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Dr hab. Katarzyna Dziewanowska, prof. UW
Uniwersytet Warszawski
ORCID: 0000-0003-1897-0534
e-mail: kdziewanowska@wz.uw.edu.pl

Dr hab. Agnieszka Kacprzak, prof. UW
Uniwersytet Warszawski
ORCID: 0000-0003-1949-9131
e-mail: akacprzak@wz.uw.edu.pl

The impact of learning styles on student satisfaction, stress and overflow in e-learning environments

Wpływ stylów uczenia się na zadowolenie studentów, stres i przeciążenie podczas e-nauki

Abstract

Rapid technological advancements, accelerated by the COVID-19 pandemic, have made the e-learning experience a crucial aspect of the value proposition provided by higher education institutions to their students. However, general perception of the e-learning experience may be influenced by the characteristics of the students. This study specifically addresses one such critical characteristic: the individual learning style. The main research question of this study examines how individual learning styles might affect students' perceptions of e-learning experiences, with focus on their reported stress levels, feelings of overflow, and overall satisfaction with e-learning. A survey was conducted with a sample of 532 students to investigate these dynamics. The study utilized *k*-means cluster analysis to segment respondents based on their preferred learning styles and employed ANOVA with the Bonferroni *post-hoc* test to identify differences between the resulting clusters. The findings reveal that students with deep and strategic learning styles reported significantly lower levels of stress and overflow during the pandemic, compared to their peers with a surface learning style. Additionally, they expressed greater satisfaction with their e-learning experience. These insights indicate that online learning is best utilized as a supplement to traditional face-to-face instruction, as exclusive reliance on online modalities may increase stress and overflow for many students.

Keywords
e-learning experience, learning styles, segmentation, higher education

Streszczenie

Postęp technologiczny, przyśpieszony przez pandemię COVID-19, sprawił, że doświadczenie e-nauki stało kluczowym elementem propozycji wartości, którą uczelnie oferują swoim studentom. Jednak percepcja doświadczenia e-nauki może być zależna od cech studentów. Niniejsze badanie skupia się szczególnie na jednej z cech, a mianowicie na indywidualnym stylu uczenia się. Główne pytanie badawcze dotyczy wpływu stylów uczenia się na percepcję doświadczeń e-nauki przez studentów, ze szczególnym uwzględnieniem odczuwanego stresu, przeciążenia i ogólnego zadowolenia. W celu zbadania tych zależności przeprowadzono ankietę na próbie 532 studentów. W badaniu wykorzystano analizę skupień *k*-średnich do podziału respondentów na grupy na podstawie ich preferowanych stylów nauki oraz zastosowano analizę wariancji ANOVA z testem *post-hoc* Bonferroniego, aby zidentyfikować różnice między grupami. Wyniki wskazują, że studenci o głębokim i strategicznym stylu uczenia się doświadczali istotnie niższego poziomu stresu i uczucia przeciążenia w okresie pandemii w porównaniu ze swoimi rówieśnikami o stylu powierzchownym, a także wyrażali wyższe zadowolenie. Oznacza to, że zajęcia online najlepiej sprawdzą się jako uzupełnienie tradycyjnych zajęć stacjonarnych, gdyż wyłączne poleganie na metodach online może skutkować poczuciem wyższego stresu i przeciążenia.

Słowa kluczowe
doświadczenie e-nauki, style uczenia, segmentacja, szkolnictwo wyższe

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Introduction

With the onset of the COVID-19 pandemic, online learning swiftly became the predominant mode of education for students globally. Higher education institutions across various countries were faced with the abrupt transition from traditional classrooms to virtual platforms. As the intensity of the pandemic subsided, students gradually returned to physical classrooms. Nonetheless, the debate regarding the long-term role of e-learning and whether it should persist as the primary mode of instruction in modern world, continues.

