UDK 159.953.5:165]-057.875 **Original Scientific Paper**
Doi 10.7251/SANUS2503089V

COMPARING EPISTEMOLOGICAL BELIEFS ACROSS ACADEMIC DISCIPLINES: A MIXED-METHODS STUDY

***Aleksandar J. Vlahovic*[1*], *Sanja D. Tomic*[1]**
[1]Medical Faculty of University of Novi Sad, Hajduk Veljkova 3, Novi Sad, Republic of Serbia

Abstract. *This mixed-methods study examined and compared the epistemological beliefs of university students in Serbia across various academic disciplines, using Biglan's classification of fields of study. Epistemological beliefs—individuals' conceptions of knowledge and learning—play a key role in shaping how students approach studying, problem-solving, and assimilating new information, all of which are essential for academic development. The quantitative part was designed as a cross-sectional, analytical-descriptive, and comparative study with data collected between January and March 2024. 387 students were surveyed using a multidimensional epistemological beliefs questionnaire, and the data was analysed using non-parametric statistical methods in SPSS 27. For the qualitative part, 10 students were randomly selected for semi-structured interviews, and thematic analysis was utilized to reveal key themes using the MAXQDA Software. Results of CFA analysis confirm the structure validity of the proposed model. Findings indicate that students possess sophisticated epistemological beliefs ($p < 0.001$; $r = 0,840$). Beliefs about learning were found to be more developed than the beliefs about knowledge ($p < 0.001$; $r = 0.585$) in majority of participants ($n = 222$). No significant differences in beliefs were found between students across Biglan's broader disciplinary categories ($p = 0.066$; $p = 0.552$; $p = 0.461$). Qualitative analysis revealed five key themes: students viewed knowledge as evolving and interconnected; emphasized that learning occurs through understanding and application; valued persistence and intrinsic motivation in managing complex material; saw learning ability as shaped by both internal and external factors; and perceived education as essential for personal and societal development. The integration of quantitative and qualitative findings offers a comprehensive understanding of how students conceptualize knowledge and learning, highlighting implications for educational practices aimed at fostering deeper epistemological development.*

Key words: *Epistemological beliefs, Higher education, Biglan's Classification, Mixed-method research*

Introduction

Epistemology and epistemological beliefs have long been a focus of research due to their profound influence on the course of education. The development of epistemology has significantly shaped educational theory and practice, guiding the evolution of epistemological stances from traditional perspectives— which regard knowledge and learning as static and absolutist—toward more contemporary views that emphasize the dynamic and constructivist nature of knowledge. By cultivating advanced epistemological stances, educators foster environment in which critical thinking and deeper theoretical understanding are dominant, even promoting scientific research. Contemporary studies in educational psychology underscore the importance of understanding how individuals construct knowledge, as well as the role of personal characteristics in this process. Epistemological development has been described by several influential models. Perry's Scheme was a foundational framework, outlining a progression through nine positions (often grouped into four stages) from Dualism (knowledge as black-and-white facts) to Multiplicity (recognition of uncertainty). [1] Another perspective by Deanna Kuhn [2] identifies categories of epistemological views: from "Realist" (naïvely assuming knowledge equals an external reality) to "Absolutist" (believing experts have certain truths), "Multiplist" (seeing knowledge as subjective opinion), and ultimately "Evaluativist" (weighing claims with evidence and reasoning) [2]. Despite differing terminologies, these stage-based models all characterize a developmental shift from simplistic, authority-bound beliefs toward more nuanced, reflective conceptions of knowledge [3]. Not all scholars view epistemic growth as a single trajectory, however. Researchers such as Schommer argued that personal epistemology has multiple independent dimensions (e.g. certainty of knowledge, simplicity of knowledge, source of knowledge, etc.) that do not always develop in unison. For instance, one may become more sceptical about knowledge certainty while still believing learning ability is fixed [3–5]. To date, research in the field of epistemology has shown that epistemological beliefs exert a significant influence on students' motivation and choice of learning strategies, thereby affecting both academic outcomes and the overall cognitive process. Insight into epistemological beliefs may reveal more than the way individuals acquire knowledge. It may provide valuable insight into how they interpret novel information, and, consequently, their approach to problem solving – highlighting the importance of having developed epistemological beliefs in clinical environments [6 – 13]. Many studies have attempted to explore how students perceive the epistemology of the science they study, from various perspectives and using different methods. According to the academic literature, epistemology (of science) can be conceptualized in multiple ways—for example, as the Nature of Science (NOS) or as personal epistemological beliefs. In order to capture the multidimensional characteristics of epistemological beliefs, researchers are increasingly employing diverse methodologies, often combining quantitative and qualitative approaches [12-16]. The classification of disciplines utilized in this study was proposed by Biglan. In accordance with Biglan's classification of academic disciplines, fields are categorized along three dimensions: hard vs. soft, pure vs. applied, and life vs. non-life [17].

This classification has shown a remarkable consistency, even in recent research, and has proven reliable in predicting differences in both teaching and learning styles, as well as epistemological orientations [18-21]. Investigating epistemological beliefs across disciplines helps educators tailor pedagogical strategies and design effective curriculums to maximise learning outcomes [7-8, 22-26]. Biomedical studies, as a scientific discipline have a clear methodology which is used to construct evidence – based base of knowledge. In addition to the scientific method, another defining characteristic is its pronounced holistic approach to patient care. This approach entails recognizing the unique attributes of each patient (as complex individuals) and the clinical context. Consequently, within the framework of higher education for students of biomedical studies, adequate comprehension and internalization of knowledge represent essential elements of the learning process. For this reason, deeper understanding of students' epistemological beliefs could provide critical insights into how they interpret, value, and integrate theoretical knowledge into clinical practice [27-33].

