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Editorial office:

SGH Warsaw School of Economics
Centre for Open Education
al. Niepodległości 162
02-554 Warsaw, Poland
tel. +48 22 564 97 23
fax. +48 22 646 61 42
redakcja@e-mentor.edu.pl

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Dear “e-mentor” readers,

I am pleased to share with you the latest collection of papers. The topics covered in this issue are related to trends in education and trends in management.

Readers primarily interested in trends in education can learn about the concept of *Team as Support*, explaining how psychological safety experienced by students leads to higher performance. Subsequently, readers can discover various aspects of implementing new technologies in pedagogy, including the potential of ICT in counteracting the social exclusion of students with mild intellectual disabilities and the application of augmented reality for teacher candidates. Finally, readers are invited to reflect on how universities can achieve sustainable development through mutual cooperation.

The part dedicated to trends in management concerns, among other subjects, knowledge management. Readers will learn about the use of machine learning in enhancing data and information management processes, as well as about the relationship between knowledge, communication and organisational silos. In the context of technological transformation, two other articles explore the challenges posed by digital transformation in family businesses and the implications of dualism in attitudes towards the metaverse in online consumer behaviours. Finally, two last texts address the problem of effects of the reference price in the context of the Omnibus Directive and the issue of synergy effect of selected management tools.

I hope you will enjoy exploring this issue. At the same time, I would like to cordially invite you to contribute to „e-mentor” and to support our efforts to internationalise the journal. Following an analysis of the results of the project financed by the Ministry of Science and Higher Education (Poland) completed in Oct 2024 (RCN/SP/0361/2021/1), we have decided to publish all articles in **English only**. Please be advised that from the beginning of 2025, there will be no further calls for manuscripts prepared in Polish. Furthermore, we have decided to redefine the scope of the journal, focusing on **higher education in management and economics**. Our goal is to make “e-mentor” a journal that serves as a forum for the presentation and discussion of research and ideas related to teaching and learning in management and economics higher education. We aim to provide a platform for the exchange of knowledge and insights on the use of technology in education, including e-learning, forms and methods of education, the verification of learning effects, and the integration of new trends in management and economics into higher education.

“E-mentor” is an open-access journal available free of charge, both online and in printed form. All scientific papers are peer-reviewed and we provide free proofreading of papers accepted for publication. Every article gets an individual DOI registered in Crossref, and the journal is indexed in several global databases, including Web of Science ESCI and EBSCO. There is **no publishing fee for the authors**. Further details are available online at http://www.e-mentor.edu.pl/eng/page/8/Info_for_Authors. Should you have any questions concerning publications in “e-mentor”, please contact the editorial team at redakcja@e-mentor.edu.pl.

Małgorzata Marchewka
Editor



WE RECOMMEND



Management International Conference (MIC 2025), 4–7 June 2025, Zadar (Croatia)

Management International Conference (MIC 2025) is designed to tackle pressing geopolitical, economic, and environmental challenges of our time. This year’s theme underscores the importance of fostering discussions among scientists, researchers, and policymakers on key topics such as management, economics, marketing, entrepreneurship,

sustainable development, and digitalization, with a strong emphasis on building resilience and adaptability in an ever-evolving world. With resilience as a cornerstone for navigating uncertainty and innovation as a driver of progress, the conference seeks to inspire strategies that align economic goals with sustainability and technological advancement. Emphasizing the interconnectedness of global challenges, MIC 2025 encourages participants to explore solutions that balance economic performance, societal well-being, and environmental preservation. By encouraging collaboration across disciplines and welcoming diverse perspectives, the conference seeks to help leaders and organisations prepare for future challenges and work towards a fairer and more sustainable world.

More information at: <https://www.mic.fm-kp.si/>
“E-mentor” is one of the Conference supporting journals.

Lea
Fridman

Dorina
Tila

Amy
Haas

Tauba
Zipper

Petra
Neuhold

Iris
Mendel

Dmitry Y.
Brogun

Team as Support (TAS): How Building Psychological Safety into Classroom Design Led to Higher Performance and More

Abstract

The pedagogy described in this paper has been transformative in European as well as in New York classrooms. *Team as Support (TAS)* is a structured and replicable teaching model focused on creating “psychological safety” within permanent semester-long teams of 6–7 students. Our eight years of teacher and student experience and our preliminary data make clear how the removal of a fear of criticism along with the creation of a student-driven structure of support brings the student greater freedom in expressing and testing ideas, exposure to multiple points of view, improved metacognition, critical thinking, engagement and much more. Combining elements of Team-Based Learning (TBL) and the Team Management and Leadership Program (TMLP), TAS uniquely emphasizes trust, kindness, and community as central to academic success and personal growth.

At the same time, this paper addresses a critical gap in Higher Education studies. “Psychological safety” is well established in research on performance and innovation across multiple fields (business, leadership, management, psychology, social psychology, trauma studies, medicine) although notably absent as in Higher Education. Our work and data on TAS open a new direction in Higher Education studies, work that is supported by research in Higher Education itself on the impact of fear on cognition, critical thinking and memory as well as by the established insights on the benefits of collaborative learning and on the emotional dimensions of learning. The emphasis in TAS on the key ideas of ‘possibility,’ support and breakdown as the path to breakthrough is a unique and innovative toolbox of a growth mindset valued across Higher Education.


Keywords: psychological safety, higher education, workforce-ready skills, transformative pedagogy, Social-Emotional Learning (SEL), teamwork strategies


No passion so effectively robs the mind of all its powers of acting and reasoning as fear.

Edmund Burke, 1756¹


Many times each of us had an issue with something that made us really sad and hopeless, but my team was always there to help. We text all the time through messages and make zoom conversations before we start our assignment. (P1)²

Lea Fridman, City University of New York, The United States of America,  <https://orcid.org/0009-0009-7787-8165>


Dorina Tila, City University of New York, The United States of America,  <https://orcid.org/0000-0003-0488-9161>

Amy Haas, City University of New York, The United States of America,  <https://orcid.org/0009-0007-2607-5309>

Tauba Zipper, City University of New York, The United States of America,  <https://orcid.org/0009-0002-8654-8423>

Petra Neuhold, University College of Teacher Education Vienna, Austria,  <https://orcid.org/0009-0006-5245-0179>

Iris Mendel, University of Graz, Austria,  <https://orcid.org/0000-0001-9117-0651>

Dmitry Y. Brogun, City University of New York, The United States of America,  <https://orcid.org/0009-0001-4065-3263>

¹ Cited in Amy C. Edmundson’s *The Fearless Organization: Creating Psychological Safety in the Workplace for Learning, Innovation and Growth*. Wiley, 2018.

² Citations from student reflective writing are included here and else where because the “voice” of the student is revealing of their experience. The quotes are marked with P1, P2, etc.

Team as Support (TAS): How Building Psychological Safety...