This study aims to discern how students, characterized by different learning styles, have perceived and responded to the abrupt shift to online education during the pandemic, examining factors such as reported stress, feelings of overflow, and overall satisfaction with e-learning experience. We postulate that the reception of the e-learning experience is contingent on students' predominant learning styles. Specifically, we hypothesize that students with a deep learning orientation, marked by refined study strategies and intrinsic motivation, would exhibit a more favourable perception of online education. In contrast, those adopting a surface learning approach, merely striving to pass courses with minimum effort, might find the demands of e-learning daunting, which is reflected in elevated stress levels and diminished satisfaction. This has profound consequences on functioning of the higher education system. Higher education institutions face numerous challenges, from fierce competition to budget cuts, and increasingly focus on understanding and satisfying needs of their key stakeholders, i.e. students.

To investigate this, we segmented 532 management students from a prominent Central European university, based on their learning styles using *k*-means clustering. Subsequently, an ANOVA coupled with the Bonferroni test was employed to discern differences in stress perceptions, feelings of overflow, and overall e-learning satisfaction across the clusters.

This paper is organized sequentially, commencing with a review of the underlying theoretical constructs encompassing learning styles, e-learning experiences, and the dynamics of student stress and overflow. Following this, research design is presented, detailing the sample characteristics, adopted measures, and the analytical approach. The ensuing section presents the research findings, culminating in a comprehensive discussion and conclusion including implications of the study for key stakeholders.

Theoretical framework

Learning styles

Learning does not occur automatically through instruction. Instead, it necessitates a pedagogical approach marked by adaptability, creativity, and accountability to cater to individual learners. Over the past few decades, educators have advocated for a more effective teaching approach by considering students' diverse learning styles, with several different models proposed, each holding some validity. The quality of learning outcomes is significantly influenced by the learning activities students engage in. One persistent challenge faced by university instructors is the need to align teaching methods with the unique learning styles of their students to enhance academic performance (McKeachie, 1995; Tulbure, 2012).

Learning styles encompass various definitions, with some using the terms "learning style" and "cognitive style" interchangeably, while others differentiate between them (Cassidy, 2004). Cognitive style, according to Allport (1937), pertains to an individual's customary problem-solving, thinking, perceiving, and remembering tendencies. In contrast, "learning style", as described by Riding and Cheema (1991), focuses on the application of cognitive style in a learning context. Early definitions describe learning styles as how individuals absorb and retain information and skills (Dunn, 1984), the characteristic approaches individuals take when tackling different learning tasks (Hartley, 1998), or as attitudes and behaviours that dictate an individual's preferred learning method (Honey & Mumford, 1992). Additionally, learning styles consider information processing, distinguishing between global and analytic approaches (Cutolo & Rochford, 2007).

Learning styles can be perceived as either stable traits or dynamic processes, subject to modification in response to the educational environment (Cassidy, 2004). Recent research leans towards distinguishing between a cognitive style, seen as the processing of information and relatively stable, and a learning style, which defines one's preferred approach to learning tasks (Evans et al., 2010). Furthermore, the relationship between the learner and the teacher is an essential consideration in understanding learning styles (Pashler et al., 2008).

In the past three decades, educational researchers have taken a phenomenological approach to understanding learning. They've utilized qualitative methods to investigate how students experience learning and how they individually approach their course tasks, shifting

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Table 2. Initial and final cluster centres

Variable	Cluster 1 Deep Learners		Cluster 2 Strategic Learners		Cluster 3 Surface Learners	
	initial	final	initial	final	initial	final
Deep learning style scale score*	30	23.71	6	21.31	6	18.91
Strategic learning style scale score*	6	18.79	30	24.19	6	15.86
Surface learning style score *	6	17.10	6	16.96	30	22.74

*Scores on the scale from 6 to 30.

Source: own study.

To evaluate the disparities among the segments concerning stress levels, information overload, and satisfaction, an ANOVA was conducted, followed by a Bonferroni *post-hoc* test. ANOVA determines the presence of differences among the segments but without defining which specific segments differ significantly. For this reason, subsequent to a significant ANOVA outcome, the Bonferroni *post-hoc* test was employed to conduct pairwise comparisons, thereby identifying the distinct segments that exhibit statistically significant differences. All statistical analyses were conducted using IBM SPSS software, version 26.

