problem solving as important learning outcomes rather than optional enrichment. The Partnership for 21st Century Learning framework identifies creativity and innovation together with critical thinking and problem solving among core learning and innovation skills (Battelle for Kids, 2019). Similarly, the OECD Learning Compass 2030 includes creativity and problem solving among the competencies needed to navigate unfamiliar contexts and shape future outcomes (OECD, 2019). UNESCO's ICT Competency Framework for Teachers also

emphasizes the role of teacher development in enabling learners to become collaborative, creative problem solvers in technology-rich educational environments (UNESCO, 2018).

Creativity itself is commonly understood as involving both originality and effectiveness or appropriateness (Runco & Jaeger, 2012). In professional teaching, however, creativity is broader than idea generation alone. It can involve recognizing ill-structured problems, reframing constraints, generating alternatives, selecting workable solutions, and adapting those solutions to learners and contexts. For technology teachers, these processes are particularly relevant because classroom tasks frequently combine pedagogical, technical, material, and design constraints.

Uzbekistan has continued to reform its education system within a contemporary legal framework established by the 2020 Law on Education (Republic of Uzbekistan, 2020). Within this context, evidence about the competencies of future teachers can help teacher educators identify areas in which curricula and practical training may need strengthening. Empirical work focused specifically on the creative and problem-solving competencies of pre-service technology teachers in Uzbekistan remains limited relative to the broader international literature. The present study contributes descriptive evidence from three higher education institutions.

Creative Competency and Problem-Solving

Creative competency is best treated as a multidimensional construct rather than a single score that can be fully represented by one skill. The standard definition of creativity emphasizes the production of outcomes that are both original and effective (Runco & Jaeger, 2012), while broader educational frameworks connect creativity with critical thinking, collaboration, reflection, and problem solving (Battelle for Kids, 2019; OECD, 2019). Accordingly, a measure focused on problem solving can provide information about an important component of creative performance, but it should not be interpreted as a comprehensive measure of creativity.

Problem solving is especially relevant to technology teacher preparation because technology education involves identifying needs, working within constraints, testing alternatives, and refining solutions. These processes overlap with creative thinking when problems are open ended and permit multiple plausible pathways. Research with pre-service teachers in other contexts has likewise shown uneven performance on tasks that require flexible or varied solutions. For example, Ubah and Ogbonnaya (2021) found that many pre-service primary teachers had difficulty generating varied solutions to pattern-based problem-solving tasks. Although their context and assessment differed from the present study, their findings illustrate the importance of examining problem-solving processes directly rather than assuming that teacher candidates automatically acquire them through disciplinary coursework.

Accordingly, this study focuses specifically on problem-solving competency as one dimension of creative competency. The assessment does not represent the full construct of creativity, and the descriptive design does not support causal explanations for participants' performance.

Design Thinking as a Pedagogical Implication

Design Thinking has attracted interest in education because it organizes problem solving around iterative, human-centered processes such as understanding needs, defining problems, generating ideas, prototyping, testing, and revising. Razzouk and Shute (2012) described Design Thinking as an analytic and creative process involving experimentation, model creation, feedback, and redesign. Henriksen et al. (2017) further argued that Design Thinking can help educators approach complex problems of practice that do not have simple linear solutions.

Research reviews support the relevance of Design Thinking to educational settings while also showing that its implementation varies substantially. Cook and Bush (2018) described Design Thinking as a useful approach for integrated STEAM learning, and Li and Zhan's (2022) systematic review of K-12 Design Thinking-integrated learning identified its use in developing a range of twenty-first-century competencies. More recently, Alvarado (2025) reviewed Design Thinking as an active methodology in

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higher education and reported recurring associations with creativity, problem solving, critical thinking, active participation, and interdisciplinary collaboration.

On this basis, Design Thinking is considered a relevant pedagogical framework for future work in technology teacher education. The current study did not implement an intervention, so no conclusions are drawn about its effectiveness. Its role here is to inform pedagogical interpretation and identify a direction for subsequent experimental or quasi-experimental research.

