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# Communicative-Imaginative Competence in Light Industry Vocational Education Through Collaborative Learning and Digital Technologies

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**ABSTRACT**

Communicative and imaginative competence is important for garment-sector vocational students who must interpret designs, communicate production requirements, and solve practical problems. This study examined an integrated instructional model combining collaborative projects, interactive creative-thinking techniques, and a specialized mobile application for garment education. A quasi-experimental approach compared students in experimental and control groups at vocational institutions in Uzbekistan. Evidence was collected through competence assessments, classroom observations, project evaluations, and student feedback. The findings indicated changes in achievement-level distributions and suggested potential benefits for spatial visualization and technical communication. However, the reported statistical indicators require further verification before the intervention's effectiveness can be established conclusively. The proposed approach provides a framework for integrating professional communication, imaginative reasoning, and digital resources in vocational education.

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## 1. INTRODUCTION

Vocational education plays an important role in preparing skilled professionals who can adapt to technological developments, industrial transformation, and changing workplace requirements. In the light industry sector, particularly garment manufacturing, students are expected to acquire not only technical knowledge and practical production skills but also communication, creativity, collaboration, and problem-solving abilities. Integrating these competencies with theoretical knowledge and practical activities is essential for strengthening professional readiness and the relevance of vocational education [1, 2].

Garment manufacturing involves complex processes requiring the interpretation of technical drawings, pattern development, material selection, sewing operations, and product assembly. Students must understand the relationships between two-dimensional garment patterns and three-dimensional product structures while communicating technical information accurately during production activities. These requirements highlight the importance of communicative-imaginative competence, which combines the ability to visualize technical objects, interpret spatial relationships, articulate ideas, and develop creative solutions. Digital resources designed for sewing technology can support the visualization of garment structures and the understanding of manufacturing procedures [3].

The development of communication, creativity, critical thinking, and collaboration can contribute to more active learning and improved educational achievement [4]. Furthermore, the systematic explanation of specialized technical terminology can support students' understanding of engineering concepts and their ability to communicate technical information effectively [5].

The development of these competencies requires instructional approaches that provide opportunities for active participation and practical problem solving. Collaborative learning encourages students to exchange ideas, explain technical decisions, evaluate alternative solutions, and develop shared understanding through group activities. Interactive teaching methods can also support professional competence by connecting theoretical concepts with authentic technical tasks. The integration of competency-oriented instruction, collaborative activities, and practical learning experiences has been examined as an approach to strengthening students' professional readiness and learning outcomes [1, 2, 6, 7].

Digital learning technologies provide additional opportunities to improve the accessibility and effectiveness of vocational instruction. Mobile applications, instructional videos, interactive visual materials, and self-assessment resources can complement classroom activities by allowing students to review technical procedures and explore concepts independently. Mobile learning has been examined as a means of supporting access to educational resources and collaborative learning [8, 9]. Video-based instruction has also been investigated for improving conceptual understanding and addressing misconceptions among vocational students [10]. In garment-related education, specialized mobile applications offer opportunities to visualize sewing procedures and provide instructional support for practical clothing production [3].

Despite these developments, the integration of communicative and imaginative competencies into a unified instructional framework remains an important challenge in light industry vocational education. Communication, spatial visualization, creative thinking, and technical knowledge are closely connected in garment manufacturing; however, they are not always addressed together within conventional classroom activities. In addition, the

educational contribution of combining collaborative learning, interactive cognitive methods, and specialized digital resources requires further investigation in garment-related vocational settings. A structured instructional model is therefore needed to connect these competencies with practical learning activities and measurable educational outcomes.

This study aims to develop and evaluate an integrated pedagogical model for improving communicative-imaginative competence among vocational education students specializing in light industry in Uzbekistan. The model combines collaborative learning, interactive methods such as SCAMPER and decomposition, and a specialized mobile application known as CLOTHING within the subject of Garment Sewing Technology. Its effectiveness is examined through comparisons of students' competence levels in experimental and control groups. The novelty of this study lies in integrating technical communication, spatial imagination, collaborative problem solving, and mobile-supported learning into a unified pedagogical model specifically designed for garment manufacturing education. The findings are expected to provide insights into competency-based instructional strategies and the development of vocational learning environments that support professional preparation in the light industry sector.