The research is extensive and well-documented. Over one thousand studies on leadership, management and business support the view that the highest-performing groups/teams are those that share a key characteristic: psychological safety (Duhigg, 2016a; Duhigg, 2016b; Edmondson & Shike, 2014; Kish-Gephart et al., 2009; Newman et al., 2017). This is fundamental in the fields of business, management, leadership, psychology, trauma studies, social psychology and medicine (Agency for Healthcare Research and Quality, 2019; Edmondson, 1999; Herman, 1992; Porges, 2011; Tulshyan, 2021; Wanless, 2016). Surprisingly, there is almost no focus on psychological safety in teamwork and its role in the classroom in higher education, although educational studies into related areas of the social and emotional dimensions of learning are extensive (Deutsch, 1949; Johnson & Johnson, 1989; Piaget, 1970; Vygotsky, 1978). *Team as Support* (TAS) is a transformative pedagogy that addresses this gap. Our data and eight years of implementation open an important new direction for higher education practice and research, one that is just beginning to attract interest. (Davidson & Katopodis, 2022; Lory, 2022).

TAS is a pedagogy that revolves around creating *psychological safety* or a “shared belief held by members of a team that it’s OK to take risks, to express their ideas and concerns, to speak up with questions, and to admit mistakes – all without fear of negative consequences” (Gallo, 2023). The approach has been a gamechanger for students taking our classes and for us as instructors in both in-person and, importantly, online teaching situations (Roberts-Grmela, 2023). As applied to higher education, the research suggests, and the experience of both teachers and students for the past eight years confirms, that nurturing psychological safety, trust and intimacy within permanent, semester-long student teams enhances academic outcomes, course engagement and satisfaction, while providing students with desperately needed social support, training them in effective collaboration and preparing them to be part of a workforce (Aronson, 2020; Clark, 2020). This is a pedagogy that teaches students *how* to collaborate, *how* to take initiative and *how* to lead. It is an approach that creates real connection, trust and bonding within diverse student teams. It gives students (and their instructors!) a language, metacognitive tools and real-world practice in creating *possibility* and *opportunity* out of failure, or, in the language of this pedagogy, *breakthrough out of breakdown.* It does all this by actively fostering support, kindness, generosity and a true sense of community in the work of the classroom, to far-reaching effect. See Appendix A for recent discussions of kindness, learning and the emotional life of the student. (Denial, 2024; Gorny-Wegrzyn, et al., 2022; Simons & Almasry, 2019; <https://www.qc.cuny.edu/cetll/pedagogy-of-kindness-building-a-community-of-inquiry/>; <https://www.qc.cuny.edu/cetll/the-pedagogy-of-kindness-the-discussion-continues/>; <https://www.qc.cuny.edu/cetll/udl-approach-across-cuny/>).

Imagine!

What if every student in your class had their own support team of five or six peers – a permanent, semester-long team that allowed them to deepen bonds of trust over the course of a semester – as they navigated the demands of college, work, family, the aftermath of Covid and online learning? What if students, so many of them still suffering from the isolation brought on by this extended COVID period of crisis, were connected to their teams through chats and virtual meetings and, because of the trust, familiarity and sense of safety encouraged within this specific cohort design, could easily lean on one another to understand and prepare for assignments, brainstorm without fear of criticism or of “looking bad” to others and even make new friends? What would the impact of such a classroom design be for the online student; for critical thinking and metacognitive skills that come with the freedom to express ideas without fear of criticism and with exposure to multiple points of view; for learning outcomes, collaborative skills, workforce development, retention, course engagement and satisfaction: in other words, for the lives, hopes and dreams of the students we serve?

What I like the best about The Power Rangers is the sense of belonging. We all instantly tried to make the best of our group. We started to communicate and even found commonality between each other. We began with our interests and what we wanted to do in life. ... It was an immediate feeling of safeness and comfort each and every time our group comes together. We tried to really make each other feel as if they’re heard and contributing to the group. (P2)

While *psychological safety* has not until now entered the vocabulary of higher education as a focus of research, its opposite, fear, has been widely studied. This is pointedly underlined in the opening citation from Edmunde Burke to this article. Today – almost eight centuries later – fear is well recognized for the ways in which it activates the amygdala, narrowing focus at the expense of reasoning, critical thinking, openness and problem-solving (LeDoux, 2000; Medina, 2008). The direct impact on the brain and on critical thinking has been studied in works by John Bransford as well as by Richard S. Lazarus and Susan Folkman (Bransford et al., 2000; Lazarus & Folkman, 1984). In his influential *What the Best College Teachers Do*, Ken Bain (2004) looks at fear and anxiety as barriers to transformational and deep learning. The issue of fear in the development of critical thinking has been studied by Stephen Brookfield (1987; 2012) as well as in works by Patricia King and Karen Kitchner (1994; 2002). Carol Dweck (2007), best known for her work on fixed vs. growth mindsets, directly addresses the fear of failure as it manifests itself in identity issues and affects academic performance. Similarly, Claude Steele and others have studied identity issues and

the role of fear in students from marginalized backgrounds (Cohn-Vargas & Steele, 2013; Steele, 1997). The list goes on.

Being part of a team can help overcome fear and shyness, and improve confidence. Being part of a team that you feel comfortable with can help you be more talkative. Being part of a team gives you the opportunity to help others if they need anything. Having a team also gives you the opportunity to meet new people. I personally learned and gained a lot from being part of a team. I never had this opportunity before and I definitely enjoyed it. Being part of a team made my learning experience more enjoyable. (P3)

The pedagogy of TAS incorporates key features from two well-established approaches to teamwork – Team-Based Learning (TBL) and the Team Management and Leadership Program (TMLP) – but with a fundamentally new focus on the principle of psychological safety. Whereas TBL organizes students in permanent semester-long teams around a principle of accountability towards the team for the purpose of course mastery and is well known in academic settings, Landmark’s TMLP approach focuses on ideas of possibility, of creating opportunity and of treating breakdowns as the path to breakthroughs within corporate and business settings (Elizade-Utnick, n.d.; LeGassick et al., 2011; Michaelsen et al., 2004; Michaelsen & Sweet, 2008; Sibley et al., 2014; Zapolski & DiMaggio, 2011; Zeffron & Logan, 2011). Importantly, Landmark emphasizes leadership and the role and responsibilities of a team leader.

From 2008 onwards, Kingsborough faculty, intensively trained in both methodologies, used a combination of these two teamwork approaches in the classroom, and this continued until 2016. Newly aware of the critical link between psychological safety and performance, instructions given to our students shifted from *you are accountable to your team* (spotlight on the self) to *your job is to support the work of your teammates* (spotlight on others) (Duhigg, 2016a; Duhigg 2016b). With these new instructions, TAS came into being. See Appendix B for a history of the evolution of TAS and detailed comparison of the common and contrasting features of TAS.

TAS redirects the attention of students from the self to others; from students experiencing themselves as solo players out to earn a good grade, to experiencing themselves as an integral part of a team. Instead of working alone and in competition with others, students took the initiative to creatively connect to and support the work of others (Buettner, 2012; Murthy, 2023; Shaghali et al., 2010). It was this subtle but dramatic shift that made all the difference in the experiences of teachers and students in our TAS classes. It accounts for the corroborating data from both faculty observation and student surveys we have collected, data – albeit at this time preliminary – that now adds higher education to the list of fields to which

the study of psychological safety is clearly and deeply relevant (see Appendix B).

