STRUCTURAL AND FUNCTIONAL DESIGN OF TECHNOLOGICAL COMPETENCE DEVELOPMENT IN SCHOOL TECHNOLOGY EDUCATION

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Abstract. *This paper proposes a structural and functional design for developing technological competence in school technology education. The design includes goal-oriented, methodological, content, process and diagnostic blocks. It treats competence development as a systemic process in which technological knowledge, practical design, collaboration and reflection are coordinated through integrative learning tasks.*

Keywords: *structural-functional design, technological competence, school technology education, pedagogical model, competence components*

INTRODUCTION

A structural and functional design is necessary when an educational outcome consists of several interdependent components. Technological competence belongs to this category. It is not a single skill, nor is it limited to knowledge about tools or materials. It includes understanding, planning, safe operation, collaborative action and evidence-based evaluation. School technology education often faces a methodological contradiction. On the one hand, it is expected to prepare learners for a technologically complex environment. On the other hand, classroom practice may remain centred on product reproduction. A structural-functional design helps to overcome this contradiction by aligning goals, content, activity and assessment.

The purpose of this article is to develop a model that describes how technological competence can be formed through technology lessons organized according to an integrative approach.

METHODS

The study uses systemic modelling and conceptual analysis. The theoretical basis includes competence-based education, technological and engineering literacy standards, experiential learning and assessment theory. Each component of the design was derived from the functional requirements of a technology lesson. The model was constructed in five blocks. The goal block defines the intended competence outcome. The methodological block includes integrative, activity-based, competence-oriented and reflective principles. The content block selects interdisciplinary knowledge and practical tasks. The process block organizes learner action. The diagnostic block identifies criteria and levels.

The analytical procedure focused on the relationship between structure and function. A component was included in the model only if it performed a necessary pedagogical function in competence development.

RESULTS

The goal block defines the development of learners capable of analysing a technological problem, selecting appropriate resources, planning operations, creating a product and evaluating outcomes. This goal differs from a narrow objective such as “learning to use a tool” because it requires independent technological reasoning. The methodological block is based on four principles. The integrative principle requires the connection of scientific, digital, ecological and economic knowledge. The activity principle requires hands-on design and implementation. The competence principle requires transfer of knowledge to a practical situation. The reflective principle requires analysis of decisions and errors.

The content block includes materials, tools, technological processes, safety rules, digital sketches, elementary design documentation and ecological responsibility. Content is not presented as separate theoretical information. It is embedded in tasks such as designing, making, testing and improving a product. The process block includes six stages: problem setting, interdisciplinary inquiry, design planning, practical implementation, presentation and reflective evaluation. The diagnostic block includes criteria related to knowledge, action, collaboration and reflection.

DISCUSSION

The model shows that competence development is possible only when classroom elements are aligned. A technology lesson may include practical work, but if the learner does not plan, justify or evaluate the process, competence remains incomplete. Similarly, theoretical explanation without practical decision making does not produce technological readiness. The structural-functional design clarifies teacher actions. The teacher should not simply demonstrate an operation. The teacher creates a task context, supports inquiry, guides safety, organizes collaboration and uses criteria for feedback. This role corresponds to contemporary views of teaching as pedagogical design.

For schools, the model may serve as a basis for lesson planning, methodological training and development of diagnostic instruments. It can also help identify weaknesses in current practice. For example, if reflection is absent, the diagnostic block will show that competence development is not fully supported. Empirical validation remains a necessary next step. The model should be tested through classroom observation, student work analysis and comparison of learning outcomes across different task designs.

The structural-functional design is useful because it distinguishes between the elements of the model and their pedagogical work. A component that has no function in the learning process should not be included. Conversely, a necessary function such as reflection or safety control must have a visible place in the structure. The goal block provides direction for all other blocks. If the goal is competence, the content cannot remain purely informative and the assessment cannot remain product-centred. Alignment between goal, activity and diagnosis is the core principle of the design.

The process block is the most dynamic part of the model. Students may move back from practical implementation to redesign when a mistake appears. This iterative movement reflects the real nature of technological work and should be treated as learning rather than failure. The diagnostic block transforms the model into a research tool. It allows the teacher or researcher to observe development in separate components, compare groups and identify methodological weaknesses. Without diagnostics, the model cannot be evaluated empirically.

The design can support teacher professional development. Teachers can analyse their lessons by asking which block is weak: unclear goal, disconnected content, passive learner activity or insufficient assessment. This makes the model practical for school improvement.The model also supports curriculum coherence. Different grade levels may use different materials and tasks, but the same structural logic can be preserved. This continuity helps competence development become cumulative rather than accidental.

CONCLUSION

The structural-functional design provides a systematic framework for developing technological competence in school technology education. It integrates goals, principles, content, learning process and diagnostics into one pedagogical system. The proposed design can support curriculum implementation and methodological improvement. Its value lies in connecting technology learning with real design thinking, practical activity and reflective assessment.

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