Structure-Based Modeling of Professional Physical Education for Students of Bridge Construction Majors

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Abstract. This paper dwells on the issue of curricula and teaching and learning materials efficiency in shaping professional physical education for students majoring in bridge and transport tunnel construction. Aiming at modeling students’ professional physical education predetermines profiling the mandatory PE instruction so that future professionals will gain maturity in necessary social and personality skills through physical learning. The experiment conducted and its results reveal the level of gain theoretical knowledge, vocationally relevant physical and personality traits that are vital for bridge construction occupations. The paper presents the conclusions that are drawn from the research and proves that in-depth profiling of professional physical education course at the university level has positive effect upon shaping certain aspects of one’s personality traits and skills which are important for both social and vocational maturity.

1. Introduction
Currently, the process of personality becoming resolves itself into mere acquiring of professional knowledge and locomotive skills, which determine the basics of vocationally applicative physical education. By reflecting its vocational character, physical education is regarded as a form of students’ vocationally applicative physical training at vocationally-orientated educational institutions. What is left behind the scope of research and development is the social impact of physical education on students’ personality.

2. Topicality of the Research
There are several leading scholars who pointed at the topicality of professionals’ personality becoming, their acquiring of professional knowledge and skills which are important for using vocationally applicative physical education values independently [1, 2, 12, 13]. Scholars point out the significance of elaboration and implementation of athletic curricula which are profiled in accordance with the occupational type [12, 17].

The research connected with essential personality shaping of railway engineering students via professional physical education (PPE) is of certain interest. Up to now, there have not been studied aspects of professional life, as well as the framework of significant vocational mind-body qualities with regard to bridge construction engineering specificity. Unfortunately, there is no profile curriculum to provide professional physical education for the above mentioned vocation. That is why the research devoted to targeted academic impact on students’ complex development by means of
physical education is topical. The whole of locomotive skills, personality abilities and cultural peculiarities can define professional physical maturity in intended specialists [9, 10].

In the context of the existing situation there has been outlined a non-borrowed sociological, biomedical and pedagogical research, which aims at revealing vocationally relevant qualities, properties and functions for professionals and a comprehensive “model” structure of their moving abilities [16].

3. Methods and materials
During the experiment conducted there were formed three groups of testees:
– the control group followed the PE curriculum approved by the Ministry of Education [6, 7];
– the 1st experimental group followed the professionally-designed PE curriculum for railway universities that was recommended for application several years ago [5];
– the 2nd experimental group followed the PE curriculum that was designed by the authors of this research [11].

The experiment was carried out with the aim of assessing efficiency of the teaching and learning materials in shaping students’ PPE and maturity of general knowledge, vocationally relevant physical and personality traits that are vital for bridge and transport tunnel constructors.

The efficiency of the PPE curriculum for the bridge construction major was assessed in accordance with the indices of gain theoretical knowledge, personality value system and vocationally relevant locomotory and personality abilities.

The summary of results achieved through the experiment regarding theoretical knowledge gained by students of the 2nd experimental group, the 1st experimental group, and the control group are presented in Table 1.

Table 1. Indices analysis of students’ gain theoretical knowledge.

| Knowledge contents and its assessment | 2nd experimental group | 1st experimental group & control | P |
|--------------------------------------|------------------------|---------------------------------|---|
|                                      | X ± m                  | X ± m                           |   |
| PPE significance & goals             | 4.3 ± 0.39             | 4.0 ± 0.44                      | >0.05 |
| Job specification basics             | 4.5 ± 0.42             | 3.3 ± 0.39                      | <0.05 |
| Healthy lifestyle basics             | 4.3 ± 0.27             | 3.7 ± 0.42                      | <0.05 |
| Basics of PPE theories and principles| 4.4 ± 0.34             | 4.2 ± 0.31                      | >0.05 |
| Basics of applied swimming training, autotraining & psychohygienic self-control | 4.2 ± 0.42             | 3.1 ± 0.51                      | <0.05 |
| Summative assessment                 | 4.34 ± 0.37            | 3.66 ± 0.41                     | <0.05 |

The results obtained through the research show that the index of gain theoretical knowledge among the testees of the 2nd experimental group is significantly higher than that of the 1st experimental and control groups, both in absolute terms (4.34 vs. 3.66), and in percentage terms (18.2% higher; p < 0.05).

It is worth noting that the testees of the 2nd experimental group revealed themselves to be better trained in PPE job specification basics and more aware of healthy lifestyle and ways of psycho-physical self-improvement.