Importantly, TAS is not a variation on *group work* (Fiechtner & Davis, 1985; LaBeouf et al., 2016; Oakley et al., 2004; Taylor, 2011). In TAS pedagogy, instructors do not create an assignment, give it to a team and collect the work. TAS requires the familiarity and trust that is nurtured over a full semester. A real psychic infrastructure of safety takes time and repeated experiences of support, generosity and kindness within a team to make a difference, to break down the barriers of fear, open minds to new ideas and create meaningful results. How is this accomplished? How is a TAS class organized? What kinds of assignments provide the best support for TAS? What are its guiding ideas and procedures? See Appendix D for key teaching materials.

My team honestly made everything easier for me. As I stated before, being able to say I don’t understand something and we all come together to help each other understand was very satisfying. They allowed me to think outside of the box. Sometimes I have my own understanding of things and they allow me to see different points of view. (P4)

How is Tas Organized in the Classroom?

Seating, team name and social media

In the classroom, students sit in teams, in circles facing one another throughout the class and throughout the semester – and not in a traditional row formation facing the instructor. This re-designing of the classroom space powerfully facilitates team bonding, discussion and presentations; it creates what Charles Duhigg, in *Smarter, faster, better* (2016a), calls a shifting of the *locus of control*. That shift, from reliance on the instructor to a student-and team-centered class, brings with it constant opportunities for student independence and initiative in learning, for the support of the members of their team, and thus, also, for improved academic outcomes, all of which are echoed in the brief but illustrative comments from students on their experiences cited in italics throughout this paper. See Appendix D for key teaching materials that detail this teaching design.

Students are placed into groups of between six and seven students on the first day of class. Instructors organize these groups alphabetically or according to the availability of students for video conferences and to chat within their team. Teamwork is prominently featured and detailed in the course syllabus. At their first meeting, the teams select the social media platform for their team ‘chat.’ Chats and virtual meetings are a critical form of support that allows students to help one another, ask questions, exchange ideas, prepare for examinations and assignments and bond with one another. In one case, a student checked her phone following surgery for a leg injury and saw mes-

Team as Support (TAS): How Building Psychological Safety...

sages from her team. *It made me happy*, she said when she spoke to her instructor.

An important activity (and icebreaker) in the first week of class is to ask each team to brainstorm a name for their team (chosen names include *The Giraffes*, *Phantom Fugitives*, *C's Get Degrees*, and *The Scholars*). Once a team has agreed on a team name, students write their team's name on all submitted work.

Rotating Team Leader and Chief Technology Officer

In this model of teamwork, leadership rotates weekly and, for the sake of simplification, alphabetically by last name. It is the job of the Team Leader to lead in the support of their team, to reach out to students who are absent, and to be attentive to the needs of individuals within their team and creative in offering support. *And it is the job of team members to support their Team Leader in that role.* Some instructors find it helpful to have one student act as the Chief Technology Officer of their team. This provides an extra layer of support for students who struggle with technology and with the tech requirements of the course and college. In reflective writing, students continually comment on the usefulness of the experience of leadership. One student surprised his professor, telling her that he was a pre-law student and that the opportunity to be a Team Leader was contributing to his future career!

At times, shy students have said they did not want to be Team Leaders, only to be told by the professor that this feature was in the syllabus and required. In almost all cases, shy students did well as Team Leaders and became visibly more comfortable around others and with their leadership role.

Weekly Reporting: Possibility and Outgoing Team Leader Report

At the beginning of their leadership week, the Team Leader provides their instructor with several sentences clarifying the *Possibility* they plan to create for their team. The *Possibility* includes a twofold *intention* or focus for the week: one that is academic (*we will meet to prepare for an upcoming quiz; we will help one another with editing of an essay that is due*) and one that promotes team bonding and psychological safety (*we will share vacation plans; we will talk about the challenges we face above and beyond 'classwork'*). The *Possibility* represents a serious metacognitive assessment on the part of the Team Leader of where members are at in their course work, what the most effective academic intervention/ focus might be for that week and how best to enhance the bonding and sense of safety within the team.

At the end of the leadership week, the Team Leader also hands in an *Outgoing Team Leader Report* consisting of two paragraphs. The first is an assessment of the strengths and weaknesses of their team. The second details the Team Leader's creative contributions to their team: how did they *make a difference* for their teammates; what were the challenges; to what extent were they successful?

The *Outgoing Team Leader Report* has proven to be a fascinating document. The report is a behind-the-scenes view of what is going on in a particular team (and in a class), which is normally not visible to the instructor. Instructors have learned about students who, during the COVID pandemic, were absent from class but very active in their teams. They have learned about initiatives undertaken by students on behalf of one another that they could not have otherwise known about.

There are a few things I love about my team. Me and my teammates show leadership, determination, and always being able to step forward towards our future. I like how you put me and my team mates together as one because we really see ourselves being friends in the next few years. (P5)

What are the Key Ideas that Distinguish Tas?

Possibility

To begin with, TAS is embedded in the language of *possibility*. It is important for the instructor to find ways to provide students with a growth mindset of *possibility* that they can apply to their own lives. The notion of *possibility* is a theme of the course and includes, as described above, the weekly *Possibility* submitted by the Team Leader. *Possibility* is thus embedded into a continual refashioning of *intentions* by each new Team Leader on a weekly basis, with the emphasis on each member *making a difference* for the others on their team and in training students in the practical steps needed to create breakthroughs and new *possibilities* out of breakdown, missed opportunity and failure.

Support and Psychological Safety

One early study of psychological safety was of nursing teams. Amy Edmundson, then a graduate student (now the Novartis Professor of Leadership and Management at Harvard Business School) was puzzled by the fact that nursing teams with the best records of performance also had the worst records of error! It turned out that the nursing teams in which it felt safe to report errors were then able to *correct* their errors and thus save lives. This was not true for nursing teams which lacked the psychological safety needed to report error in the first place (Baskin, 2023; Carmeli & Gittell, 2009; Edmondson, 1996; Edmondson, 2018). This insight guided decades of subsequent empirical research for which Edmundson is lauded and has been widely adopted across many fields. Our experience and data suggest that Edmundson's remarkable insight is both transferable and replicable in the higher education context.

A psychic and practical infrastructure of deep support and safety among students is key to the creation of ideal communities (*teams*), the mastery of course

material, the learning of collaborative skills, the reaching of higher levels of initiative, student satisfaction and workforce development, and, importantly, the improvement of mental health. Interestingly, in informal writing about their team experiences, students often wrote about mental health and stress reduction as one of the impacts of *TAS* over the semester (Bellows, 2022; Dempsey, n.d.; George & Strauss, 2022). But how is the subtle but critical transition from merely *working together*, with its highs, lows and inevitable stresses, to a sense of safety and trust accomplished?

