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KOSALB International Journal of Human Movements Science, Vol: 3, No: 2, 2024, p 72-80, DOI: 10.70736/2958.8332.kosalb.40 | ISSN: 2958-8332 | Published: 20.12.2024

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Transforming Theoretical Knowledge into Practical Coaching Expertise in University-Level Artistic Gymnastics

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Authors' Contribution: A: Study design, B: Data collection, C: Data analysis, D: Manuscript preparation, E: Discussion and conclusion

ABSTRACT

Study aim(s): The study aims to assess the transfer ratio of theoretical knowledge to practical application among sports science students during artistic gymnastic lessons.

The study sample included 47 second-grade students (37 girls and 10 boys) from the coaching, exercise, management, recreation, and enabled people's department within the Faculty of Sport Sciences at Istanbul Gelisim University.

Methods: The analyses of the student's practical scores consist of Practical Routine (PR: 25%), Assistance in Gymnastics (AG: 15%), and Learning Steeps (LS: 15%). The student's theoretical scores were evaluated based on General Performance (GP: 10%), Physical Preparation (PP: 15%), Theoretical preparation (THP: 10%), and Technique evaluation (TE: 10%). To ensure result validity, overall scores from online education were also tested. SPSS 26 programs were used for the data analysis, applying descriptive statistics, Pearson correlation, and canonical correlation analyses.

Results: The study revealed a significant correlation between students' overall scores and both theoretical ($p<0.05$, $r=0.497$) and practical ($p<0.05$, $r=0.920$) knowledge. The correlation coefficient of the GS to the practical and theoretical variables was determined as follows: PR (r=0.686), AG (r=0.799), LS (r=0.799), GP (r=0.720), PP (r=0.685), (r=0.scores), and TE (r=0.511).

Conclusion: It can be concluded that, while practice shows a limited ability to explain theoretical knowledge, theory tends to explain practical knowledge more effectively in the first canonical variable.

Keywords: Gymnastics Curriculum, Techniques, Practice, Theory, Student's Performance

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INTRODUCTION

Transferring theoretical knowledge into practical coaching expertise in artistic gymnastics has long been a challenge for coaches. The core difficulty lies in ensuring that gymnasts fully comprehend and apply the techniques their coaches explain. This transfer of information is further more complex because of the intricate nature of gymnastics skills. Traditionally, knowledge in gymnastics relied on explanation and application. However, modern advancements have introduced powerful technological tools such as F3 Curves, 3D GYM MEN, 3D GYM WOMEN, which have significantly simplified this process. These methods incorporate real-time visual feedback, aligning with cognitive theories that emphasize the role of visual and motor imagery in skill acquisition. Additionally, they emphasize the importance of diagnostic methods and scientifically verified procedures in gymnastics education [1-2]. Moreover, the role of contextual learning in bridging theoretical and practical knowledge in sports education is strongly supported by Situated Learning Theory, which underlines the value of hands-on experiences like those in gymnastics education [3]. This is particularly relevant given the complexity of gymnastics techniques, where understanding and executing skills rely heavily on the integration of motor and cognitive processes. Research in embodied cognition highlights that motor skill development is deeply intertwined with perceptual and cognitive learning, suggesting the need for effective coaching to address both domains [4]. Especially, knowing the complexity of gymnastics, it is worth reflecting on whether we consistently apply our theoretical knowledge effectively in practice and whether this application aligns with our understanding.

The implementation of scientific knowledge in the sports training practice may shorten the path to success, reduce challenges, minimize injuries, and increase quality, etc. Therefore, besides the attempts to increase the knowledge level, we should be focusing on the implementation of this knowledge in sports coaching practices. Thus, the quality of work may be significantly increased. By reviewing the connection between the neuroscience literature and the psychological research on perception, action, and imagery, sports scientists are invited to move beyond of `black-box' approach and adopt a more integrative basis for their theories and practices [5]. Neuroscientific research on motor learning and memory has identified that structured, repetitive practice helps consolidate motor programs in the brain, making movements more automatic [6]. Furthermore, the use of imagery and mental rehearsal—a cognitive strategy widely acknowledged in sports psychology—has been shown to improve performance by activating neural pathways similar to those involved in actual execution [7]. Over the past two decades, studies have shown enormous effort to avoid the 'black-box' approach, which involves practical knowledge without a theoretical basis. However, the gap between theoretical knowledge and its practical application appears to grow. Identifying neural correlates of human behavior has been ongoing for nearly 20 years, with attempts to tease out the structure and function of various brain areas. Such an approach is gradually allowing researchers to diverge from the `black-box' approach (using psychological constructs without considering the underlying neural mechanisms) toward the study of human behavior [4]. The importance of structured practice in enhancing the transfer of theoretical knowledge is demonstrated in the work of Bransford et al. (2000), who argue that the gap between knowing and doing can be bridged through active learning environments, such as those found in gymnastics classes [8].