The indices dynamics proves the cognitive component being impactful on axiological personality via physical activity that is reflected in students’ personality value system (Table 2).
For instance, the summative index of this aspect is 22% (p<0.05) higher in the 2nd experimental group than that of the control group and 21% higher than in the 1st experimental one, respectively, which reflects the degree of students’ learning the factors that determine social and personal practices in physical activity – “I know what to do” (Table 2, Fig. 1).

Figure 1. Indices of Cognitive Component in Personal Value System.

The specificity of the cognitive aspect displays itself in the vocationally applicable Personality Value System (PVS) indices, which is reflected in the discrepancy between the 2nd experimental and the control group – 18 % (p<0.05), and the 2nd and 1st groups – 15.4 % (p<0.05). These data prove the higher level of gain theoretical knowledge regarding professional improvement via physical education in those following the experimental curriculum.

By the end of the experiment students have obtained higher open-domain concerning healthy lifestyle and the role physical education plays in maintenance and preservation of health. This is evidenced by the significant difference between the indices that characterize the recreational cognitive aspect: the difference between the 2nd experimental and the control groups is 24.5 % (p<0.05) and that of the 2nd and 1st experimental groups is 30.4 % (p<0.05). These data can be viewed as meaningful progress in shaping students’ PPE maturity.

Studying other aspects of personality value system in physical activity is of great importance for assessing students’ personality maturity regarding the axiological and need impetus aspects in their vocational learning (Table 2, Fig. 2).

Figure 2. Indices of Axiological Impetus Aspect in Personality Value System.

It is this aspect of personality value system that characterizes one’s understanding personality and societal importance of physical activity in professional growth and reflects their personal maturity through the need impetus aspect (“I want to do”).
It is worth while mentioning a substantial difference between the 2\textsuperscript{nd} experimental and control groups regarding the aspect under discussion in two dimensions - 21.2\% for recreational and 17\% for vocationally applicable ones with (p<0.05), respectively. The difference between the 2\textsuperscript{nd} and 1\textsuperscript{st} experimental groups is less prominent – 11.1 \% for recreational and 2.6 \% for vocationally applicable ones, with (p<0.05) and (p>0.05) respectively.

This may be considered logical since the 1\textsuperscript{st} experimental group followed the industry-profiling PE curriculum which included extra activities in professionally applied physical education designed to pointedly shape students’ motivation to master their railway occupation.

The testees of the 2\textsuperscript{nd} experimental group can be described as students with a higher level of readiness and understanding of learnt social and personality mindset for physical activity which reveals itself in the social activity mindset and special aptitude mindset aspects of the personality value system (“I can do” and “I do”, respectively). The summative index of the abovementioned aspects are 26.1\% (p<0.05) and 14.9\% (p<0.05) higher in the 2\textsuperscript{nd} experimental group than that of the control group, and 20\% (p<0.05) and 5.8\% (p<0.05) higher than that of the 1\textsuperscript{st} experimental one, respectively (Table 2, Fig. 3).

![Figure 3. Indices of Social Activity Mindset Aspect in Personality Value System.](image1)

The indices of the abovementioned aspects of the personality value system in the professional PE system are of notable importance because the difference in the special aptitude mindset aspect within the vocationally applicable orientation data (“I can do”) among the 2\textsuperscript{nd} experimental, 1\textsuperscript{st} experimental and control groups is within 29.9 \%, but the special aptitude mindset aspect data (“I do”) show a greater difference between the 2\textsuperscript{nd} experimental and control groups (22.4\%) and a lesser difference between the 2\textsuperscript{nd} experimental and the 1\textsuperscript{st} experimental groups (Fig. 4).

![Figure 4. Indices of Special Aptitude Mindset Aspect in Personality Value System.](image2)
The data obtained reveal that the students who follow the experimental program better understand the role and importance of PPE in connection with effective learning and societal activities in their life. The results also show that such students are better prepared for further personal growth and vocational improvement from the theoretical, methodological and practical points of view.