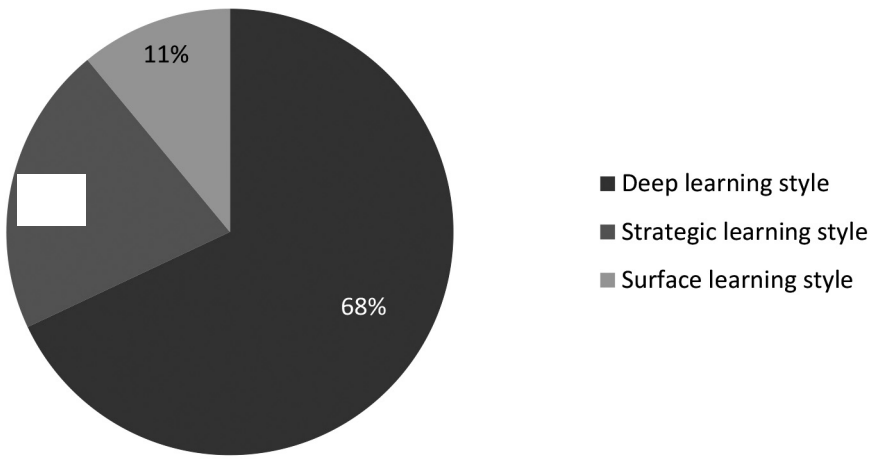
Results

In accordance with the data presented in Figure 1, it is evident that a predominant proportion of respondents (N = 356, 68%) exhibited a proclivity for the deep learning style, while 21% (N = 107) of the participants demonstrated inclination towards strategic learning style, and 11% (N = 59) manifested a surface learning style.

Regarding variations in perceived stress levels, statistically significant differences among the clusters were observed, as depicted in Table 3. Subsequent *post hoc* Bonferroni analysis unveiled that individual characterized by the surface learning style reported notably elevated stress levels (M = 3.65) compared to their counterparts in the deep (M = 2.99) and strategic learning style (M = 3.02) groups. Students adopting the strategic learning style exhibited stress levels akin to those with the deep learning style, as illustrated in Figure 2.

The clusters of students representing different learning styles also exhibit noteworthy disparities in their reported levels of information overflow, as depicted in Figure 3. Notably, students adhering to the surface learning style reported substantially

Figure 1. Respondents across clusters



Note: N = 532.

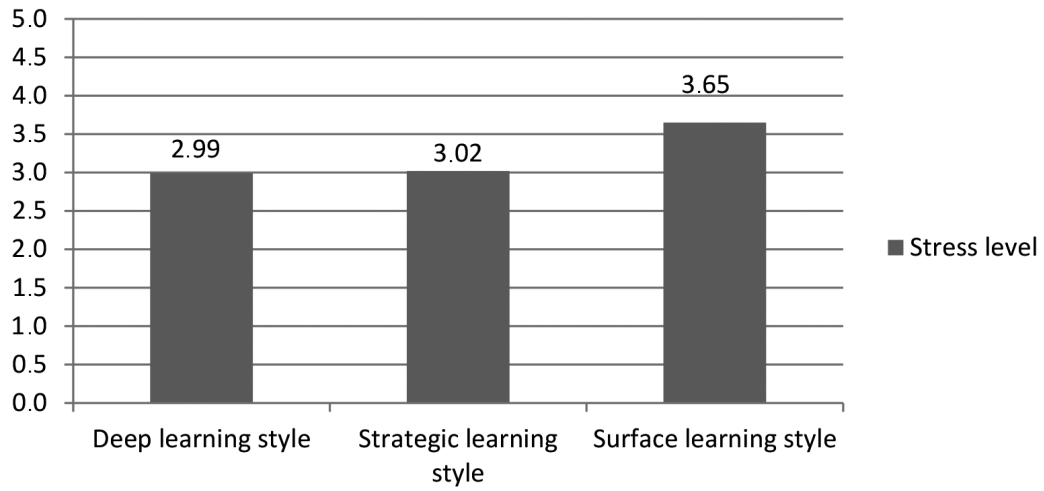
Source: own study.