It is important to introduce reading and discussion of the idea of *psychological safety* at the outset of the semester. In one case, after reading the 2016 NYT Magazine article *What Google Learned from Its Quest to Build the Perfect Team* by Charles Duhigg (2016b), a student commented, *Oh, now I understand why you put us into teams!* Amy Gallo's *What is Psychological Safety* (2023) is another insightful discussion of psychological safety that students have found helpful. It has proven instructive to ask students to reflect on the sense of *safety* they felt to speak up and share ideas in their other classes and to rate their sense of safety in two or three of those other classes on a scale of one to ten. The experience can be eye-opening for students as well as for instructors. It helps the student gain awareness of how feeling *unsafe* impacts learning, critical thinking, the sharing of ideas, engagement, academic performance and their overall college experience.

As helpful as our own college resources are to support students at Kingsborough, a two-year college that is part of the City University of New York, nothing comes close to the 24/7 support that is built into the *TAS* classroom *for every student*. This support is especially critical for the full and part-time students who work and for those who also juggle parental and family responsibilities (Perna, 2010; Perna & Odle, 2020.). One of our Kingsborough instructors was especially gratified when an entire class of students, all of whom were employed full-time, passed her course with good grades. Only teamwork framed as *support* could have made this happen.

Breakdown as the Path to Breakthrough

In *The New College Classroom* Catherine Davis and Christina Katopodis (2022), write about *TAS*, and how in this pedagogy, "breakdowns become opportunities for breakthroughs. Students gain a sense of comfort in taking risks. Shy students overcome their shyness knowing they are safe from embarrassment or shame." Training students to see breakdowns as the path to breakthrough is a key idea in the *TAS* approach imported from Landmark's TMLP. It takes the sting out of the failures and self-flagellations that students often subject themselves to when upset by a grade or other *failure*. It helps the student take a step back, assess a disappointing situation, and brainstorm the most effective way to create a new *possibility*. It teaches students what Amy Edmondson calls, in the title of her new book, *Right Kind of Wrong: the Science of Failing Well*

(Edmondson, 2023). In it, Edmondson distinguishes between failures that are springboards to better ideas (or *breakthroughs*) and failures that remain unexamined and repeated. (Edmondson, 2018; Edmondson, 2023). Training students in the *science of failing well* is a powerful metacognitive dimension of the learning process itself and of the *TAS* pedagogy specifically. It is a skill they will bring to every element of their lives.

Thus, when an entire class failed a quiz in a literature class, the *TAS* instructor asked each team to discuss what had gone wrong for its members and what they would need to do to prevent it happening again. What *breakthroughs* could be created from this *breakdown*? The teams then presented their ideas to the class. In some cases, a long-standing issue of time management was finally being confronted. In others, a student realized they could have reached out to family members for childcare help.

The opportunities to bring the language of *breakdown* as the path to *breakthrough* into the classroom are endless. In some of the most moving essays in *TAS* classes, students wrote about important breakdowns in their life trajectories they had turned into breakthroughs (hanging out with 'bad' crowds, poor attendance, attitude issues, COVID, substance abuse). Assignments that ask students to reflect on how breakdowns can lead to breakthroughs in their lives help them learn this key vocabulary. At the same time, when reviewing an essay with serious punctuation errors, a professor pointed out to the student that they were having a *breakdown* with respect to the use of the period! The implication was clear: identify where and why this was happening and the actions needed to create a *breakthrough* in the troublesome but critical area of punctuation!

Perhaps the best definition of *breakdown* came from another student, who explained to the class that every *breakdown* was simply a *learning opportunity*.

Student Surveys: The Impact of Tas

The City University of New York (CUNY) serves a diverse but also vulnerable population that was hit especially hard by the pandemic (Abdrasheva et al., 2022; Aucejo et al., 2020; Ewing, 2021; Neuwirth et al., 2020). Our surveys show that *TAS* helps break the isolation still severely affecting many students. It provides assistance to the most vulnerable students, students with work and family responsibilities, and creates a sense of belonging and community for the online student. It is an aid in retention, course engagement and academic success while training students in the collaborative, leadership and teamwork skills they will need when they join the workforce. It has proven effective in European as well as US settings, across class divides, in both undergraduate and graduate settings and in science, engineering, technology and mathematics (STEM), humanities and vocational courses across the curriculum. See Appendix C for details and discussion of student surveys with illustrative graphs.

Team as Support (TAS): How Building Psychological Safety...

Teacher and Student Experiences

Psychological safety within student teams changes the nature of conversation and of thinking itself. There is a direct connection between the development of critical thinking and psychological safety, as the work of Lev Vygotsky and higher education studies cited earlier on the impact of fear on cognition make abundantly, if indirectly, clear (Dewey, 1916; Vygotsky, 1978). Figure 1 illustrates the progress illustrates the progression we see in many students from psychological safety to better learning outcomes.

Over a period of eight years of implementation, we found that student preparation, completion of assignments, grades and retention were improved with TAS. Course satisfaction was first on the list of student comments on their TAS classes (*fun* was the word most often used). Most moving was the pride and initiative that students took in making a difference in the lives of their teammates. In one case, a student reported that because she was required to support her team, she called her teammate every morning of class at 6 am. *Otherwise*, she said, *he'd never make it to class on time*. In another class, an autistic student credited his team's support when he started turning in assignments and coming to class on time! The role of the intense peer support structure of TAS has been dramatic for the struggling student, the student with learning disabilities and for students juggling work and family responsibilities.

Practical Challenges

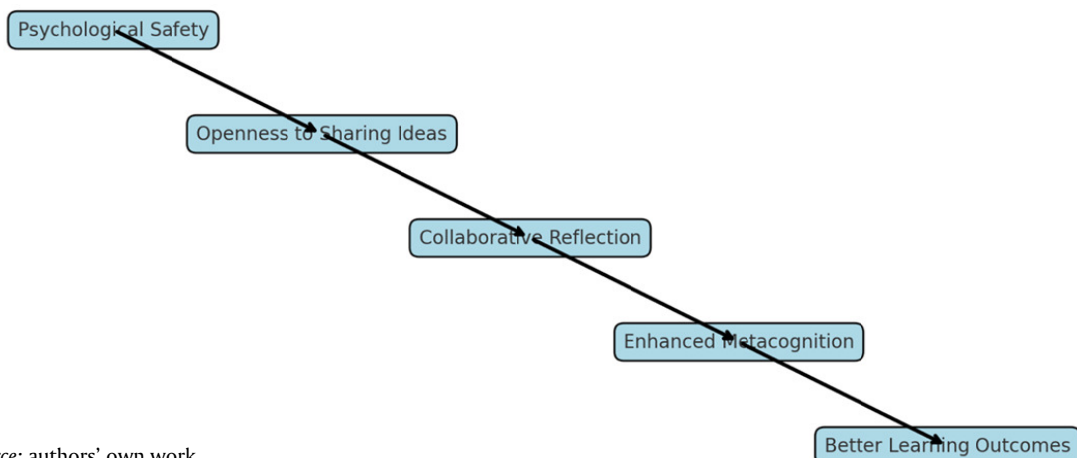
In one of our classes, an instructor new to TAS implemented her version for the duration of one project only and was disappointed not to see the results she was expecting. This pedagogy is about the directed relationship building of *psychological safety* over the two or three months of a semester and not for the week or two of a single project. The true magic of the program depends on the real-time building of psycho-

logical safety within student teams over the course of a semester. It requires educating the student regarding the point and purpose of TAS (reading, class discussion). This teacher was inspired by TAS, but the crucial underpinning of a full semester to build a strong foundation of *psychological safety* had either not been made clear to her or was discounted by the teacher. Would this instructor have been open to mentoring or video meetings to support her implementation of TAS? We look forward to using the possibilities created by online video platforms to bring training workshops to faculty everywhere. As our cohort of well-trained faculty grows, we will be able to bring mentoring to faculty requesting that support, as well.