Many studies have shown that theoretical knowledge does appear in practical coaching, particularly in gymnastics. This is especially true for the scientific knowledge that sports science students acquire during their studies. However, the gap between theoretical knowledge and practical abilities in gymnastics coaching often hinders coaches in teaching

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techniques steeps, spotting, and increasing physical abilities, among other aspects. In many countries, even if sports science students complete the required courses at university, they are not permitted to work without retaking an exam administered by a certain federation. As a result, despite all the wide literature, scientific knowledge is still not implemented into the gymnastics teaching process at recreational or competitive clubs worldwide.

The study aims to determine the transfer ratio of theoretical knowledge to practical application in students of sports science universities during artistic gymnastic lessons.

METHODS

Study Model

In the study, a causal-relational research model (mixed method) was applied to explore the cause-effect relationship between students' theoretical knowledge and their practical performance in artistic gymnastics, using both quantitative data and qualitative insights.

Sample

The study sample includes 37 boys and 10 girls enrolled in gymnastic classes, as a mandatory lesson in the university curriculum. These lessons, consisting of Artistic Gymnastics I, are scheduled for the first semester of the second year of studies. The students and data were drawn from Istanbul Gelisim University in Istanbul, Türkiye.

Variables: Evaluation criteria for artistic gymnastics

The first table of findings shows that the general score of the students comprises 55% practical knowledge and 45% theoretical knowledge.

Table 1. % of the theoretical and practical score of the gymnastic lessons

Practice score		Percentage (%)
1	PR: Practical Routine	25%
2	AG: Assistance in Gymnastics	15%
3	LS: Learning Steeps	15%
	Total (Practice)	55%
Theoretical score		Percentage (%)
1	GP: General Performance	10%
2	PP: Physical Preparation	15%
3	THP: Theoretical preparation	10%
4	TE: Technique evaluation	10%
	Total (Theory)	45%

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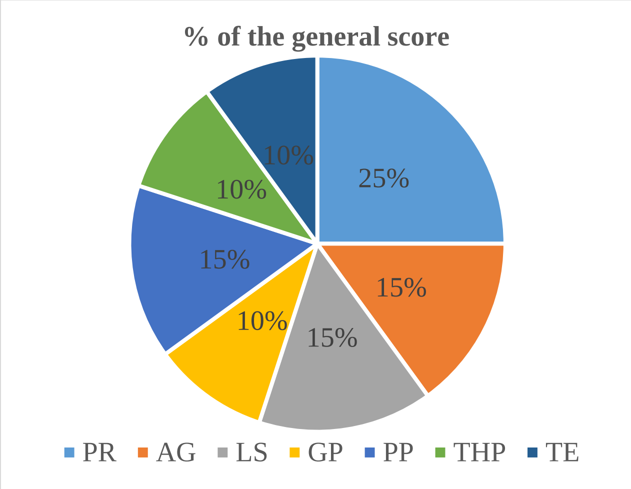

Variables: Details about the evaluation criteria for artistic gymnastic

Practice score

1. Routine Practice: Students choose a minimum of 7 and a maximum of 10 elements to create a routine. All elements belong to the A, B, or C categories, with the difficulty level excluded from the evaluation criteria.
2. Assistance in Gymnastics (Spotting): Students are evaluated based on the assistance and confidence they demonstrate while assisting an athlete.
3. Learning Steps: Students are evaluated for their ability to teach techniques and apply learning steps for each element.

Theoretical score

1. General Performance: Active participation in lessons (executing techniques, providing assistance in gymnastics, trying to explain the techniques, etc.).
2. Physical Preparation Knowledge: Students are evaluated for their knowledge about the physical preparation programs. This includes describing movements, their effect on body parts, and drawing connections between physical preparation movements and certain gymnastics elements.
3. Theoretical Preparation: Students are evaluated for the training program prepared for the specific age group and category of gymnasts.
4. Techniques Evaluation: Assessments examine students' awareness of muscle contractions in certain elements, adherence to technical requirements, assistance requirements, learning steps requirements, etc.

Data analysis

For the data analysis, the SPSS 26 software package was used. The correlation between group variables and each practical and theoretical variable was analyzed using Pearson correlation for continuous variables. The explanation ratios of theory and practice, as well as their cross-explanations of canonical correlation analyses were used. The variables were organized into two sets: Set 1 (practical variables) and Set 2 (theoretical variables).