This mixed-method study aims to explore the development and variability of epistemological beliefs among students at the University of Novi Sad through quantitative, qualitative, and integrated approaches. Quantitatively, it seeks to assess the overall sophistication of students' epistemological beliefs across six dimensions, and evaluate variations across academic disciplines classified according to Biglan's typology (hard vs. soft, pure vs. applied). Qualitatively, the study aims to gain deeper insight into students' epistemological beliefs by identifying contextual themes through thematic analysis. The combined objective is to compare and interpret consistencies or discrepancies between quantitative and qualitative findings.

Material and Methods

This study employed a cross-sectional, analytical-descriptive mixed-methods design in accordance with the Declaration of Helsinki. Before the data collection, approval of the faculties' ethical committee was acquired (number 01-39/120/1) on 29th of December, 2023., as well as the permission to use the Chinese Students' Epistemological Beliefs Questionnaire by the original authors via e-mail. For the quantitative part of the study, the data were collected through a survey between January and February 2024. Targeting students of University of Novi Sad, the surveys were distributed via "Google Forms" link and "QR" codes through the university communication channels. Active e-mail address was required as to prevent answer doubling, and informed consent was implied through participation, with the option to withdraw at any time. Descriptive and inferential statistical analyses were performed using IBM SPSS Statistics 27 Software, as well as "JASP" software for statistical analysis. The qualitative component involved thematic analysis based on semi-structured interviews conducted between February and March 2024, at the facilities of University of Novi Sad. Interviews were conducted one-on-one, with participant anonymity and privacy ensured. Consents were obtained for both participation and audio recording, prior to the start of the interview. Audio recordings were transcribed anonymously and used solely for research purposes.

Transcripts were analysed inductively: initial coding was conducted based on recurring viewpoints, followed by categorization into contextual themes and subthemes related to students' epistemological beliefs. MAXQDA software was used to support the qualitative data analysis process.

Sample

The inclusion criterion was an active student status, regardless of the type of study program, year of study, faculty, or age. For the quantitative part of the study, a sample of 387 participants was acquired consisting of students from the Faculty of Medicine, the Faculty of Technical Sciences, the Faculty of Natural Sciences, and the Faculty of Philosophy. Students were classified into different categories based on their chosen major, following Biglan's classification of academic disciplines [17]. For the qualitative part, 12 students were selected and interviewed through random sampling on a voluntary basis keeping in mind to select at least 2 students from each group of academic disciplines.

Questionnaires

Three questionnaires were utilized in this study: The sociodemographic questionnaire, The Chinese College Students' Epistemological Beliefs Questionnaire, and the semi-structured questionnaire. The sociodemographic questionnaire collected data on: (1) age, major (2), and (3) year of study. The questionnaire used to assess epistemological beliefs in this study was created in 2020 by Zhou Y. and Tan D. through modification of the original Schommer's Epistemological Questionnaire (SEQ), developed in 1990 by Schommer M. [3]. The EBQ is a multidimensional questionnaire consisting of 38 items distributed across 6 dimensions, grouped into two subscales: the knowledge subscale and the learning subscale, further consisting of three knowledge (Certain Knowledge, Simple Knowledge, and Acquisition of Knowledge) and 3 learning dimensions (Speed of Learning, Ability to Learn, and Value of Learning). Responses were rated using a five-point Likert scale from 1 (strongly disagree), 2 (disagree), 3 (neutral), 4 (agree), to 5 (strongly agree). Following author's instructions (following authors' instructions), and mean values were calculated for overall epistemological beliefs as well as for each dimension. Mean scores below 3 indicated underdeveloped or "naïve" beliefs, while scores above 3 indicated developed or "sophisticated" beliefs. The semi-structured interview protocol was constructed based on the Epistemological Beliefs Questionnaire. It consisted of open-ended questions organized into specific sections: Introductory Section (providing brief overview of research, building rapport, and obtaining consent for participation and audio recording), main section (divided into 6 themes aligned with the 6 dimensions of the EBQ), closing section (final questions concluding the interview, acknowledgments and appreciations).

Results

Confirmatory Factor Analysis and Reliability Analysis

The CFA analysis employed the Maximum Likelihood (ML) estimator with the NLMINB optimization method. Six related epistemological dimensions were

established parallel, and belonging to a second-level epistemological beliefs. The value of indices, and the rotated plot may be found in the supplementary material.