TAS is not a teaching style or fit for every instructor. We acknowledge the individuality of teacher choices and practices and that this modality involves a commitment of additional time on the part of the instructor. For some, this will not be an appropriate procedure. For us and for many others, the gratifications are worth the *cost* in time and in effort. Indeed, TAS requires divided attention on the part of the instructor as they have to monitor and encourage the team bonding that underlies *psychological safety* on top of delivery of course materials. Ideally, the program would have institutional support so that the instructor was guided and compensated for the additional time and effort the pedagogy does require. At Kingsborough, TAS faculty were designated a Faculty Interest Group by the Center for Teaching and Learning for several years, and were awarded a *Teaching Excellence Award* which distributed release time credits to several of our TAS instructors. At the university level, the CUNY Research Foundation provided several larger grants to support faculty research, writing, and, more recently, the analysis of a larger set of TAS and control data.

Educating students to redirect habits of focusing on themselves and their grades to caring about and taking initiatives on behalf of teammates is another challenge not to be overlooked. While not all teams are equal in the levels of support they create and ex-

Figure 1
Flowchart: Psychological Safety to Better Learning Outcomes



Source: authors' own work.

tend across a semester, much will depend on student understanding of the point of the TAS design of their class of their class and whether they commit. The *Outgoing Team Leader Report* makes it clear to the student that their *performance* in support of other students on their team *counts* and is *recognized*. The syllabus must articulate how *teamwork* will count towards the final grade. Where possible, student initiatives and interventions undertaken by the students on behalf of one another should be acknowledged privately and, where appropriate, publicly. At the same time, the directive to support others on their team has been meaningful and even exciting to many of our students. In one case, a student who was Team Leader told his team he would take the student who got the highest grade on an essay out to lunch. He did exactly that, to the delight of a student who happened to live in a desperately poor and violent neighborhood and who had almost never been to a restaurant. The Team Leader knew his teammates' neighborhood, having barely escaped gunfire aimed at him in that neighborhood. The outing was a highlight of his experience that semester.

When we impact others, we experience our own power in the universe. The student who recounted this event was certain that his teammate finished the course successfully only because of the kindness and support he and his team had extended. Small acts of kindness ripple outward in small and big ways. In the classroom, they make possible the vulnerability that Brene Brown, in books like *Daring Greatly* and *The Gifts of Imperfection*, considers vital for deeper learning (Brown, 2010; Brown, 2012). This is the gift of TAS.

Conclusions and Next Steps

Some will argue that assertions made in this paper rely on research in other fields. Research in higher education however, has consistently demonstrated the benefits of collaborative learning and the detrimental effects of fear on cognition, growth, mental health and academic achievement. *Team as Support* (TAS) brings the specific vocabulary and focus on psychological safety to the field of higher education, leveraging these supporting studies to address this underexplored but critical element of the learning environment. Importantly, it also addresses complaints that are common in group work and which we, too, experienced before TAS when implementing a mix of TBL and TMLP in our classes. When instructors' instructions given to students shifted from a focus on themselves and their grades to a focus on supporting their teammates, the improvement in team functioning and student satisfaction was huge.

This paper is part of a larger effort to fill a gap and promote TAS: in print, in presentations, at conferences, on a website with teaching materials we have now created, and in a full-length book that will be published as an Open Educational Resource publication. Our website (<https://teamassupport.commons.gc.cuny.edu>) features detailed teaching materials for the instructor and for students. Case studies, testimonials

and video material from conference presentations will also be included.

Although not a substitute for objective data, student self-reported surveys cited in this study (Appendix) are not to be dismissed. They reflect the experiences of our students and are supported by teacher experiences over an eight-year period and by student reflective writing and comments, some included in this paper. At the same time, larger data sets are in the process of being analyzed. We look forward to the objective data collection and longitudinal studies that will replicate, deepen and extend our findings while clarifying long-term benefits and pitfalls.

TAS provides a form of 24/7 student-driven support that even the best resourced institution cannot replicate. The support made possible for the struggling, shy, disabled or otherwise disadvantaged student cannot be overestimated. While Kingsborough and Medger Evers would come under the heading of under-resourced colleges, our TAS classes at graduate and undergraduate levels at European institutions suggest that this pedagogy is transferable to multiple levels and contexts.

TAS is an innovative teaching modality based on a broad, multidisciplinary foundation that psychological safety is central to performance. Grounded in the most up-to-date theories of collaborative learning and studies of the impact of fear on cognition itself, TAS fills a crucial gap in higher education studies by transferring the insights and findings on psychological safety from medicine, psychology, trauma studies, business, leadership, management and more to higher education. TAS was, in the words of one of our faculty quoted earlier, a *lifesaver* during the pandemic. It is a lifesaver for the struggling student and for students in under – resourced institutions, and life-changing for students everywhere. It has inspired our faculty at Kingsborough, at Medger Evers and across the seas in Austria.

What if this Kingsborough-inspired pedagogy, *TAS: Team as Support* were to become a national or global model? How would this impact student lives and even the political fabric of our communities and countries? Students who learn to extend trust and build relationships within small, diverse teams are building meaningful connections outside the frameworks that have defined their lives. We are eager to bring this pedagogy to more instructors, students and classes across the nation and around the world.

Words like *kindness* and *generosity* are not words that many of us who teach in classrooms across the academy are used to hearing, but they are vital. They are lifelines to success, to happiness, to the achievement of dreams, to a better workforce and to an energized and more inclusive citizenry as well as to a more forgiving and less fractured society. Certainly, our role as instructor is nurturing these values in our students with the TAS pedagogy. Perhaps this excerpt from Naomi Shahib Nye's poem *Kindness* (<https://poets.org/poem/kindness>) expresses the central and universal profundity of this very common word best:

Team as Support (TAS): How Building Psychological Safety...

Before you know kindness as the deepest thing inside,
you must know sorrow as the other deepest thing.
You must wake up with sorrow.
You must speak to it till your voice catches the thread of all sorrows
and you see the size of the cloth.