**Table 2.** Comparative Analysis of Personality Value System Indices in Three Testees Groups.

| # Indices | Period | Control Group | 2nd Experimental Group | Difference, % | W | P | 1st Experimental Group | 2nd Experimental Group | W | P | Difference, % |
|-----------|--------|---------------|------------------------|---------------|---|---|------------------------|------------------------|---|---|---------------|
| Cognitiv e Aspect | before | 9.04 ± 0.2 | 9.04 ± 0.29 | 0 | 0 | >0.05 | 9.08 ± 0.26 | 9.04 ± 0.28 | 0.8 | 2 | >0.05 ± 0.44 |
| | after | 9.64 ± 0.4 | 11.76 ± 0.38 | -2 | 2.4 | <0.05 | 9.72 ± 0.34 | 11.76 ± 0.38 | 3.9 | 3 | <0.05 ± 20.99 |
| Axiologi cal Aspect | before | 12.32 ± 0.4 | 12.56 ± 0.5 | -1.95 | 0.6 | >0.05 | 12.24 ± 0.45 | 12.56 ± 0.49 | 0.9 | >0.05 ± 2.61 |
| | after | 10.64 ± 0.2 | 12.68 ± 0.29 | -3.4 | 19.17 | <0.05 | 11.88 ± 0.4 | 12.68 ± 0.28 | 0.8 | 6 | >0.05 ± 6.73 |
| Social Activity Mindset Aspect | before | 11 ± 0.2 | 11.4 ± 0.36 | -3.64 | 0.9 | >0.05 | 10.6 ± 0.35 | 11.4 ± 0.49 | 0.7 | 5 | >0.05 ± 7.55 |
| | after | 9.64 ± 0.4 | 12.16 ± 0.3 | -26.14 | 3.5 | <0.05 | 10.12 ± 0.31 | 12.16 ± 0.3 | 3.5 | <0.05 ± 20.16 |
| Special Aptitude Mindset Aspect | before | 10.2 ± 0.5 | 9.8 ± 0.63 | 3.92 | 0.7 | <0.05 | 9.88 ± 0.6 | 9.8 ± 0.63 | 0.7 | 7 | >0.05 ± 0.81 |
| | after | 10.2 ± 0.5 | 11.72 ± 0.36 | -14.9 | 1.3 | <0.05 | 12.44 ± 0.3 | 11.72 ± 0.36 | 1.1 | 5 | <0.05 ± 5.79 |
| Recreational Personal Value System | before | 21.84 ± 0.5 | 22.04 ± 0.76 | -0.92 | 0.9 | >0.05 | 21.32 ± 0.78 | 22.04 ± 0.76 | 0.6 | 6 | >0.05 ± 3.38 |
| | after | 20.72 ± 0.3 | 24.08 ± 0.73 | -16.22 | 2.7 | <0.05 | 22.04 ± 0.6 | 24.08 ± 0.77 | 1.2 | 2 | <0.05 ± 9.26 |
| Vocatiorally Applicable Personality Value System | before | 20.72 ± 0.4 | 20.76 ± 0.36 | -0.19 | 0.8 | >0.05 | 20.48 ± 0.5 | 20.76 ± 0.35 | 0.6 | 9 | >0.05 ± 1.37 |
| | after | 19.96 ± 0.4 | 24.24 ± 0.44 | -5.4 | 21.44 | <0.05 | 21.56 ± 0.6 | 24.24 ± 0.44 | 1.5 | 6 | <0.05 ± 12.43 |
| Multimodal Personality Value System | before | 42.56 ± 0.9 | 42.8 ± 1.03 | -0.56 | 0.8 | <0.05 | 41.8 ± 1.23 | 42.8 ± 1.03 | 0.8 | 3 | >0.05 ± 2.39 |
| | after | 40.68 ± 0.7 | 48.32 ± 0.88 | -18.78 | 2.8 | <0.05 | 43.6 ± 1.05 | 48.32 ± 0.87 | 1.7 | <0.05 ± 10.83 |
4. Research results and their discussion
Comparative analysis of the personality value system level that students and professionals who major in bridge and transport tunnel construction acquire through targeted physical activities confirms these to be effective (Table III, Fig. 5).

Sufficient difference between the indices of the cognitive aspect (73.7% for students and 45.4% for professionals), the special aptitude mindset aspect (73% for students and 63% for professionals) and other aspects of the personality value system proves that modeling of professional physical education for students is potent for their learning and applicable skills (Fig. 5).

It is apparent that the upward trend of the indices of testees’ Personality Value System and general knowledge is predetermined by several factors among which the following are important: the PPE curriculum includes a significant amount of theoretical knowledge, applicative knowledge and skills, nontraditional activities, such as auto-training swimming, that provide better involvement into physical activity and shaping of the need impetus aspect through raising students’ interest; focused teaching purposefulness helps to understand the role and importance of PPE as a personal value for individuals.