Descriptive Analysis

Table 1 Mean Values of Epistemological Beliefs Across Academic Disciplines and Normality of Distribution Test Values

INDEPENDENT VARIABLES				EB	CK	SK	AK	SL	AL	VL
			N					M (SD)		
Biglan's classification of academic disciplines	Hard/Pure		100	3.81 (0.37)	4.23 (0.54)	3.75 (0.62)	4.41 (0.42)	3.78 (0.82)	3.53 (0.94)	3.21 (0.75)
	CI	*LB*		*3.75*	*4.13*	*3.63*	*4.33*	*3.62*	*3.34*	*3.06*
		UB		*3.90*	*4.34*	*3.87*	*4.50*	*3.94*	*3.71*	*3.36*
	Shapiro-Wilk			*0.305*	***< 0.001***	***< 0.001***	***< 0.001***	***< 0.001***	***0.013***	***0.004***
	Hard/Applied		97	3.83 (0.29)	4.24 (0.47)	3.69 (0.53)	4.34 (0.29)	3.77 (0.60)	3.49 (0.70)	3.30 (0.67)
	CI	*LB*		*3.75*	*4.14*	*3.58*	*4.28*	*3.65*	*3.34*	*3.16*
		UB		*3.87*	*4.33*	*3.80*	*4.40*	*3.89*	*3.63*	*3.43*
	Shapiro-Wilk			***0.013***	***< 0.001***	***0.014***	*0.088*	***0.020***	*0.453*	*0.297*
	Soft/Applied		111	3.79 (0.43)	3.83 (0.61)	3.53 (0.64)	4.28 (0.48)	3.91 (0.75)	3.63 (0.85)	3.38 (0.77)
	CI	*LB*		*3.71*	*3.72*	*3.41*	*4.18*	*3.77*	*3.47*	*3.23*
		UB		*3.87*	*3.94*	*3.65*	*4.37*	*4.05*	*3.79*	*3.52*
	Shapiro-Wilk			***< 0.001***	***< 0.001***	***< 0.001***	***< 0.001***	***< 0.001***	***0.004***	***0.036***
	Soft/Pure		79	3.71 (0.51)	3.65 (0.70)	3.57 (0.53)	4.17 (0.66)	3.88 (0.74)	3.56 (0.79)	3.30 (0.81)
	CI	*LB*		*3.60*	*3.49*	*3.45*	*4.03*	*3.71*	*3.38*	*3.12*
		UB		*3.83*	*3.80*	*3.69*	*4.32*	*4.05*	*3.74*	*3.49*
	Shapiro-Wilk			***< 0.001***	***< 0.001***	***< 0.001***	***< 0.001***	***< 0.001***	***0.036***	***0.006***
	Whole Sample		387	3.79 (0.40)	4.00 (0.63)	3.63 (0.59)	4.31 (0.49)	3.84 (0.73)	3.55 (0.83)	3.30 (0.75)
	CI	*LB*		*3.75*	*3.94*	*3.57*	*4.26*	*3.76*	*3.47*	*3.22*
		UB		*3.83*	*4.06*	*3.69*	*4.35*	*3.91*	*3.64*	*3.37*
	Shapiro-Wilk						***< 0.001***			

EB – Overall Epistemological Beliefs, CK – Certain Knowledge, SK – Simple Knowledge, AK – Acquisition of Knowledge; SL – Speed of Learning, AL – Ability to Learn, VL – Value of Learning; CI – Confidence Interval; LB – Lower Bound; UB – Upper Bound

The sample (N = 387) comprised of students of the following majors (grouped by Biglan's classification of academic disciplines): Nursing, Law, Psychology, Pedagogy ("soft/applied"), English Literature, Philosophy, History ("soft/pure"), Computer Science, Biomedical Engineering, Software Engineering ("hard/applied"), and Chemistry, Mathematics, and Physics majors ("hard/pure). The age of the participants ranged from 18 to 30 years, with the average age of 21.47 (SD = 2.96).

The minimum and maximum response values for all variables ranged from 1 to 5. The lowest average value for overall epistemological beliefs was achieved by the students of "Soft/Pure" group (M = 3.71, SD = 0.5), while the highest for students of "Hard/Applied"
(M = 3.83, SD = 0.37). Interestingly, the overall average value for the learning subscale was lower than the average value of the knowledge subscale within the whole sample (M_{ks}= 4.07, SD_{ks} = 0.42; and M_{ks} = 3.53, SD_{ks} = 0.58, respectively), and within each group. The lowest average response value was achieved for the "Value of Learning" (M = 3.3, SD = 0.75), while the highest was achieved for the "Acquisition of Knowledge" dimension (M = 4.3, SD = 0.48).

Inferential Analysis – Development of Epistemological Beliefs

One-Sample Wilcoxon Signed Rank Test was used to assess the development of the epistemological beliefs in University of Novi Sad college students. The results are presented in Table 2.

Based on the results of the analysis for the whole sample (N = 387), University of Novi Sad college students have sophisticated epistemological beliefs ($p < 0.001$, $r = 0.840$). Although sophisticated, the beliefs about the value of learning showed the least development level, while the beliefs about the acquisition of knowledge showed the highest development level according effect size of the test and median values ($r = 0.328$, $M(IQR) = 3(1)$; and $r = 0.869$, $M(IQR) = 4(1)$, respectively).

Using Paired-Sample Wilcoxon Signed Rank Test, subscale analysis revealed more sophisticated beliefs about knowledge compared to learning ($p < 0.001$, $r = 0.585$) for the whole sample. The same analysis was performed according to Biglan's classification, and same results were obtained with the highest difference ($p < 0.001$, $r = 0.711$) within the "Hard/Applied" group, and the lowest within the "Soft/Pure" group of students ($p < 0.001$, $r = 0.424$).