Table 3. Differences between clusters – ANOVA results

Indicator	Between/within groups	Sum of Squares	df	Mean Square	F	Sig.
Stress level	Between groups	25.902	2	12.951	25.590	<0.001
	Within groups	267.722	529	0.506	–	–
	Total	293.624	531	–	–	–
Overflow level	Between groups	26.129	2	13.065	15.949	<0.001
	Within groups	433.334	529	0.819	–	–
	Total	459.463	531	–	–	–
E-learning experience	Between groups	9.857	2	4.929	15.791	<0.001
	Within groups	165.115	529	0.0312	–	–
	Total	174.973	531	–	–	–

Source: own study.

Figure 2. Differences in reported stress levels among clusters



Source: own study.

higher levels of information overflow (M = 4.04) in comparison to their counterparts with deep learning styles (M = 3.58) and those with strategic learning styles (M = 3.38).

As presented in Figure 4, the overall satisfaction with the e-learning experience exhibited variations among student clusters, with the lowest satisfaction reported by students exhibiting the surface learning style (M = 2.35) and the relatively highest satisfaction observed among those belonging to the deep learning style cluster (M = 2.76). A detailed analysis using Bonferroni testing, as shown in Table 4, confirmed that statistically significant differences were evident only between the surface learning style cluster and the other two segments. It is noteworthy that none of the clusters expressed satisfaction with the quality of the e-learning experience, as all mean satisfaction scores fell below 3.0 on the 1–5 scale.

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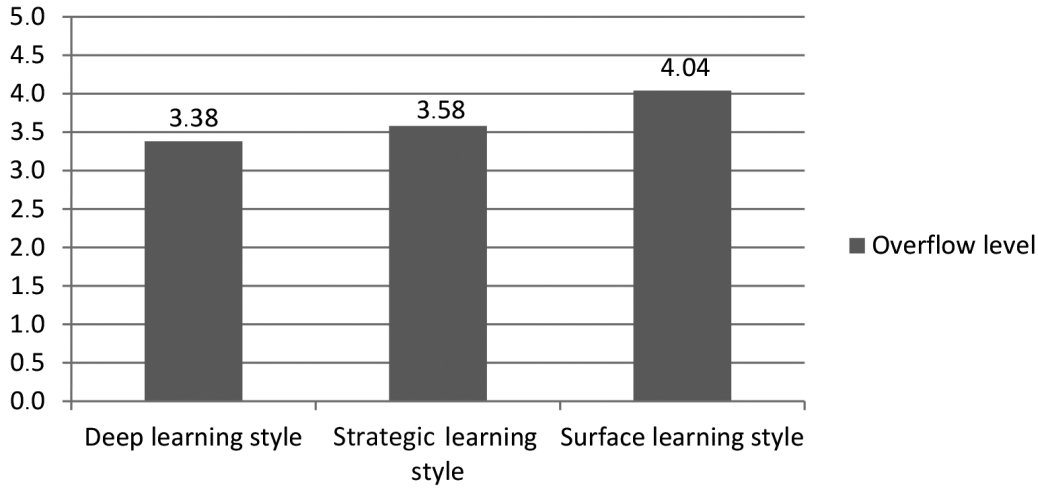
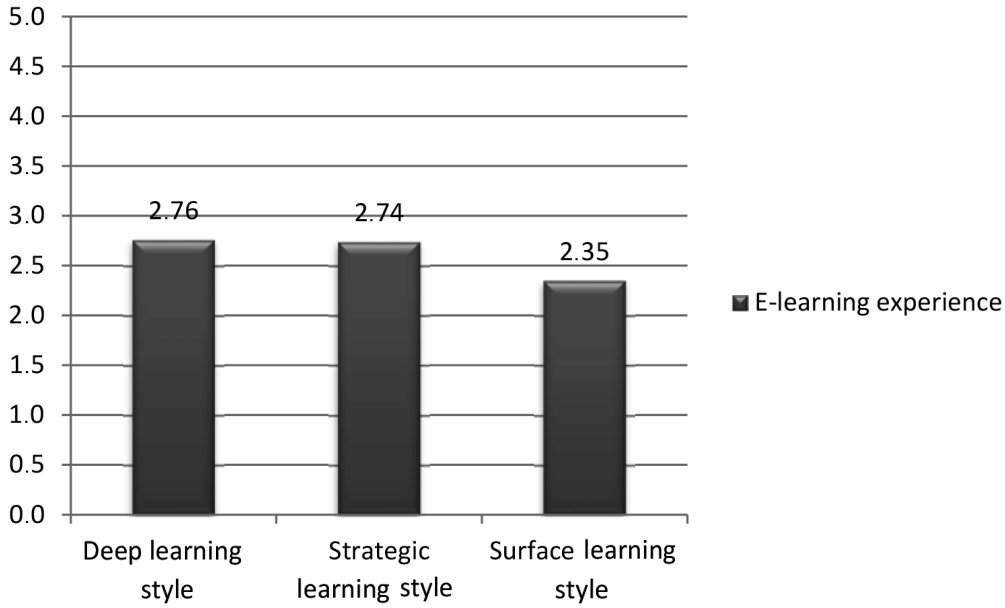
Figure 3. Differences in reported overflow levels among clusters