Then it is only kindness that makes any sense anymore,
only kindness that ties your shoes
and sends you out into the day to mail letters
and purchase bread,
only kindness that raises its head
from the crowd of the world to say
It is I you have been looking for,
and then goes with you everywhere like a shadow or a friend.

The appendices are available in the online version of the journal.

For webinar training, information and inquiries, email: leafridman120@gmail.com

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Team as Support (TAS): How Building Psychological Safety...

Lea Fridman, Emeritus Professor, is literary scholar and creative writer at CUNY with a Ph.D. in Comparative Literature. Her interdisciplinary research spans Holocaust studies, trauma, Black history, and innovative pedagogies. She founded *Team as Support*, a pedagogy impacting 2,000 students annually, which was featured in *The New College Classroom* (2022). Her book *Words and Witness* (2000) explores narrative strategies in Holocaust literature. Fridman has led projects on overlooked figures, including composer Stanley Babin, whose works—six volumes published with her introductions and more forthcoming—are published by Subito Music Corporation. Her play *W/Hole in the Heart*, a Sundance finalist, was directed by Robert Kalvin (21 Obies) and performed at the UN and off-Broadway. A published poet, her *Gaga Poems* were adapted into a dance performance in NYC.

Dorina Tila, PhD, is a professor at the Department of Business at City University of New York (CUNY) Kingsborough Community College. She is an online peer faculty mentor at the Kingsborough Center for e-Learning (KCeL), a lead Open Educational Resources (OER) adopter, as well as facilitator for *Using Data to Support Teaching and Learning* faculty interest group. In addition to academic teaching and research, she has previously worked at Ernst & Young and Deloitte and has consulted many U.S.- and non-U.S.-based multi-national companies on the economic and tax implications of various intercompany transactions for planning, restructuring, compliance, and audit defense purposes. Equipped with corporate and academic experience, she is involved in projects that support student equity and culturally responsive teaching.

Amy Haas is a CPA and a Professor of Business at Kingsborough Community College, where she has been teaching accounting since 1992. She loves to try new technology tools with her students. Prior to beginning her career in academics, she worked in both public and private accounting. She earned an MBA in Finance from Hofstra University, a BS from Binghamton University and an AS from Sullivan County Community College. She is married, with 3 children and is a grandmother of 6. She enjoys pickleball, knitting and reading in her spare time.

Taubá Zipper brings over 35 years of experience as an educator, including 13 years as a lecturer across three CUNY campuses (KCC, Medgar Evers, and City Tech). Her primary research focuses on Holocaust trauma and its intergenerational effects, informed by her personal experiences as the child of Auschwitz survivors. She has published creative writing in anthologies and community publications, exploring themes of resilience, identity, and historical memory. Currently, she is working on a memoir delving into her family's history. Tauba holds an MS in Literacy Education and an MFA in Creative Writing.

Petra Neuhold is a university lecturer at the Vienna University of Teacher Education. She studied sociology and holds a teaching degree in German and history. Her research interests lie in social inequality, multilingualism, the critique of anti-Semitism and racism, and critical approaches to pedagogical professionalization research. With over ten years of teaching experience, she has worked at various Austrian universities. She has contributed as a research assistant on diverse projects and edits the educational journal 'schulheft.' She is committed to interdisciplinary, cooperative, and creative approaches in research and practice aimed at solidarity, critical thinking, strengthening democratic values, and social justice.

Iris Mendel is a philosopher and social scientist and trained teacher and currently working at the Department of Education Research and Teacher Education at the University of Graz, Austria. Her research interests include education and social inequality, feminist theories, care and critical pedagogy. She is currently working in a participatory project with students in a secondary school on climate change and storytelling.

Dmitry Y. Brogun has been educating students in Biological Sciences at the City University of New York (CUNY) since 2007. At Kingsborough Community College, CUNY, he has served as a Metagenomics Discovery Challenge PI and as served as a mentor for both the CUNY Research Scholars Program (CRSP), Bridges/CSTEP (Bridge to Bachelor's Program at Medgar Evers College/Collegiate Science Technology Entry Program), and also as a Science Coordinator for STEP (Science Technology Entry Program). Along with his Kingsborough colleagues, he has published a Biology Laboratory Manual. His primary educational focus has been on elevating students' skills in scientific inquiry, and he also has an interest in andragogical studies to determine the best classroom/lab practice.

Agnieszka
Galarowicz

Cooperation Between Universities and the Business Community as a form of Achieving Sustainable Development

Abstract

With economic development, the role of education has changed. In addition to teaching and research, the relationship between universities and companies has also become important. This issue is particularly relevant given society's increasing focus on responsible development. The aim of this article is to identify sustainable development measures taken by selected higher education institutions in Poland, to identify good practices for cooperation with business and to formulate recommendations for the future.

First, a literature analysis was conducted of the mission of the universities and the idea of sustainable development. A case study of four universities showed that universities engage in such activities to varying degrees, and that these measures most often concern the quality of education and support for lifelong learning. Examples of activities supporting communities and the environment were given. The ways in which universities collaborate with business were determined, and recommendations were given. This study serves as a prelude to empirical research involving individual interviews with representatives of stakeholder groups regarding sustainable development initiatives at Polish universities.

Keywords: sustainable development, SDG, sustainable development goals, university, Poland

Introduction

The advancement of technology, new management methods, and stakeholder expectations are reshaping the traditional role of education. Universities' relationships with the community are expanding to include knowledge exchange with businesses and public administration. Initiatives for local communities and the natural environment are also gaining in importance. Universities are increasingly supporting the establishment of business incubators and special purpose vehicles, facilitating high-level research, and encouraging students to become involved in student organisations. The aim of this article is to examine the sustainable development activities of selected higher education institutions in Poland, identify good practices for cooperation with business, and formulate recommendations for the future.

To achieve this, an analysis of reports and documents containing information on the sustainable development activities of Polish higher education institutions published after 2018 was conducted. Additionally, the case study method was employed. The first part of this article contains a review of the literature on the third mission of universities and the idea of sustainable development, while the subsequent sections present the research findings and recommendations.

Sustainable Development at Universities – Literature Review

University Mission

The higher education system has undergone transformations over the centuries, driven, among other factors, by new expectations from stakeholder groups (Guerrero & Menter, 2024). Other factors that have had a significant impact are new social challenges (Menter, 2023), technological advancements (Ignaciuk, 2022), economic crises (Lehmann et al., 2018), pandemics (Siegel & Guerrero, 2021), and armed conflicts

(Tverdokhliebova & Yevtushenko, 2023). The publication of *Transforming Our World: The 2030 Agenda for Sustainable Development* (United Nations, 2015) and *The 17 Goals* (SDGs, n.d.) has prompted universities to revise their approach to sustainable development.