FINDINGS

Table 2. Correlations Between General Score and Practical Score Parameters

Scores	Correlation	General score	% of the general score
Theoretical score	r	.497**	**45**
	p	.002	
Practical score	r	.920**	**55**
	p	.000	

***. Correlation is significant at the 0.01 level (2-tailed).*
Practice: Practical Routine, Assistance in Gymnastics, Learning Steeps
Theory: General Performance, Physical Preparation, Theoretical preparation, Technique evaluation
GS_FF: General Score (face to face)

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The results presented in Table 2 carry out the significant correlation between the general score of the students and their theoretical ($p<0.05$, $r=0.497$) and practical knowledge ($p<0.05$, $r=0.920$).

Table 3. Correlations Between Theoretical and General Scores Parameters

Scores	Correlation	General score	% of the general score
GP: General Performance (10% of general score)	r	.720**	10
	p	.000	
PP: Physical Preparation (15% of general score)	r	.658**	15
	p	.000	
THP: Theoretical preparation (10% of general score)	r	.000	10
	p	.988	
TE: Technique evaluation (10% of general score)	r	.511**	10
	p	.000	

***. Correlation is significant at the 0.01 level (2-tailed).*

The results in Table 3 carry out the significant correlations between the general score of the students and their theoretical knowledge variables. The correlation coefficient of the GS to the theoretical variables are as follows: GP ($p<0.05$, $r=0.720$), PP ($p<0.05$, $r=0.685$), ($p>0.05$, $r=0.000$), and TE ($p<0.05$, $r=0.511$).

Table 4. Explanation ratio of the theory and practice by each other (Variance Ratios of Canonical Variables)

Canonical variables	Set 1 by Self (Practice)	Set 1 by Set 2 (practice by theory)	Set 2 by Self (Theory)	Set 2 by Set 1 (Theory by practice)
1	.530	.327	.314	.194
2	.324	.089	.337	.093
3	.146	.001	.120	.001

Practice (set1); PR: Practical Routine (25% of general score); AG: Assistance in Gymnastics (15% of general score)
LS: Learning Steeps (15% of general score); Theory (set2); GP: General Performance (10% of general score)
PP: Physical Preparation (15% of general score); THP: Theoretical preparation (10% of general score)
TE: Technique evaluation (10% of general score)

Table 4 carried out the explained variance for Set 1 and Set 2, along with their cross-variances. These results provide insights into the self-explanation for practice and theory variable groups. However, while the practice has shown a low capacity to explain theoretical knowledge, the theory has tendencies to explain practical knowledge, particularly in the first canonical variable.

Table 5. Explained canonical variables

Explained factors	Correlation	Eigenvalue	Wilks Statistic	F	Num D. F	Denom D.F.	Sig.
1	.785	1.604	.277	5.389	12.000	103.476	.000

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2	.524	.379	.721	2.370	6.000	80.000	.037
3	.076	.006	.994	.	.	.	.

Based on the table 5. The factor 1 shows the strongest statistical contribution, Factor 2 has moderate significance, and Factor 3 contributes negligibly.

Table 6. Canonical loadings of the Practical (Set 1), and Theoretical (Set 2) scores of the students

Set 1 Canonical Loading (Practice)				Set 2 Canonical Loadings (Theory)			
Variable	1	2	3	Variable	1	2	3
PR	-.436	.832	-.342	GP	-.981	-.056	-.184
AG	-.633	.529	.565	PP	-.440	.682	.482
LS	-1.000	-.020	-.001	THP	.229	.168	-.372
				TE	-.220	.924	-.276

The table 6 indicates strong canonical loadings in Set 1 for PR (.832) and AG (.529) on the second function, while LS consistently dominates the first function. In Set 2, GP (-.981) strongly influences the first function, while TE (.924) is most prominent on the second function.

Table 7. Cross loadings of the Practical (Set 1), and Theoretical (Set 2) scores of the students

Set 1 Cross Loadings (Practice)				Set 2 Cross Loadings (Theory)			
Variable	1	2	3	Variable	1	2	3
PR	-.342	.436	-.026	GP	-.770	-.029	-.014
AG	-.497	.277	.043	PP	-.346	.357	.037
LS	-.785	-.010	.000	THP	.180	.088	-.028
				TE	-.173	.484	-.021

Table 4 provides an in-depth presentation of the canonical loading coefficients for practical knowledge scores (Set 1) and theoretical knowledge scores (Set 2), along with their respective cross-loadings. These coefficients offer valuable insights into the internal relationships within each set of variables, as well as the interplay and correlations between the constructs of practical and theoretical knowledge. By analyzing these values, the table illustrates how well each variable contributes to its respective set and how these two dimensions of knowledge interact, shedding light on the broader connections between practical applications and theoretical understanding.