Table 3. Comparative Analysis of Personality Value System Indices in Three Testees Groups.

| #  | Indices                        | Professionals X ±m | 2nd Experimental Group X ±m | Difference, % | T     | P     |
|----|--------------------------------|--------------------|----------------------------|---------------|-------|-------|
| 1  | Cognitive, recreational aspect, implementation intention aspect | 3.46 ±0.27 | 5.48 ±0.28 | -58.1 | -5.11 | <0.05 |
| 2  | Aspect, Vocationally applicable orientation aspect | 5.33 ±0.42 | 6.28 ±0.20 | -17.8 | -2.02 | <0.05 |
| 3  | Social Activity Mindset, recreational aspect | 6.46 ±0.3 | 6.6 ±0.22 | -2.06 | -0.35 | >0.05 |
| 4  | Aspect, Vocationally applicable orientation aspect, Cognitive Activity Mindset, applicable | 5 ±0.17 | 6.12 ±0.17 | -22.4 | -2.05 | <0.05 |
| 5  | Aspect, Vocationally applicable orientation aspect | 3.8 ±0.36 | 6.28 ±0.24 | -65.3 | -5.64 | <0.05 |
| 6  | Social Activity Mindset, recreational aspect, Special Aptitude Mindset, applicable | 5.66 ±0.43 | 6.4 ±0.18 | -12.9 | -1.56 | >0.05 |
| 7  | Aspect, Vocationally applicable orientation aspect, Special Aptitude Mindset, applicable | 4 ±0.18 | 5.56 ±0.18 | -39 | -4.19 | <0.05 |
| 8  | Cognitive Aspect (in whole) | 7.26 ±0.54 | 11.76 ±0.38 | -61.8 | -6.72 | <0.05 |
| 9  | Implementation intention aspect | 11 ±0.81 | 12.68 ±0.28 | -15.3 | -1.95 | >0.05 |
| 10 | Social Activity Mindset (in whole) | 10.47 ±0.55 | 12.16 ±0.3 | -16.2 | -2.66 | <0.05 |
The results obtained and their analysis to some extent elaborate and show agreement with the data of the previous research on the theoretical and methodological background of shaping personality physical culture through physical education [13, 15].

Moreover, the maturity of the abovementioned aspects of Personality Value System, students’ focus on physical self-improvement (beginning with receiving and realizing knowledge through true involvement) can be regarded as the basis of personality physical culture, for instance, its axiological, need impetus and learning aspects.

The specific focus of the personality value system on PPE makes it possible to state the maturity of the specific PPE personality which allows making prognosis on shaping physical and learning aspects of personal culture, which means achieving an adequate level of physical and psychophysical readiness, desirable physical development, and locomotive knowledge and skills maturity.

5. Conclusions and recommendations
The data obtained throughout the research prove that implementing the specifically designed physical activity with Vocationally Applicable Orientation can be efficient for shaping students’ personality aspects in their vocational education.

The leading components of designing and implementing professional physical education are as follows:
1. The scheme for PPE implementation in shaping personality traits includes intentions → involvement in physical activity → character traits and personality qualities. This assumed scheme is well within the scope of a contemporary view on this process. Our results fully correlate with several
research data whose authors believe that one of the most important factors for one’s motivation enhancement and providing coupling back within the system “instructor-activity-result-student” is shaping one’s attitude towards physical education and, as a result, their mature personality qualities [2, 17].

2. Applied swimming and unconventional PPE means, such as psycho regulation and auto-training, become a new and greater factor in stimulating students’ involvement in the classes, in shaping their need impetus personality trait, which leads to creating an entire system of personal values and attitude to their professional improvement. Enhancement of students’ psycho emotional state at PPE lessons contributes to establishing friendly and adequate relations, manifesting relevant personal qualities, shaping one’s attitude to people and environment.

3. The PPE curriculum widely displays muscle training activities in a game mode whose efficiency reveals itself through shaping various personal traits, qualities and characteristics; for example, modeling interpersonal relations in the game context benefits learning and professional activities due to further “transfer” of already established relationship.

4. Following primarily personal orientation in physical activities promotes such aspects and qualities as:
   - an athletic aspect is correlated with independent behavior, patience, concentration, integrity, self-discipline;
   - a gymnastic aspect is correlated with aesthetic qualities, neatness, tidiness, ethics, honesty;
   - an athletic-actable aspect is correlated with solidarism, reliability, friendliness, tolerance, team spirit;
   - a field-and-track aspect is correlated with composure, proficiency, vigilance, concentration, patience, outgoingness;
   - an unconventional-sport aspect is correlated with independent behavior, vigilance, emotional resilience, concentration, courage, determination.

In this regard it will be noted that the abovementioned qualities include humanistic and communicative ones which reflect a personality social nature and culture in its interpersonal interactions. They also address vocationally relevant qualities that characterize a well-trained professional.

Thus, it can be argued that a quantum leap achieved through implementing a specifically designed professional physical education process promotes shaping personal traits, qualities and skills which characterize a personality with its culture and awareness, on the one hand, and a professional personality and professional physical culture, on the other.

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