Categorized according to Biglan's classification of academic disciplines, and according to the test effect sizes, the highest overall epistemological beliefs were found for "Hard/Applied" group ($r = 0.898$), and lowest for "Soft/Pure" group of students ($r = 0.796$). Further analysis of dimensions also revealed sophisticated beliefs for all dimensions, and all groups ($p < 0.001$), however with varying effect sizes. The lowest effect size was noted for the beliefs about the value of learning within the "Hard/Pure" group ($r = 0.229$), while the highest for the beliefs about the acquisition of knowledge within the "Hard/Applied" group ($r = 0.893$). Mann-Whitney U test was used to assess the differences in epistemological beliefs among the 4 groups. The results may be found in supplementary material. Based on the results of the Mann-Whitney U test, the discipline-based differences were limited to knowledge dimensions. No differences emerged from overall epistemological beliefs, and learning dimensions ($p > 0.05$). The "Hard/Applied" group of students scored higher on beliefs about the acquisition of knowledge compared to hard-pure students ($p = 0.016$, $r = 0.172$). When contrasted with "Hard/Pure" students, their "Soft/Pure" peers scored lower on beliefs about the certain knowledge ($p < 0.001$, $r = 0.352$) and the acquisition of knowledge ($p = 0.003$, $r = 0.218$), whereas "Soft/Applied" peers

scored lower on all 3 knowledge dimensions ($p < 0.001$, $r = 0.278$; $p = 0.019$, $r = 0.162$; $p = 0.003$, $r = 0.208$, respectively). Both "Soft/Pure" students, and "Soft/Applied" students scored lower compared to hard-applied counterparts on beliefs about "Certain Knowledge" ($p < 0.001$, $r = 0.388$, and $p < 0.001$, $r = 0.311$, respectively).

Table 2 Development Level of Students' Epistemological Beliefs According to Biglan's Classification of Academic Disciplines

INDEPENDENT VARIABLES			EB	CK	SK	AK	SL	AL	VL
N					Mdn(IQR)				
Biglan's classification of academic disciplines	Hard/Pure	100	4(0)	4(1)	4(0.5)	5(1)	4(1)	4(1.5)	3(1)
	p		***< 0.001***	***< 0.001***	***< 0.001***	***< 0.001***	***< 0.001***	***< 0.001***	***0.022***
	r		0.866	0.841	0.715	0.891	0.689	0.514	0.229
	Hard/Applied	97	4(0)	4(1)	3.5(1)	4(1)	4(1)	3.5(1)	3(1)
	p		***< 0.001***	***< 0.001***	***< 0.001***	***< 0.001***	***< 0.001***	***< 0.001***	***< 0.001***
	r		0.898	0.864	0.744	0.893	0.749	0.508	0.368
	Soft/Applied	111	4(0)	4(0.5)	3.5(1)	4(1)	4(1)	4(1.5)	3(1)
	p		***< 0.001***	***< 0.001***	***< 0.001***	***< 0.001***	***< 0.001***	***< 0.001***	***< 0.001***
	r		*0.800*	*0.713*	*0.583*	*0.877*	*0.722*	*0.558*	*0.414*
	Soft/Pure	79	4(0)	4(1)	3.5(0.75)	4(1)	4(1)	4(1.5)	3.5(1)
	p		***< 0.001***	***< 0.001***	***< 0.001***	***< 0.001***	***< 0.001***	***< 0.001***	***< 0.001***
	r		0.796	0.617	0.700	0.819	0.752	0.578	0.297
	Whole Sample	387	4(0)	4(1)	3.5(1)	4(1)	4(1)	3.5(1.5)	3(1)
	p		***< 0.001***	***< 0.001***	***< 0.001***	***< 0.001***	***< 0.001***	***< 0.001***	***< 0.001***
	r		0.840	0.772	0.681	0.869	0.724	0.538	0.328

EB – Overall Epistemological Beliefs, CK – Certain Knowledge, SK – Simple Knowledge, AK – Acquisition of Knowledge; SL – Speed of Learning, AL – Ability to Learn, VL – Value of Learning; p – Asymptotic value; r – Rank-Biserial Correlation; Mdn – Median; IQR – Interquartile Range

Qualitative (Thematic) Analysis

A thematic analysis was conducted to identify contextual themes and sub-themes related to students' epistemological beliefs with 5 themes emerging which encapsulate students' epistemological beliefs. Representative themes, sub-themes and quotes may be found in supplementary material.

Discussion

Factorial Validity and Reliability of Chinese College Students' Epistemological Beliefs Questionnaire

The Chinese College Students' Epistemological Beliefs Questionnaire was chosen because of its in-depth structure to various epistemic dimensions proven to differ in different academic disciplines. To the best of our knowledge, this is the first time Chinese College Students' Epistemological Beliefs Questionnaire was used in Serbia. The closest, and most recent adaptation of Schommer's Epistemological Beliefs Questionnaire was done by author Kervan [34] revealing acceptable fit indices, while reliability analysis produced satisfactory results [34]. The original authors [3] also reported good psychometric properties of the selected questionnaire, as well as Reliability Analysis results of 0.830 for the whole questionnaire, and values ranging from 0.609 to 0.766 for the dimensions of knowledge, and learning.