Study Purpose and Research Question

The purpose of this study was to describe the distribution of problem-solving competency scores among pre-service technology teachers in Uzbekistan using the study assessment and aggregate score distribution. The following research question guided the analysis:

How are problem-solving competency scores distributed across low, medium, and high descriptive bands among the participating pre-service technology teachers?

Method

Research Design

A quantitative descriptive, cross-sectional design was used to characterize the distribution of problem-solving scores among the participating pre-service technology teachers. The study did not test causal relationships or intervention effects, making a descriptive design appropriate to the research question (Creswell & Creswell, 2018).

Participants and Sampling

The sample consisted of 130 pre-service technology teachers enrolled at three higher education institutions in Uzbekistan: the National Pedagogical University of Uzbekistan named after Nizami, Termez State Pedagogical Institute, and Bukhara State University. Participants were selected through purposive sampling from technology teacher education programs. The use of three institutions broadened the geographical and institutional coverage of the study, but purposive sampling does not support claims of national representativeness. The present analysis treats the 130 participants as one aggregate sample and does not make institution-level comparisons.

Instrument

Data were collected using a 15-item online assessment administered through Google Forms. The items presented pedagogical problem scenarios and required participants to identify or formulate an appropriate solution. The assessment was developed for the study with reference to competency-oriented teacher education and international frameworks that emphasize creativity and problem solving. Content was reviewed by the research supervisor and subject-matter specialists in pedagogical sciences before administration.

Total performance was converted to a percentage score. Scores were then classified into three descriptive bands defined for this study: low (0%-40%), medium (41%-70%), and high (71%-100%). These categories were used to summarize the observed score distribution and were not treated as externally validated diagnostic cut scores. A reliability coefficient and detailed item-level psychometric statistics are not reported. Accordingly, the assessment is interpreted as a locally developed descriptive measure rather than a fully validated scale.

Procedure and Ethical Considerations

The online assessment was distributed to participants through their academic departments. Participation was voluntary, and participants were informed that the data were being collected for academic research purposes. Responses were collected anonymously, and no personally identifying information was reported in the study dataset. Data collection was conducted across the three participating institutions using the same online format.

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Data Analysis

Frequencies and percentages were used to summarize the distribution of participants across the three descriptive score bands. To indicate sampling uncertainty around each proportion, 95% Wilson confidence intervals were calculated from the observed counts. The analysis was conducted for the sample as a whole; institution-level and demographic inferential analyses were not performed.

Results

The distribution of the 130 participants is presented in Table 1. The largest group was the medium band, which contained exactly half of the sample (n = 65, 50.0%). The low and high bands were nearly equal in size: 32 participants (24.6%) were classified in the low band, and 33 participants (25.4%) were classified in the high band.

Table 1

Distribution of Problem-Solving Competency Scores (N = 130)

Score band	Score range	n	%	95% CI
Low	0%-40%	32	24.6	18.0%-32.7%
Medium	41%-70%	65	50.0	41.5%-58.5%
High	71%-100%	33	25.4	18.7%-33.5%
Total	-	130	100.0	-

Note. Confidence intervals are Wilson 95% confidence intervals for proportions. The score bands were defined for descriptive analysis in this study and do not represent externally validated diagnostic thresholds.

The 95% confidence interval for the medium-band proportion ranged from 41.5% to 58.5%. The corresponding intervals were 18.0% to 32.7% for the low band and 18.7% to 33.5% for the high band. The near-equal low- and high-band proportions show variation in performance across the sample. Because no external proficiency benchmark was used, these categories describe the score distribution and should not be interpreted as pass/fail or competence/incompetence classifications.

Discussion

Interpretation of the Findings

Problem-solving performance was distributed across all three descriptive bands, with the medium band containing the largest share of participants. Exactly half of the sample fell in the medium band, while the remaining half was almost evenly divided between the low and high bands. This pattern indicates substantial variation in problem-solving performance rather than concentration in a single performance band.