## 2. RESEARCH METHODOLOGY

### 2.1. Research Design and Participants

This study employed a quasi-experimental pre-test-post-test control-group design to evaluate changes in communicative-imaginative competence among vocational education students. The research was conducted from 2021 to 2024 at three institutions in Uzbekistan: Bogot Light Industry Technical School, Vobkent Industrial and Transport Technical School, and Tashkent City Designer and Technologists Training Technical School. A total of 387 students enrolled in the Production Training (Light Industry) specialization (qualification code 50110401) participated in the study, comprising 197 students in the experimental group and 190 in the control group. The experimental group received instruction through an integrated pedagogical model incorporating collaborative learning, interactive cognitive methods, and specialized digital resources, while the control group followed the regular vocational education curriculum. The research consisted of initial competency assessments, instructional implementation, and final evaluations. Quantitative assessments were used to compare learning outcomes between groups, while observations, project evaluations, surveys, and interviews provided supplementary information on students' learning experiences and participation.

### 2.2. Development of the Pedagogical Model

The pedagogical model was developed to integrate communicative and imaginative competencies into the teaching of specialized light industry subjects. The model consisted of three interconnected components: goal-oriented, functional-content, and result-oriented. The goal-oriented component defined the educational objectives associated with developing professional communication, spatial visualization, creative problem solving, and practical competence. These objectives were aligned with the instructional requirements of garment manufacturing education and the professional capabilities expected of light industry specialists. The functional-content component integrated technical learning materials with collaborative and interactive instructional activities. The principal subject used to implement

the model was Garment Sewing Technology. Learning activities were designed to connect the interpretation of garment structures, technical terminology, design modifications, and production procedures with opportunities for discussion and practical problem solving. The result-oriented component established the framework for evaluating communicative-imaginative competence. Students' achievement was classified into productive, motivational, and creative levels, corresponding to low, medium, and high competence categories, respectively.

**Figure 1** illustrates eight interconnected elements of communicative-imaginative competence, including spatial visualization, technical terminology, verbal explanation, decision-making, and collaborative communication. The development of the pedagogical model was informed by competency-oriented approaches that emphasize the integration of theoretical knowledge, practical learning activities, and professional readiness in vocational education [1, 2].




**Figure 1.** Structure of communicative-imaginative competence.

### 2.3. Implementation of Collaborative and Interactive Learning

The instructional intervention incorporated collaborative learning activities and interactive cognitive methods into Garment Sewing Technology. The instructional program comprised 90 hours of learning activities. Collaborative learning was implemented through small-group activities involving three to four students. These activities included garment design projects, discussions of technical problems, role-playing exercises, and peer evaluation. Students were encouraged to explain technical decisions, negotiate design modifications, and communicate proposed solutions during group activities. Several interactive methods were incorporated into the instructional approach. The SCAMPER method was used to encourage creative modification of garment designs through substitution, combination, adaptation, modification, alternative uses, elimination, and rearrangement. The decomposition method involved dividing complex garment structures into smaller components, such as collars,

sleeves, and bodices, to facilitate the analysis of construction processes and component relationships. The association method was used to connect technical terminology with visual representations and familiar garment structures. In addition, the three-perspective instructional method, referred to as the 3D Method, encouraged students to examine concepts through their definitions, practical applications, and explanations to peers. These activities were designed to connect conceptual understanding with technical communication and imaginative reasoning. The selection of collaborative and interactive instructional activities was supported by previous research highlighting the importance of active participation, practical competence, and technology-supported learning in vocational education [6, 7].

### 2.4. Integration of Digital Learning Resources

Digital learning resources were incorporated into the instructional model to support students' independent access to technical information and garment-related instructional materials. The CLOTHING mobile application was developed and implemented as a digital learning resource during the research period (2021-2024). The application was subsequently registered in 2025 under Certificate No. DGU 55099. The application included instructional modules addressing men's, women's, and children's garment technology. Its educational features comprised technical terminology resources, visual representations of garment structures, video demonstrations of sewing procedures, and self-assessment activities. The application was also designed to support offline access to instructional materials. The mobile application served as a complementary resource to classroom instruction and practical learning activities. Students could use its instructional materials to review sewing procedures, interpret technical concepts, and reinforce their understanding of garment construction processes. The incorporation of specialized mobile learning resources was supported by studies examining mobile-assisted instruction, collaborative digital learning, and the application of mobile technologies in garment manufacturing education [3, 8, 9].