Various definitions of the third mission of universities can be found in the literature. Researchers suggest that it encompasses all activities not classified as teaching and research (Göransson et al., 2009). This concept is often replaced with terms like *technology transfer*, *university-business cooperation*, or *social engagement* (Compagnucci & Spigarelli, 2023). According to Gibbons et al. (1994, p. 54), the third mission of higher education institutions involves collaboration with the socio-economic environment, responding to emerging challenges. Traditional areas such as education and research, which form the first and second pillars of the university mission, are insufficient in the face of growing demands for quality education and research development (Wrona et al., 2019). Universities are also becoming more engaged in ethical, cultural, and civilisational dimensions (Kola & Leja, 2015). Activities in these areas contribute to societal and economic development. Examples include knowledge sharing and the development and commercialisation of inventions and technologies through academic spin-offs or through licensing and patents (Guerrero & Menter, 2024). Other forms of entrepreneurial activity undertaken by higher education institutions include collaboration with businesses through the establishment of start-ups, building science parks, and business incubators (Compagnucci & Spigarelli, 2023).

In this article, the third mission of universities is understood as collaboration with the community on multiple levels, involving knowledge and capital exchange and engagement in community development.

Collaboration Between Universities and the Community

Collaboration between higher education institutions and the community can take various forms depending on the level of commitment of the entities involved. Eight types of relationships have been identified, as presented in table 1.

All of these types of relationships exist in Polish higher education institutions. The aforementioned definition of the third mission of universities is linked to the development of academic entrepreneurship through the support of innovative activities, the development of new curricula tailored to market needs, knowledge commercialisation, collaboration between units, and academic mobility. Co-governance, which involves involving staff in decision-making processes and considering their feedback regarding university activities, also helps to achieve this goal.

University-business collaboration is defined as a relationship or process involving knowledge exchange between entities, enabling achievement of goals and mutual benefits (Wrona et al., 2019). Companies gain:

- easy access to the latest knowledge,
- the opportunity to use technological infrastructure such as technology parks,
- more efficient problem-solving,
- increased productivity,
- a competitive advantage.

Universities can tailor teaching methods to market needs and support research projects and new academic initiatives. This collaboration enables university staff to develop professionally and update their knowledge. Informal relationships between academics and business employees play a crucial role in organisational interactions. This cooperation benefits both parties,

Table 1
Types of Relationships Between Universities and Organisations

Relationship type	Definition
Co-governance	A form of cooperation involving academics and university staff in the decision-making processes of organisations.
Academic entrepreneurship	Collaboration between universities and organisations in market analysis and the creation of new enterprises, as well as the development of innovative initiatives within universities.
Lifelong learning and continuous education	Courses and training programmes offered by universities for adults and employees of organisations.
Curriculum development and implementation	Enhancement of courses and teaching modules; collaboration with stakeholders in designing and delivering undergraduate, postgraduate, and doctoral programmes
Commercialisation of R&D results	Establishment of spin-off companies, disclosure of innovations, and filing for patents and licences.
Academic mobility	Temporary or permanent movement of researchers or staff between universities and businesses.
R&D collaboration	R&D activities such as research contracts, supervision of dissertations, implementation of student projects in cooperation with businesses, sponsorship, and scholarships.

Source: own work based on: „Action research” w kształtowaniu współpracy uczelni z interesariuszami: korzyści, szanse i wyzwania (pp. 54–55), S. Wrona, E. Bogacz-Wojtanowska, A. Pluszyńska, & P. Jedynek, 2019, Wydawnictwo Uniwersytetu Jagiellońskiego; „Academic engagement and commercialisation: A review of the literature on university–industry relations”, M. Perkmann, V. Tartari, M. McKelvey, E. Autio, A. Broström, P. D’Este, R. Fini, A. Geuna, R. Grimaldi, A. Hughes, S. Krabel, M. Kitson, P. Llerena, F. Lissoni, A. Salter, & M. Sobrero, 2013, *Research Policy*, 42(2), 427–429 (<https://doi.org/10.1016/j.respol.2012.09.007>).

and facilitates further social and economic development (Wrona et al., 2019).

Based on the type of university collaboration with the community, Sánchez-Barrioluengo and Bennerworth (2019) identified three university models:

- entrepreneurial university, which focuses on commercialising results (Perkmann et al., 2013) by connecting academics with businesses and using various methods to promote innovation pathways, such as spin-offs, patents, or licences. Differences exist between the European and American models of the entrepreneurial university (Feola et al., 2021).
- engaged university, which combines knowledge creation with structural changes in knowledge exchange and management. Activities include industry training, aligning educational programmes with requirements, and applying for patents and licences
- regionally engaged university, which is associated with knowledge transfer to small and medium-sized enterprises in the region. It facilitates access to resources and fosters innovation, often through financial support from local partners.

The literature on university-community collaboration introduces the *triple helix* model of relationships. It considers knowledge and innovation transfer and highlights the growing interdependence between business, academia, and public authorities. Recently, this concept has been expanded to include the quadruple and quintuple helix. This expansion is due to the increasing role of higher education institutions in economic development and emergence of new interactions. The quadruple helix concept involves collaboration (Carayannis et al., 2012):

- the business sector,
- public administration,
- higher education institutions and research institutions,
- civil society, and the media.

In the fourth mission, universities can generate ties between research institutions worldwide, absorb knowledge and innovation, and collaborate with businesses and local communities as agents of change (Rinaldi et al., 2017).

The quintuple helix model adds the natural environment as the fifth element. This concept is based on the interaction between society and nature, their joint development and evolution. It forms the foundation for the idea of sustainable development.

The Idea of Sustainable Development

The concept of sustainable development appears in numerous scientific publications and legal acts, with the first mentions dating back to 1972 in the report *The Limits to Growth* prepared for the Club of Rome. It described the potential negative consequences of economic growth with limited resource supply. The best known definition comes from the 1987 report *Our Common Future* (United Nations, 1987)

developed by the United Nations World Commission on Environment and Development. It emphasises current development while considering the needs of future generations.

In 2015, a key document on sustainable development, *Transforming our world: the 2030 Agenda for Sustainable Development* (United Nations, 2015), was signed at the UN headquarters. It is an action plan aimed at strengthening peace, building partnerships, eliminating poverty and inequality, and caring for the natural environment. 17 Sustainable Development Goals (SDGs) and 169 tasks were set for the agenda's signatories, covering economic, social, and environmental areas. They focus on five transformational changes known as the 5Ps: People, Planet, Peace, Prosperity, and Partnership. The following sustainable development goals were highlighted:

1. No Poverty
2. Zero Hunger
3. Good Health and Well-being
4. Quality Education and Lifelong Learning
5. Gender Equality
6. Clean Water and Sanitation
7. Affordable and Clean Energy
8. Decent Work and Economic Growth
9. Industry, Innovation, and Infrastructure
10. Reduced Inequality
11. Sustainable Cities and Communities
12. Responsible Consumption and Production
13. Climate Action
14. Life Below Water
15. Life on Land
16. Peace, Justice, and Strong Institutions
17. Partnerships for the Goals.