Source: own study.

Figure 4. Differences in satisfaction with e-learning experience among clusters



Source: own study.

Discussion

The study results indicate that the largest group of students are Deep Learners (68%), followed by Strategic Learners (21%), with Surface Learners representing the minority (11%). Since the data is based on respondents' declarations, it should be taken at face value. This finding aligns with previous student segmentations based on value co-creation, where the largest segment consists of The Maximalists (34%), who deeply engage in various academic activities, while the smallest segment comprised The Minimalists (15%), whose low engagement is similar to surface learning approach (Dziewanowska, 2018). However, this contrasts with another study investigating factors that are important to students during their studies. As a study by Dziewanowska (2017) shows, students tend to favour functional and relational value (such as learning new skills and networking) over

Table 4. *Post hoc* Bonferroni test results – multiple comparisons

Dependent Variable	(I) Cluster **	(J) Cluster	Mean Difference (I…J)	Std. Error	Sig.	95% Confidence Interval	
						lower bound	upper bound
Stress level	1	2	–0.04302	0.07843	1.000	–0.2314	0.1453
		3	–0.66477*	0.09357	<0.001	–0.8895	–0.4400
	2	1	0.04302	0.07843	1.000	–0.1453	0.2314
		3	–0.62175*	0.10984	<0.001	–0.8855	–0.0358
	3	1	0.66477*	0.09357	<0.001	0.4400	0.8895
		2	0.62175*	0.10984	<0.001	0.3580	0.8855
Overflow level	1	2	–0.20453	0.09978	0.123	–0.4442	0.0351
		3	–0.66193*	0.11905	<0.001	–0.9478	–0.3760
	2	1	0.20453	0.09978	0.123	–0.0351	0.4442
		3	–0.45740*	0.13974	0.003	–0.7930	–0.1218
	3	1	0.66193*	0.11905	<0.001	0.3760	0.9478
		2	0.45740*	0.13974	0.003	0.1218	0.7930
E-learning experience	1	2	0.01422	0.06159	1.000	–0.1337	0.1621
		3	0.40810*	0.07349	<0.001	0.2316	0.5846
	2	1	–0.01422	0.06159	1.000	–0.1621	0.1337
		3	0.39388*	0.08626	<0.001	0.1867	0.6010
	3	1	–0.40810*	0.07349	<0.001	–0.5846	–0.2316
		2	–0.39388*	0.08626	<0.001	–0.6010	–0.1867

*The mean difference is significant at the 0.05 level. ** 1 – deep learning style; 2 – strategic learning style; 3 – surface learning style.

Source: own study.

self-development and epistemic value, which are typically associated with deep learning approach.