Developmental Level of Epistemological Beliefs

Overall, quantitative and qualitative results mutually reinforce the conclusion that epistemological beliefs are sophisticated but differentiated across dimensions and disciplines. Sophisticated beliefs at the undergraduate level imply that students possess a more mature understanding of knowledge and learning, viewing it as dynamic, interconnected, acquired through understanding and reasoning all the while being aware of complex factors which comprise one's ability to learn, and understanding that persistence in learning is important as well as that learning itself has an intrinsic value. These findings are in line with different results which also support that most students enter a sophisticated stage of epistemic development at the higher education level [3, 5, 16, 32-33]. Recognizing students' sophisticated epistemological beliefs enables educators to foster higher-order thinking skills more effectively, enhancing both learning outcomes and professional competencies. Particularly in disciplines like nursing, where holistic and evidence-based reasoning is crucial, sophisticated epistemological beliefs prepare students effectively for real-world decision-making and complex clinical judgments [5, 7, 11]. Higher value of knowledge over learning presents a critical area for educational improvement. This utilitarian perspective implies that, despite recognizing the complexity and importance of knowledge, the process of learning may not be equally appreciated or internalized. Such a discrepancy underscores the need for educational strategies that not only support knowledge acquisition but also promote reflective and intrinsically motivated learning, especially crucial in fields like nursing where lifelong learning and adaptability are essential. Nurses must continuously update their skills and knowledge throughout their careers. Recognizing sophisticated ways of learning ensures nurses effectively engage in lifelong learning and professional development. Addressing this discrepancy can significantly enhance nursing education, leading to better-prepared nurses capable of effective clinical reasoning and evidence-based practice [27-29, 31].

Diversity of Epistemological Beliefs

Although sophisticated, the effect sizes, however, varied highly across dimensions. This further supporting Schommer's multidimensional model which posits epistemic dimensions mature at different rates [4-5]. This multidimensional view is supported by findings that some epistemological beliefs (belief in simple, certain knowledge or quick learning) decline over the college years, indicating increased sophistication, while other dimensions may lag. Overall, these theoretical frameworks (both stage-like and multidimensional) provide a lens for understanding how college students' beliefs about knowledge evolve from freshman year through graduation and beyond. This heterogeneity was noted by other authors as well, in diverse cultural and disciplinary settings [1, 3, 35]. In their longitudinal study, author Rosman [36] also pointed out significant differences in epistemological beliefs among students of Technological major, vs. students of Psychology major as in "hard" vs. "soft" disciplines.

Psychology students demonstrated significant development toward more sophisticated epistemic beliefs over time. Conversely, computer science students maintained a more static, absolutistic beliefs [36]. Similar findings were noted literature to view epistemic growth as context-dependent – students learn to adjust their criteria for knowing to fit the norms of different knowledge domains. Apart from domain-specific influence of epistemological development, different social and cultural factors have also been noted in having a significant influence on epistemological development [3, 16, 37-39]. By addressing this discrepancy, educators can more effectively promote deep learning and help students become skilled and adaptable learners capable of navigating complex professional and real-world scenarios. Recognition of different developmental levels in epistemological beliefs calls for personalized teaching strategies, helping students enhance their beliefs about learning to align with their already advanced understanding of knowledge itself [5, 8, 15, 25-26]. It has been noted that students of "Hard/Pure" disciplines, such as physics or mathematics, are more likely to hold absolutist beliefs-viewing knowledge as certain, and/or derived from "authority". Conversely, students of "Soft/Applied" disciplines, such as education or psychology, have a constructivist view of knowledge-viewing knowledge as context-dependent. Furthermore, life sciences accommodate the nuanced, variable nature of living systems, combining empirical rigor with ethical consideration, whereas non-life sciences are associated with objectivity, abstraction, and methodological precision. [16, 40-43]. Our findings also align with previously noted differences in epistemic belief values according to Biglan's typology: the participants of soft/pure disciplines scored lower than the hard/applied participants (although without statistically significant difference). However, students of hard/applied and hard/pure studies showed more sophisticated beliefs about the certainty of knowledge, compared to their soft/pure, and soft/applied peers, with medium effect sizes. This further indicates that academic discipline has an effect in shaping epistemological beliefs, as previously stated [11, 21, 36, 40-41]. "Hard/Applied" or "Hard/Pure" curricula usually include empirical testing, and evidence-based decision-making, with technological or paradigm-shifting change, all of which may cultivate a greater tolerance for uncertainty. This is further supported

by qualitative findings with participants stating: *"Some things we once treated as axioms—truths never to be questioned—now make us laugh. We believed in those 'scientifically proven facts,' yet science's very purpose is to question everything, to doubt itself. We've even found a different use for a drug that's still prescribed today. So, whatever seems true now—well, we can't be certain it really is; time will tell."* (Aleksa("H/A")); Conversely, soft/pure or soft/applied fields often privilege interpretive frameworks, potentially reinforcing a perception of knowledge as more stable or authoritative. Qualitative findings further support this theoretical framing with participants stating: *"Within Seriban literature, not a lot of things can change. The language has indeed developed over time, and itself may further develop, however, not significantly."* (Milica("S/P")).