### 2.5. Assessment of Communicative-Imaginative Competence

Students' communicative-imaginative competence was assessed using multiple instruments, including diagnostic tests, structured observation protocols, project evaluations, surveys, and interviews. Diagnostic assessments addressed spatial visualization and technical communication. Spatial visualization involved interpreting garment patterns, recognizing relationships among garment components, and mentally representing three-dimensional structures from technical drawings. Technical communication involved explaining production procedures, using specialized terminology, and presenting technical decisions. Structured observations were used to examine students' participation in collaborative activities, communication during group discussions, and engagement in practical learning tasks. The inclusion of observable communication behaviors is consistent with research examining the development of communicative skills in other educational contexts [11]. Project assessments considered students' garment design outputs, technical accuracy, creative modifications, and presentation of proposed solutions. Research on assessment tools in culinary education similarly highlights the importance of evaluating practical competence using context-specific instruments, although such instruments require adaptation and validation for garment education [12]. Surveys and interviews were used to obtain information about students' experiences with the instructional activities and digital learning resources. Student achievement was classified into three levels of communicative-imaginative competence:

productive (low), motivational (medium), and creative (high). The productive level reflected the ability to complete routine tasks with instructional guidance, while the motivational level indicated greater independence, participation in discussions, and limited design modification. The creative level represented independent design development, effective technical communication, advanced spatial visualization, and complex problem-solving abilities. The competence classifications provided the basis for describing changes in student achievement between the initial and final assessments. The assessment framework considered the importance of communication, creativity, collaboration, and technical understanding as interconnected dimensions of student competence in vocational learning environments [4, 5].

### 2.6. Data Analysis

Quantitative data were summarized using frequencies, percentages, and arithmetic mean values to describe students' achievement across competence levels. Comparisons were conducted between the experimental and control groups at the beginning and end of the instructional intervention. Measures of variability, including standard deviation and standard error, were considered in the quantitative analysis. Between-group comparisons were evaluated using an independent-samples Student's t-test. An effectiveness coefficient was also used to summarize relative performance between instructional approaches. Observations, interviews, and student feedback were used as supplementary information to contextualize students' experiences with collaborative learning, technical communication, imaginative activities, and digital learning resources.

## 3. RESULTS AND DISCUSSION

### 3.1. Changes in Communicative-Imaginative Competence

The development of communicative-imaginative competence was evaluated by comparing student achievement levels before and after the instructional intervention. The assessment involved 387 vocational education students, consisting of 197 participants in the experimental group and 190 participants in the control group. Students were classified into three competence levels: creative (high), motivational (medium), and productive (low). The distribution of achievement levels is presented in **Table 1**.

**Table 1.** Comparative analysis of students' communicative-imaginative competence before and after the intervention.

| ACHIEVEMENT LEVEL | EXPERIMENTAL GROUP (n = 197) | | CONTROL GROUP (n = 190) | |
|---|---|---|---|---|
| | INITIAL (%) | FINAL (%) | INITIAL (%) | FINAL (%) |
| High (Creative) | 26.2 | 27.5 | 18.3 | 24.3 |
| Medium (Motivational) | 46.3 | 52.2 | 37.8 | 40.9 |
| Low (Productive) | 27.5 | 20.3 | 43.9 | 34.8 |
| Total (reported) | 100 | 100 | 100 | 100 |

*Note: Values represent the percentages of students in each achievement category at the initial and final assessments. The experimental and control groups comprised 197 and 190 students, respectively.*

**Table 1** shows changes in the distribution of communicative-imaginative competence within both groups. In the experimental group, the proportion of students achieving the high competence level increased from 26.2 to 27.5%, representing an increase of 1.3 percentage points. The proportion of students at the medium level increased from 46.3 to 52.1%,

corresponding to an increase of 5.8 percentage points. Meanwhile, the proportion of students at the low level decreased from 27.5 to 20.2%, representing a reduction of 7.3 percentage points. Changes were also observed in the control group. The proportion of students achieving the high competence level increased from 18.2 to 24.2%, representing an increase of 6.0 percentage points. The medium category increased from 37.8 to 40.9%, whereas the low category decreased from 43.9 to 34.8%. Students in both groups experienced changes in achievement distributions during the instructional period.

The experimental group initially had a higher proportion of students at the high competence level and a lower proportion at the low competence level than the control group. Although both groups showed changes in achievement distributions, the increase in the high competence category was greater in the control group (6.0 versus 1.3 percentage points). Therefore, baseline-adjusted comparisons are required before attributing the observed differences to the instructional intervention. Both groups demonstrated improvements in achievement distributions, although their initial competence levels differed. The experimental group showed a reduction of 7.3 percentage points in the low competence category, compared with 9.1 percentage points in the control group. The increase in the high competence category was also greater in the control group (6.0 versus 1.3 percentage points). These findings indicate that the effectiveness of the instructional intervention cannot be established solely from changes in achievement distributions.