It is interesting to note that respondents reported average levels of stress, though there is a significant difference between Deep and Strategic learners and those classified as Surface Learners. The stress level for Surface Learners is 3.65, while for the other two segments, it is 2.99 and 3.02, respectively. This implies that Surface Learners experienced the highest level of stress during their online e-learning experience. This result partially confirms Kulawska's study showing that students experiencing higher levels of stress rated e-learning lower, however, at the same time, students exhibited high levels of stress during the pandemic (Kulawska, 2021).

Regarding overflow, the reported level is moderately high for all respondents but significantly higher for Surface Learners (4.04) compared to 3.38 and 3.58 for Deep and Strategic Learners. This finding is consistent with Hilliger's (2023) and Gurbisz's (2021) discovery of students generally experiencing academic overflow.

The satisfaction level reported in the study is low: 2.76 for Deep Learners, 2.74 for Strategic Learners, and 2.35 for Surface Learners. Interestingly, dissatisfaction is significantly lower for Surface Learners. This contrasts with previous evidence of students responding positively to online courses (Judson et al., 2017; Olszyńska et al., 2021; Ćwiertniak et al., 2022). However, previous studies also demonstrate that the use of technology in the classroom is not positively related to the student experience (Bowden & D'Alessandro, 2011).

A consistent finding is that Surface Learners did not perform well in the online learning setting. They experienced higher stress and overflow levels combined with lower satisfaction. This aligns with previous findings that show this particular learning style is not successful in academic settings, as a surface approach has a negative correlation with academic achievement, as well as other factors such as self-efficacy and locus of control (Cassidy & Eachus, 2000). Students who adopt a surface learning approach tend to focus primarily on passing exams and obtaining their diploma, with less emphasis on engaging deeply with the material. This attitude towards learning posed a particular challenge in the e-learning environment, which demanded greater effort from students compared to traditional classroom settings. Specifically, e-learning required students to organize a suitable study space at home, manage their study schedule independently, particularly in asynchronous courses, rather than

simply attending classes and following the lead of their instructors (Rodek, 2020). This increase in responsibility and self-direction likely contributed to lower satisfaction levels and higher stress and feelings of being overwhelmed among students with a surface learning style.

Conclusion

In our research, we found that fully online learning poses significant challenges for the majority of students. It demands specific competencies, such as intrinsic motivation, proficient planning, and self-management, which not all students inherently possess. Under non-pandemic circumstances, our findings suggest that online learning should serve primarily as an adjunct to in-person instruction. Our research results suggest that exclusive online education may result in heightened stress and overflow for many students. Interestingly, the push for a transition to exclusively online courses frequently originates from students attempting to balance full-time employment with their studies (Gurbisz, 2021; Ćwiertniak et al., 2022). These students often view online learning as a more convenient option than traditional classroom-based education. It is highly probable that these individuals embody a surface learning approach, potentially unaware of the unintended consequences of their preference, such as inadvertently increasing their own levels of stress and feelings of overflow. Based on our findings, we recommend a blended learning model, which can potentially enrich the educational experience, rather than a wholly online university experience.

These findings provide guidelines for higher education institutions, especially regarding the structure of study programs (product offerings), the mode of instruction (delivery methods), cost borne (financial, psychological, emotional), and the design of communication content and strategy.

Firstly, it appears that many students declare their willingness to engage in the educational process and focus on acquiring high-quality knowledge. They independent and committed learners, capable of planning and executing learning activities. For such students, access to vast online resources creates added value they can and are ready to embrace.

Secondly, online study programs, which have recently gained popularity, may come with a significant psychological and emotional cost for those students who were primarily attracted by the promise of convenience and affordability. Therefore, it is crucial to understand the needs of the customers (students) and shape their expectations in a way that allows them to derive maximum value from the university's offerings. A combination of online and offline resources, along with a certain degree of freedom for individuals to choose the right combination, seems to be a potentially successful approach, enabling students to gain knowledge, develop the skills and competencies they need, and find satisfaction in the process.

Nevertheless, this study has its limitations. It was conducted in a single higher education institution during the unique circumstances of a pandemic, potentially amplifying stress levels beyond what might be typical. Utilizing a survey methodology meant relying on declarative responses, which carries the risk of respondents, for instance, overstating the depth of their learning approach.