DISCUSSION

Based on the study results, practical knowledge has a greater impact on students' overall performance. While the theoretical components of the assessment criteria scored higher than the practical ones, practical knowledge demonstrated a stronger correlation with student's overall scores. Additionally, practical knowledge proved to be more effective than theoretical knowledge. Based on the correlation

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between students' overall scores and practical knowledge variables, it can be concluded that practical knowledge is a more significant determinant of overall performance compared to theoretical knowledge.

The current literature provides insight into how theoretical knowledge can be transferred into practical coaching, which is a key focus of this study [9]. Lave's Situated Learning Theory emphasizes that learning in practical contexts enhances knowledge transfer [10]. However, despite the positive correlations observed, the data reveals limitations in how theoretical knowledge predicts practical performance. For instance, the canonical loadings indicate that while practical variables demonstrate explanatory power for theoretical knowledge, the reverse is less robust. This imbalance may be attributed to cognitive load theory [11], where excessive theoretical information can overwhelm

However, theoretical knowledge shows a limited ability to account for practical knowledge, which demonstrates a stronger tendency to explain theoretical knowledge, particularly in the first canonical variable.

Human behavior is shaped and influenced by our understanding of the neurophysiological foundations of brain activity. To establish a suitable theoretical framework for studying behavior, Edelman (1992) introduced the concept of 'biological epistemology', emphasizing the importance of integrating current knowledge of brain activity and body morphology as key constraints on behavior [14]. Furthermore, research by Day and Goldstone (2011) underscores the role of 'contextual similarity' in effectively transferring theoretical knowledge to practical skills [15].

The literature suggests that expanding the theoretical knowledge of sports performers is essential. In gymnastics, assistance (AG: 15% of the total score) reflects a student's ability to provide safe

students, impeding their ability to transfer knowledge into practice. These findings underscore the need for structured, simplified approaches when teaching complex techniques.

According to [12], the role of context in knowledge transfer suggests that incorporating hands-on practice in gymnastics lessons can help bridge the gap between theoretical and practical knowledge [13]. Furthermore, the connection between structural similarity and successful knowledge transfer can enhance coaching performance [9].

Theoretical knowledge alone does not accurately represent the knowledge level of gymnastics coaches. The explained variance for both Set 1 and 2, along with the cross-variances, suggests a level of self-explanation within both practical and theoretical variable groups.

and effective spotting, which is both a physical and psychological task. The confidence and trust demonstrated during assistance build the gymnast's and coach's self-efficacy. This finding aligns with self-determination theory [16], which emphasizes the importance of autonomy, competence, and relatedness in motivation and learning. By expanding the knowledge base of sports performers through the integration of additional and alternative research, sports scientists can enhance the theoretical frameworks that inform both research and interventions in sports psychology [5]. Integrating these theories into practical lessons can facilitate motor imagery. Jeannerod (1994) introduced the compelling idea of a dynamic, biologically rooted representation accessible through both motor preparation and motor imagery [17]. As will be discussed later, this integrative modeling approach has been successfully applied in sport psychology research [1,18].

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CONCLUSIONS

This study underscores the vital role of practical knowledge in enhancing students' overall performance, demonstrating its stronger influence compared to theoretical knowledge. Additionally, the study provides valuable insights into the psychological and cognitive aspects of transferring theoretical knowledge to practical coaching in artistic gymnastics. It reveals that, although there is a significant correlation between theoretical understanding and practical application, the relationship is not entirely straightforward. The findings highlight the importance of contextual learning, repetition, and feedback in bridging this gap, aligning with cognitive theories such as Situated Learning Theory and embodied cognition. Despite theoretical components receiving higher assessment scores, practical knowledge is identified as a more significant determinant of success. The literature supports this view, emphasizing the importance of integrating theoretical knowledge into practical coaching contexts to enable effective knowledge transfer.

The findings advocate for an expanded theoretical framework that incorporates diverse approaches, thereby enriching sports psychology. By enhancing the integration of practical experiences into theoretical lessons, educators and coaches can foster improved performance outcomes. This approach lays the groundwork for future exploration into effective methodologies that strengthen the connection between practical knowledge and coaching effectiveness.

Because practical and theoretical knowledge are based on different foundations, and since the brain does not process theoretical knowledge as it does for practical uptake (or vice versa), we should teach the theory of gymnastics simultaneously with practice during the execution movements. Integrating current research from neurosciences with psychological models of sports behavior can result in a more robust theoretical basis for understanding the nature of psychological processes in sports.

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CONFLICT OF INTERESTS

No potential conflict of interest was reported by the authors

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FOR CITATION

Kirişçi et al. Transforming Theoretical Knowledge into Practical Coaching Expertise in University-Level Artistic Gymnastics. KOSALB International Journal of Human Movements Science, Vol: 3(2), 2024, p 72-80, DOI: 10.70736/2958.8332.kosalb.40.