These findings highlight the importance of evaluating competency development through multiple indicators rather than relying only on the final distribution of achievement categories. Competency-oriented vocational education requires the integration of practical knowledge, student participation, professional communication, and independent problem-solving abilities [1, 2].

### 3.2. Statistical Evaluation of Learning Outcomes

Quantitative evaluation was conducted to examine student performance and the reported effectiveness of the instructional model. The analysis included arithmetic mean values, effectiveness coefficients, standard errors, and Student's t-statistics. The reported statistical results are summarized in **Table 2**. The experimental group achieved a mean score of 3.85, compared with 3.41 in the control group, representing a difference of 0.44 points. The reported effectiveness coefficients were 1.24 and 1.03, respectively. However, these coefficients cannot be directly reconstructed from the reported means, suggesting that additional information about their calculation is needed. Furthermore, interpretation of the mean difference requires clarification of the scoring scale and baseline measurements. The reported t-statistics were 2.60 and 0.96 for the experimental and control groups, respectively. Because these statistics represent separate group-level results, they do not independently demonstrate a statistically significant difference between the two groups. A valid comparison of intervention effectiveness requires clearly defined statistical contrasts, appropriate variance estimates, and consideration of baseline differences. The available statistical indicators suggest differences in reported performance but do not yet provide sufficient information for a definitive conclusion regarding the magnitude or statistical significance of the intervention effect. A transparent comparison of baseline and final outcomes is necessary to determine whether the observed differences are attributable to the proposed pedagogical model.

**Table 2.** Reported statistical indicators of students' communicative-imaginative competence.

| STATISTICAL INDICATOR | EXPERIMENTAL GROUP (n = 197) | CONTROL GROUP (n = 190) |
|---|---|---|
| Arithmetic mean (M) | 3.85 | 3.41 |
| Effectiveness coefficient (Keff) | 1.24 | 1.03 |
| Standard error (m) | 0.08 | 0.09 |
| Student's t-statistic (T) | 2.60 | 0.96 |
| Reported hypothesis conclusion | $H_1$ Accepted | $H_0$ Accepted |

*Note: The values are retained as reported. The effectiveness coefficient, test comparisons, and hypothesis decisions require clarification before definitive statistical conclusions can be drawn.*

### 3.3. Development of Spatial Visualization and Technical Communication

In addition to the aggregate achievement categories, the study reported several indicators related to specific dimensions of communicative-imaginative competence. These indicators included spatial visualization, technical communication, creative problem solving, and engagement with digital learning resources. The spatial visualization assessment indicated that 89% of students in the experimental group could mentally construct three-dimensional garment representations from two-dimensional patterns, compared with 64% in the control group. This reported difference suggests stronger performance on the assessed spatial visualization task among students receiving the integrated instructional approach. However, interpretation of the result depends on the assessment instrument, scoring criteria, and consistency of evaluation between groups. Learning resources that demonstrate sewing procedures and garment construction can help students connect technical representations with practical manufacturing activities [3]. The study also reported a 41% improvement in the use of specialized technical terminology during oral presentations. Technical communication involves describing production procedures, explaining design decisions, and communicating appropriate terminology during discussions and collaborative assignments. The development of these skills is important because technical knowledge must be expressed accurately and interpreted consistently by different participants in vocational production activities. The integration of technical language into engineering education provides a relevant foundation for connecting conceptual understanding with professional communication. Structured explanations of specialized concepts can support students' interpretation and expression of technical knowledge [5]. In garment education, similar principles can be applied when students explain pattern construction, material requirements, sewing operations, and alternative production procedures.

### 3.4. Creative Problem Solving Through Interactive Learning

The instructional model incorporated interactive methods intended to support creative thinking and the interpretation of garment design problems. These included SCAMPER, decomposition, association, and the three-perspective instructional method. The study reported a 45% increase in the generation of original, non-standard design modifications following activities involving the SCAMPER technique. This indicator suggests potential improvement in students' ability to propose alternative garment designs and consider modifications to conventional product structures. However, the basis of the reported percentage requires clarification, including the number of design outputs, the assessment rubric, and the procedure used to classify an idea as original. These activities provide

opportunities to connect imaginative thinking with practical technical reasoning. Students are encouraged to consider relationships among garment components, explain alternative design solutions, and evaluate the practical consequences of proposed modifications. The integration of communication, creativity, collaboration, and critical thinking provides a relevant educational foundation for such interactive learning activities [4]. Additionally, collaborative and competency-oriented learning approaches can support practical participation and the application of knowledge in vocational education [6, 7].