For future research, there are several promising avenues. Comparative studies between fully online and hybrid courses would be beneficial, as would exploring perceptions of elective versus mandatory online modules. Replicating this study in various higher education settings and among students from diverse academic backgrounds will also be instrumental in assessing the consistency of our findings and uncovering any cross-cultural variations. An experimental design, where students experience the same course in both online and offline settings, is also recommended to more accurately gauge the differences in educational experiences.

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Dr hab. Katarzyna Dziewanowska, prof. UW

Associate Professor in Marketing at the Faculty of Management, University of Warsaw, Poland. She is a member of the European Marketing Academy, Polish Scientific Association of Marketing and Marie Curie Alumni Association (MCAA). She has authored and co-authored books and articles in journals such as "Journal of Services Marketing", "Journal of Higher Education Policy and Management", "Baltic Journal of Management". Her research interests focus on consumer behaviour, value co-creation, consumer experiences and experiential marketing, particularly in the context of higher education.

Dr hab. Agnieszka Kacprzak, prof. UW

Associate Professor in Marketing at the Faculty of Management, University of Warsaw, Poland. She is a member of the European Marketing Academy. She received her PhD in marketing from the University of Warsaw. She has authored and co-authored books and articles in journals such as "Journal of Services Marketing", "Journal of Consumer Behaviour" and "European Journal of Management Review". Her research interests focus on consumer behaviour, consumer experiences and experiential marketing in both online and offline settings.

Dr hab. Katarzyna Dziewanowska, prof. UW

Pracownik Wydziału Zarządzania Uniwersytetu Warszawskiego. Jest członkiem European Marketing Academy oraz Polskiego Towarzystwa Naukowego Marketingu. Jest autorką i współautorką książek i licznych artykułów, opublikowanych m.in. w „Journal of Services Marketing", „Journal of Higher Education Policy and Management", „Baltic Journal of Management". Jej zainteresowania badawcze koncentrują się na zachowaniach konsumentów, współtworzeniu wartości, doświadczeniach konsumentów i marketingu doświadczeń, szczególnie w kontekście szkolnictwa wyższego.

Dr hab. Agnieszka Kacprzak, prof. UW

Pracownik Wydziału Zarządzania Uniwersytetu Warszawskiego. Jest członkiem European Marketing Academy. Jest autorką i współautorką książek oraz artykułów w czasopismach takich jak „Journal of Services Marketing", „Journal of Consumer Behaviour" i „European Journal of Management Review". Jej zainteresowania badawcze koncentrują się na zachowaniach i doświadczeniach konsumentów oraz marketingu doświadczeń zarówno w środowisku online, jak i offline.

Agnieszka Kurczewska

EDUKACJA W ZAKRESIE PRZEDSIĘBIORCZOŚCI. W KIERUNKU SYNTEZY TEORII, PRAKTYKI KSZTAŁCENIA I ETYKI

W monografii, którą oddajemy do rąk Czytelników, autorka proponuje ugruntowane w nauce i etyce ramy kształcenia w zakresie przedsiębiorczości na poziomie uczelni. Monografia służy uporządkowaniu wiedzy na temat edukacji w zakresie przedsiębiorczości, krytycznemu spojrzeniu na dynamikę postępu w badaniach i wyznaczeniu kierunków jej rozwoju pod kątem przyszłych projektów naukowych. Jak sugeruje podtytuł monografii, zadaniem pracy jest synteza teorii, praktyki kształcenia i etyki. Do zilustrowania przedstawionych wątków teoretycznych w monografii omówiono przykład kształcenia w obszarze przedsiębiorczości na poziomie uniwersyteckim. Wykorzystano do tego stworzoną przez autorkę Akademię Przedsiębiorczości, będącą egzemplifikacją omawianych teorii i podejść w nauczaniu. Zadaniem monografii jest wsparcie nauczycieli akademickich, tak by mogli zaoferować solidne, poparte wynikami badań podstawy kształcenia przedsiębiorczości na poziomie uczelni.

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