Knowledge over Learning

The findings also show the discrete difference in value of knowledge over learning, as well as the least developed beliefs about the value of learning with some participants pointing out that learning should have pragmatic value for it to be "valuable". There appears to be a greater emphasis on the utility of knowledge over the intrinsic value of the learning process itself which shapes the views about learning as primarily a mean to acquire knowledge for external outcomes, such as passing exams or achieving professional success: „*If the subject matter difficult, it still has to be learned because at the end of the day you have to pass the exams"* (Andrijana("H/A")); Furthermore, there appears to be a climate where the act of learning itself is often characterised as stressful, and mostly worthwhile to secure that valuable "end product: *"Knowledge makes any job easier."* (Vanja("S/A")); "*Learning equals hard work, commitment and sometimes stress, but in the end its always worthwhile*." (Vanja("H/P")). Quantitative findings showed the highest scores for the "Acquisition of Knowledge" dimension portraying it as the most sophisticated dimensions. These findings were further backed by participants emphasizing that meaningful, true knowledge is achieved through understanding and practical application, internalized through explanation and retention: "*When I can explain a concept to a middle-school pupil in my own words, as well as through application, then I know I really learnt it."* (Ana("H/P")).

Differences in Epistemological Beliefs Across Academic Disciplines

The most prominent difference in the way students acquire knowledge was discovered between the "Hard/Pure" vs "Soft/Pure", and "Hard/Pure" vs "Soft/Applied". Through qualitative analysis, it was noted that both participants from "Soft/Pure", and "Soft/Applied" groups point out the benefit of reading and repetition *("In general, you have to sit down and study—read, connect the material with real-life examples, or otherwise make it relatable. Everyone learns differently, of course, but diligence is the only way."* (Sara("S/A")). On the other hand, participants of "Hard/Pure" disciplines discipline pointed out that acquisition of knowledge is "peering further" into the truth, providing in-depth look and understanding, but from different perspectives ("*Science is always evolving. We keep getting new ways to prove just about everything, and our instruments only grow more precise. The deeper we go—especially in my field, electrochemistry, right down to the electron level—the*

more we see how today's ultra-precise tools can reveal something new and different every single day. And that, after all, is the very purpose of the science we practice: to keep pushing the boundaries we have set so far." (Ana("H/P")).

Conclusion

Taken together, these findings highlight both strengths and growth areas in the epistemic development of University of Novi Sad college students. The confirmed six-factor structure establishes a sound measurement tool for future cross-cultural work, while the prevalence of sophisticated beliefs about knowledge suggests that current curricula cultivate an appreciation of its dynamic, evidence-based character. However, the "learning–knowledge gap" underscores the need for instructional approaches that nurture intrinsic motivation, metacognitive reflection, and deep engagement with the learning process—especially in practice-oriented disciplines such as nursing, where continual upskilling and adaptive reasoning are vital. Integrating active, reflective, and interdisciplinary pedagogies could harmonize students' already advanced conceptions of knowledge with equally mature beliefs about learning, ultimately fostering lifelong learners capable of navigating complex professional contexts and improving patient-care outcome.

References

[1] Hofer BK, Pintrich PR. The development of epistemological theories: beliefs about knowledge and knowing and their relation to learning. Rev. Educ. Res. 1997;67:88–140. DOI: 10.3102/00346543067001088

[2] Kuhn D, Cheney R,Weinstock M. The Development of Epistemological Understanding. Cognitive Development. 2000;15: 309-28. DOI: 10.1016/S0885-2014(00)00030-7.

[3] Zhou Y, Tan D. The Construction and Initial Application of Chinese College Students' Epistemological Beliefs Questionnaire. Front Psychol. 2020;11(54): 1 – 8. DOI: 10.3389/fpsyg.2020.00054

[4] Schommer M. Epistemological development and academic performance among secondary students. Journal of Educational Psychology. 1993;85(3): 406–11. https://doi.org/10.1037/0022-0663.85.3.406

[5] Schommer-Aikins M. Explaining the epistemological belief system:introducing the embedded systemic model and coordinated research approach. Educ. Psychol. 2004;39: 19–29. DOI:10.1207/s15326985ep3901_3

[6] Siegel H. What's in a name?: Epistemology, "Epistemology," and science education. Sci. Edu. 2014; 98(3): 372 – 4. DOI: 10.1002/sce.21104

[7] Xipei G, Xuemin H, Wenbo D, Xin J, Shuoqi X, Weiping H. The relationship between epistemological beliefs, reflective thinking, and science identity: a structural equation modeling analysis. IJ STEM Ed. 2022;40(9): 1 - 17. https://doi.org/10.1186/s40594-022-00355-x

[8] Klopp E, Krause-Wichmann T, Stark R. Profiles of epistemological beliefs, knowledge about explanation norms, and explanation skills: changes after an intervention. Front. Psychol. 2023;14:1-19. https://doi.org/10.3389/fpsyg.2023.1178129

[9] Al-Natsheh N, Qandeel N, Mariam AA. Impact of different levels of academic achievement on epistemological beliefs. Nurture. 2024;18(4):764–72. https://doi.org/10.55951/nurture.v18i4.807

[10] Arslantaş HA. Epistemological Beliefs and Academic Achievement. Journal of Education and Training Studies. 2015;4(1):215-20 http://dx.doi.org/10.11114/jets.v4i1.1107