### 3.5. Contribution of the CLOTHING Mobile Application

The evaluation of the CLOTHING mobile application focused on students' perceived usefulness and engagement with digital learning resources. 91% of experimental-group students considered the application beneficial for understanding complex sewing components. The application was also associated with a reported 35% increase in self-directed study time. These findings suggest favorable student perceptions and potential benefits for access to learning resources. However, the measurement procedures and baseline information underlying these percentages should be clarified. The application provided offline access to instructional content, a feature intended to facilitate independent learning in vocational institutions with limited internet connectivity. Students could use the digital materials to review technical concepts and examine sewing procedures beyond conventional classroom activities. Mobile-assisted learning can support flexible access to educational resources and provide opportunities for independent and collaborative learning [8, 9]. Video-based instructional resources have also been examined for their potential to strengthen conceptual understanding and reduce misconceptions among vocational students [10]. The availability of specialized visual learning materials is particularly relevant to garment manufacturing because students frequently need to interpret technical diagrams and understand sequential production operations. The use of mobile applications for learning sewing techniques has been explored as a means of supporting access to garment-related instructional materials [3]. The reported perceptions of application usefulness should be distinguished from objectively measured learning gains. Additional evaluation is required to determine whether the CLOTHING application independently improves technical competence or whether its potential contribution is associated with the broader combination of collaborative and interactive instructional activities.

### 3.6. Educational Implications and Research Limitations

The findings provide a basis for considering the integration of technical communication, spatial imagination, collaborative learning, and digital resources into specialized vocational education. The integration of technical competencies, practical learning experiences, and sustainability considerations has also been discussed in mechanical engineering education, providing a broader perspective on the development of industry-relevant educational approaches [13]. In garment manufacturing education, these competencies are interconnected because students must simultaneously interpret technical representations, explain production procedures, and evaluate design decisions. The proposed instructional model offers a structured approach for incorporating these activities into Garment Sewing Technology. The emphasis on communication and professional interaction is also consistent with research addressing socio-pedagogical competence in teacher education, although its instructional context differs from garment manufacturing [14]. Collaborative assignments provide opportunities for communication and discussion, interactive methods encourage

alternative problem-solving strategies, and digital resources support access to technical explanations and visual learning materials. Interactive approaches in vocational education may support student engagement and collaborative participation, providing a useful comparison with the instructional activities implemented in this study [15].

The practical relevance of this approach is consistent with educational perspectives emphasizing the development of applied competence and professional readiness through integrated learning activities [1, 2]. Its implementation may also support the broader objectives of quality education and industry-relevant vocational training. Research on digital language-learning materials also highlights the potential of multimedia resources to support student engagement, although their application differs from garment manufacturing education [16].

Several limitations should be considered when interpreting the findings:

(i) The study involved three vocational institutions in Uzbekistan, which may limit the generalizability of its results to other educational environments or industrial specializations.

(ii) The evaluation relied on achievement classifications and reported performance indicators whose scoring procedures, reliability, and validation require further documentation.

(iii) The initial competence distributions differed between the experimental and control groups. The available statistical summaries do not fully establish the equivalence of the groups or the comparative significance of their changes.

(iv) The individual contributions of collaborative learning, interactive cognitive methods, and the mobile application were not separately evaluated.

(v) The study period and the documented registration date of the CLOTHING application require clarification to establish the timeline of digital resource implementation.

(vi) Future research should use validated competence assessments, clearly documented intervention procedures, and appropriate statistical comparisons to evaluate the effectiveness of the proposed model more conclusively.

## 4. CONCLUSION

This study examined a pedagogical model combining collaborative learning, interactive design activities, and the CLOTHING mobile application for vocational garment education in Uzbekistan. Across 387 students, achievement distributions changed in both experimental and control groups, with the experimental group showing increases in high and medium categories and a reduction in the low category. Reported assessments also suggested benefits for spatial visualization, technical communication, and creative problem solving. However, the available statistical summaries do not establish a reliable comparative effect, and several indicators require clarification. Future studies should apply validated instruments, transparent statistical procedures, and consistent intervention timelines to determine effectiveness.

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## 6. AUTHORS' NOTE

The authors declare that there is no conflict of interest regarding the publication of this article. The authors confirmed that the paper is free from plagiarism.

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