This finding is relevant to teacher education because problem solving is one component of the broader set of competencies associated with creativity and future-oriented learning (Battelle for Kids, 2019; OECD, 2019). The assessment focused on problem-solving scenarios; therefore, the findings refer specifically to this dimension and do not represent participants' overall creative competency. Other dimensions, including originality, flexibility, divergent production, creative self-efficacy, collaboration, and the quality of implemented products, were not measured separately.

The uneven distribution is broadly compatible with research showing that pre-service teachers can vary substantially in their ability to generate or apply flexible solutions. Ubah and Ogbonnaya (2021), for example, reported difficulty among a substantial portion of pre-service teachers when tasks required varied creative solutions. Direct numerical comparison is not appropriate because the participants, tasks, and scoring systems differ, but both studies point to the value of making creative problem solving an explicit object of assessment and instruction.

Implications for Technology Teacher Education

The findings suggest that technology teacher education programs could provide more systematic opportunities for candidates to practice ill-structured problem solving, generate multiple alternatives,

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justify design choices, test prototypes, receive feedback, and revise solutions. Such experiences would align with the broader emphasis on creativity and problem solving in international competency frameworks (OECD, 2019; UNESCO, 2018).

Design Thinking is one possible framework for organizing such experiences. Its iterative movement among understanding users, defining problems, ideating, prototyping, testing, and revising is conceptually aligned with the types of open-ended problem solving required in technology and STEAM education (Cook & Bush, 2018; Razzouk & Shute, 2012). Reviews of Design Thinking in K-12 and higher education also report recurring links with creativity, problem solving, collaboration, and active learning (Alvarado, 2025; Li & Zhan, 2022).

The study did not test whether Design Thinking improves problem-solving scores. Future research could develop a validated competency measure and evaluate a structured Design Thinking intervention using a pretest-posttest design, preferably with a comparison group. Such a study could examine not only total scores but also specific components such as problem identification, idea fluency, solution originality, feasibility, iteration, and reflection.

Limitations and Future Research

This study has several limitations. First, purposive sampling from three institutions limits generalizability to the national population of pre-service technology teachers. Including participants from multiple institutions broadens coverage but does not make the sample statistically representative of Uzbekistan.

Second, the instrument assessed problem solving rather than the full multidimensional construct of creative competency. Its reliability and item-level psychometric properties require further evaluation, and the low, medium, and high cut points have not been externally validated. The score bands therefore function only as descriptive categories. Future research should pilot the instrument, document the response format and scoring rubric in detail, quantify content validity, report internal-consistency or inter-rater reliability as appropriate, and examine construct validity.

Third, the analysis was limited to aggregate frequency data. It did not examine institution-level sample sizes, demographic characteristics, item-level patterns, means, standard deviations, or raw-score distributions. Future studies should retain and analyze these data so that subgroup variation, item difficulty, and the specific types of problem-solving tasks that are most challenging can be evaluated.

Finally, the cross-sectional descriptive design cannot identify causes of participants' performance or establish the effectiveness of Design Thinking. Longitudinal, experimental, or quasi-experimental studies are needed before causal claims about pedagogical interventions can be made. The ethical procedures described in this study include voluntary participation and anonymous reporting, but formal ethics approval or exemption status is not documented. Future research should record this status explicitly in accordance with institutional and journal requirements.

Conclusion

This study provides a descriptive baseline of problem-solving competency, treated as one dimension of creative competency, among 130 pre-service technology teachers from three higher education institutions in Uzbekistan. Half of the participants fell within the medium score band defined for this analysis, while approximately one quarter fell in each of the low and high bands. The distribution demonstrates substantial variation in performance but should not be interpreted as a national estimate or as evidence against an external proficiency standard.

Overall, the findings describe variation in problem-solving performance rather than overall creative competency. Design Thinking offers a relevant direction for future research but requires direct evaluation using validated measures and stronger research designs. Future studies should strengthen sampling, retain item-level data, and establish psychometric validity.

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