[11] Guo J, Hu X, Marsh HW, Pekrun R. Relations of epistemic beliefs with motivation, achievement, and aspirations in science: Generalizability across 72 societies. Journal of Educational Psychology. 2022;114(4): 734–751. https://doi.org/10.1037/edu0000660
[12] Mirkov S, Jakšić I. Epistemological beliefs among university students: Developmental trends and relation to academic achievement. European Conference on Educational Research 2015 ”Education and Transition - Contributions from Educational Research”. 7th - 11th September 2015, Budapest (Hungary). European Educational Research Association, University of Debrecen, Corvinus University Budapest. http://www.eera-ecer. de/ecer-programmes/conference/20/contribution/34924
[13] Mirkov S. Relations between university students’ epistemological beliefs and their learning goals and strategies. International scientific conference Effects of physical activity application to anthropological status with children, youth and adults, Conference proceedings (37-54), Univerzitet u Beogradu, Fakultet sporta I fizičkog vaspitanja, 10 - 11. decembar 2016. Beograd. http://www.fsfvconference.rs/documents/zbornik_radova_2017_04_28.pdf
[14] Elby A, Macrander C, Hammer D. Epistemic cognition in science: Uncovering old roots to turn over new leaves. In: Greene JA, Sandoval WA, Bråten I, editors. Handbook of epistemic cognition. Routledge;. 2016. p. 113 – 27.
[15] Lee SW, Luan H, Lee MH, Chang HY, Liang JC, Lee YH, et all. Measuring epistemologies in science learning and teaching: A systematic review of the literature. Sci Educ. 2021;105(5): 880 – 907. DOI: 10.1002/sce.21663
[16] Assenheimer D, Knox K, Nadarajah VD, Zimitat C. Medical Students′ Epistemological Beliefs: Implications for Curriculum. Education for Health. 2016;29(2):107-12. DOI: 10.4103/1357-6283.188748
[17] Biglan A. The characteristics of subject matter in different academic areas. Journal of Applied Psychology. 1997;57(3):195–203. https://doi.org/10.1037/h0034701
[18] Stoecker JL. The Biglan classification revisited. Res High Educ 1993;34:451–64. https://doi.org/10.1007/BF00991854
[19] Simpson A. The surprising persistence of Biglan’s classification scheme. Studies in Higher Education. 2015;42(8):1520–31. https://doi.org/10.1080/03075079.2015.1111323
[20] Michel JO, Campbell CM, Dilsizian K. Is STEM too Hard? Using Biglan to Understand Academic Rigor and Teaching Practices across Disciplines. Journal of the Professoriate. 2018;9(2):28
[21] Schommer-Aikins M, Duell OK, Barker S. Epistemological Beliefs Across Domains Using Biglan's Classification of Academic Disciplines. Research in Higher Education. 2003;44:347–66 https://doi.org/10.1023/A:1023081800014
[22] Thorne S. Rethinking Carper's personal knowing for 21st century nursing. Nurs. Philos. 2020;21(4):1–7. DOI: 10.1111/nup.12307
[23] Sabariego-Puig M, Sánchez-Marti A, Ruiz-Bueno A, Sánchez-Santamaría, J. The effects of learning contexts on the development of reflective thinking in university education: Design and validation of a questionnaire. Sustainability. 2020;12(8):3298. https://doi.org/10.3390/su12083298
[24] Khine MS, Fraser BJ, Afari, E. Structural relationships between learning environments and students’ non cognitive outcomes: Secondary analysis of PISA data. Learn. Environ. Res. 2020;23(3):395 – 412. DOI: 10.1007/s10984-020-09313-2
[25] Guilfoyle L, McCormack O, Erduran S. The "tipping point" for educational research: the role of pre-service science teachers’ epistemic beliefs in evaluating the professional utility of educational research. Teach. Teach. Educ. 2020;90(1):1 – 15. https://doi.org/10.1016/j.tate.2020.103033.
[26] Milutinović JJ, Anđelković AK. Relations Between Teachers’ Epistemological Beliefs and Teaching Practice in Serbia. The New Educational Review. 2018;53(3):239-50. DOI: 10.15804/tner.2018.53.3.20
[27] Sandvik AH, Hilli Y. Understanding and formation—A process of becoming a nurse. Nurs. Philos. 2023;24(1):1 – 8. DOI: 10.1111/nup.12387

[28] Theodoridis K. Nursing as concrete philosophy, Part I: Risjord on nursing knowledge. Nurs Philos. 2018;19(2). DOI: 10.1111/nup.12205
[29] Reed PG. Standpoint Epistemology and Nursing Science. Nurs Sci Q. 2022; 35(1): 41- 5. DOI: 10.1177/08943184211051361
[30] Reed PG. The Epistemic Dignity of Knowledge Developed Through Nursing Practice. Nurs Sci Q. 2021;34(1):39-44. DOI: 10.1177/0894318420965206
[31] Jasem SA, Gargari RB, Emanzadeh A, Mamoudi F. Psychometric properties of the changing epistemic beliefs questionnaire in Iraqi nursing students. International Journal of Health Sciences, 2022;6(S5): 5837–49. https://doi.org/10.53730/ijhs.v6nS5.10291
[32] Oh SA, Chung EK, Han ER, Woo YJ, Kevin D. The relationship between medical students' epistemological beliefs and achievement on a clinical performance examination. Korean J Med Educ. 2016;28(1):29-34. DOI: 10.3946/kjme.2016.7.
[33] Chiu YL, Liang JC, Hou CY, Tsai CC. Exploring the relationships between epistemic beliefs about medicine and approaches to learning medicine: a structural equation modeling analysis. BMC Medical Education 2016;18:16:181. DOI: 10.1186/s12909-016-0707-0.
[34] Kervan S, Tezci E, Morina S. Adaptation of the epistemological belief scale to Kosovo. European Journal of Educational Research. 2021;10(1):299-312. https://doi.org/10.12973/eu-jer.10.1.299
[35] Aytur-Ozen T, Kantek F, Yeşilbaş H. 'Factors affecting epistemological beliefs of undergraduate nursing students: descriptive cross-sectional study'. Türkiye Klinikleri Journal of Nursing Sciences. 2022;14(4):1090–98. DOI: 10.5336/nurses.2022-91726.
[36] Rosman T, Mayer AK, Kerwer M, Krampen G. The differential development of epistemic beliefs in psychology and computer science students: A four-wave longitudinal study. Learn. Instr. 2017; 49:166–77. https://doi.org/10.23668/psycharchives.2377
[37] Shultz M, Nissen J, Close E, Dusen BV. The role of epistemological beliefs in STEM faculty's decisions to use culturally relevant pedagogy at Hispanic-Serving Institutions. IJ STEM Ed 9. 2022;32. https://doi.org/10.1186/s40594-022-00349-9
[38] Englund C, Olofsson AD, Price L. The influence of sociocultural and structural contexts in academic change and development in higher education. Higher Education 2018;76(1):1051–69 https://doi.org/10.1007/s10734-018-0254-1
[39] Huang T. "Integrating the Ontological, Epistemological, and Sociocultural Aspects: A Holistic View of Teacher Education." Teachers and Teaching 2018;22(8):947–64. DOI:10.1080/13540602.2016.1200547.
[40] Paulsen MB, Wells CT. Domain differences in the epistemological beliefs of college students. Research in Higher Education, 1998;39(4):365–84. https://doi.org/10.1023/A:1018785219220
[41] Karimi MN, Atai R. ESAP students' comprehension of multiple technical reading texts: Insights from personal epistemological beliefs. Reading Psychology. 2014;35(8):736–61. https://doi.org/10.1080/02702711.2013.802753
[42] Urhahne D, Kremer K. 'Specificity of epistemic beliefs across school subject domains', Educational Psychology. 2023;43(2–3):99–118. DOI: 10.1080/01443410.2023.2179605.
[43] Jehng JCJ, Johnson SD, Anderson RC. Schooling and students′ epistemological beliefs about learning. Contemporary Educational Psychology. 1993;18(1):23-35. https://doi.org/10.1006/ceps.1993.1004

Dodatak 1: Additional qualitative results
Dodatak 2: Additional quantitative results
(Extended data and materials are available in the electronic version of the paper)

KOMPARATIVNA ANALIZA EPISTEMOLOŠKIH STAVOVA STUDENATA UNIVERZITETA U NOVOM SADU

***Aleksandar J. Vlahović*[1], *Sanja D. Tomić*[1]**
[1]Medicinski Fakultet Univerziteta u Novom Sadu, Hajduk Veljkova 3, Novi Sad, Republika Srbija

Sažetak. *Ovo mešovito istraživanje imalo je za cilj da ispita i uporedi epistemološka uverenja studenata Univerziteta u Novom Sadu oslanjajući se na Biglanovu klasifikaciju akademskih disciplina. Epistemološka uverenja — shvatanja pojedinaca o prirodi znanja i procesa učenja — igraju ključnu ulogu u načinu na koji studenti pristupaju učenju, rešavanju problema i usvajanju novih informacija, što je od suštinskog značaja za njihov akademski razvoj. Kvantitativni deo istraživanja je sproveden kao analitičko-deskriptivna, komparativna studija preseka. Podaci su prikupljeni u periodu od januara do marta 2024. godine. 387 studenata je anketirano korišćenjem multidimenzijalnog upitnika za procenu epistemoloških stavova. Kvantitativna analiza je sprovedena pomoću neparametrijskih statističkih metoda u SPSS 27 softveru. Nakon kvantitativne analize, 10 studenata je nasumično izabrano za kvalitativnu analizu. Uz pomoć MAXQDA softvera za kvalitativnu analizu podataka sprovedena je tematska analiza na osnovu transkripta polustrukturisanih intervjua. Rezultati faktorske analize potvrdili su strukturnu validnost predloženog modela. Rezultati ukazuju da studenti poseduju razvijena epistemološka uverenja ($p < 0,001$; $r = 0,840$). Uverenja o procesu učenja pokazala su se sofisticiranijima od stavova o prirodi znanja ($p < 0,001$; $r = 0,585$) kod većine ispitanika ($n = 222$). Nisu uočene značajne razlike u odnosu na Biglanovu klasifikaciju akademskih disciplina ($p = 0,066$; $p = 0,552$; $p = 0,461$). Kvalitativnom analizom istaklo se pet tematskih celina: studenti znanje vide kao promenljivo i međusobno povezano; učenje doživljavaju kao proces koji zahteva razumevanje i primenu; ističu važnost istrajnosti i unutrašnje motivacije pri savladavanju složenog gradiva; sposobnost za učenje povezuju sa unutrašnjim predispozicijama i spoljašnjim faktorima; a obrazovanje smatraju ključnim za lični i društveni razvoj. Ovo istraživanje pruža detaljan uvid u studentska shvatanja znanja i učenja, ističući značaj obrazovnih strategija usmerenih na razvoj dubljih epistemoloških uverenja.*

Ključne reči: *Epistemološka uverenja, visoko obrazovanje, Biglanova klasifikacija, mešovita studija*