These sustainable development goals can be applied to activities undertaken by businesses, non-profit organisations, and higher education institutions. Reporting on the achievement of these goals is becoming increasingly common. The surrounding community has a significant influence on universities, expecting information on activities supporting environmental protection, local communities, and the development of scientific and research collaboration (Krasodomska & Godawska, 2020). Each of the 17 goals can be achieved to varying degrees, depending on the size of the university, research areas, funding, and collaboration with businesses.

Special indicators have been developed to measure these goals. *Voluntary National Reviews* are conducted to summarise sustainable development activities. Poland participated in the review in 2018 and 2023. The latest report presented conditions and challenges accompanying goal implementation and highlighted new priorities (*Realizacja Celów Zrównoważonego Rozwoju w Polsce*, 2023). Statistics Poland also monitors the extent to which these goals are achieved, according to the indicators described in the agenda, publishing results in the SDG Report. In 2023, the analysis focused on women's roles in social and economic life. In addition to equality, access to education and healthcare was also examined (GUS, 2023).

Research Methodology

The aim of the research was to identify sustainable development measures taken by selected higher education institutions in Poland, to identify good practices for cooperation with business and to formulate recommendations for the future. The following research questions were posed:

1. What actions are universities taking to implement the idea of sustainable development?
2. Which sustainable development goals are being pursued by universities?
3. How is university-business cooperation in this area structured?

The study utilised a literature review on sustainable development in higher education institutions and a case study method. After an initial analysis of activities conducted by 53 universities that are signatories to the Declaration of Social Responsibility of Universities (Ministry of Science and Higher Education) (MNiSW, 2022), the author selected four universities for detailed examination: the AGH University of Science and Technology in Kraków, the Krakow University of Economics, the SGH Warsaw School of Economics, and the University of Warsaw. The criteria for selection were as follows:

1. Signing the Declaration of Social Responsibility of Universities. This document, drawn up in 2017, outlines sustainable development premises for universities.
2. Implementation of the premises outlined in the Declaration of Social Responsibility of Universities, such as:
 - developing inter-university cooperation to strengthen sustainable development actions;
 - minimising the negative impact of the academic community on the natural environment;
 - cooperation with stakeholders.
3. Information regarding social, environmental, and economic activities in documents such as activity reports or social reports.

In January 2024, the author reviewed information contained in the social reports and statements prepared by the selected universities. The article lists the main activities of these universities and the sustainable development goals they are pursuing.

University-business collaboration in this area was also examined. This analysis enabled the research objectives to be attained and recommendations to be formulated.

Research Results

One criterion for including universities in the study was being a signatory to the Declaration of Social Responsibility of Universities. This document pertains to four main areas of university activity: supporting academic values, conducting social responsibility projects, university management, and cooperation with the community (MNiSW, n.d.). Another source of materials for analysis was the *Catalogue of Good Practices of Universities in ESG Areas* (Ministry of Development Funds and Regional Policy) (MFIPR, 2023), which lists universities' social, environmental, and economic activities. A total of 146 new and improved practices were reported, with the majority concerning social impact. No less than 70 activities were related to education (SDG 4), and over 20 initiatives addressed reducing inequalities in the academic community (SDG 10). This catalogue serves as a source of information on the degree to which SDGs are attained.

The mentioned documents feature terms such as *corporate social responsibility* and *sustainable development*. In the literature, these are often used interchangeably due to their interdependencies (Sołek-Borowska, 2024). *Social responsibility* is considered at the micro level and involves voluntary social and environmental actions taken by organisations, as well as collaboration with stakeholders. In contrast, *sustainable development* at the macro level pertains to the entire economy and individual entities. The social responsibility model forms the basis for achieving SDGs (Sołek-Borowska, 2024). Given the social, environmental, and economic premises laid down in the Declaration, the author analyses this document in the context of sustainable development. Figure 1 presents examples of university activities with respect to sustainable development.

AGH University of Krakow

The AGH University of Krakow is one of Poland's technical universities, offering education in 17 faculties and the opportunity to conduct research at the

Figure 1

Activities of Universities regarding Social Responsibility and the Implementation of SDGs

Social Area	Environmental Area	Economic Area
<ul style="list-style-type: none">• Improving the quality of education by expanding the range of postgraduate studies and study programmes on offer.• Supporting international exchanges of academic staff and students.• Organising events and workshops to integrate the community.	<ul style="list-style-type: none">• Increasing environmental awareness among the academic community and business representatives.• Conducting research and projects, including those related to circular economy practices.	<ul style="list-style-type: none">• Collaborating with the business sector by conducting implementation research and developing innovations.• Managing the university in a responsible manner and supporting the academic community.

Source: author's own work based on *Zaproszenie do przystąpienia do Deklaracji Społecznej Odpowiedzialności Uczelni*, MNiSW, 2022, May 25 (<https://www.gov.pl/web/nauka/zaproszenie-do-przystapienia-do-deklaracji-spolecznej-odpowiedzialnosci-uczelni>).

Academic Centre for Materials and Nanotechnology. According to its new strategy, AGH's goals include modern education, encouraging students from home and abroad to choose this university, further development as a research university and innovation leader, and national and international cooperation (AGH, 2022).

One of its auxiliary units is the AGH-UNESCO International Centre for Promotion of Technology and Education (<https://www.unesco.agh.edu.pl>). Established in 2010, it was the first unit in Poland supporting knowledge exchange and transfer. Its purpose is to promote, manage research, and provide university education on an international scale. The activities of the AGH UNESCO Centre align with the fourth sustainable development goal concerning quality education and lifelong learning. Each year, it announces a competition among university staff for young scientists, involving an internship at one of the AGH's units. The scholarship recipient obtains higher qualifications and the opportunity to conduct research in a chosen field. Other activities of the centre include visits to collaborating institutions, organising open days, and hosting scientific seminars (Centrum Międzynarodowej Promocji Technologii i Edukacji AGH-UNESCO, n.d.).

The Faculty of Management at the AGH offers postgraduate studies in sustainable enterprise development, facilitating the implementation of innovative solutions (Wydział Zarządzania, n.d.). The Department of Sustainable Energy Development (Katedra Zrównoważonego Rozwoju Energetycznego, n.d.) at the Faculty of Energy and Fuels conducts research related to sustainable energy development and offers courses in renewable energy and energy management. In Miękinia, the Centre for Sustainable Development and Energy Efficiency conducts educational and practical classes for students, as well as workshops and conferences on renewable energy sources (Katedra Surowców Energetycznych, n.d.). These initiatives help to achieve SDGs 6 and 9.

The AGH collaborates with businesses, higher education institutions, and other entities. It provides professional research teams, equipment, and software necessary for conducting high-level research. To fos-

ter academic entrepreneurship and innovation, the INNOAGH Krakow Centre for Innovative Technologies (<https://www.innoagh.pl>) was established, with a mission to create academic, technological start-ups. This supports social and economic activities focused on innovation development (SDG 9) and strengthening partnerships between institutions (SDG 17).

Information about the AGH, its research activities, and collaborations can be found on the university's official website (<https://www.agh.edu.pl>) and in legal documents. The AGH Nauka channel (https://www.youtube.com/playlist?list=PLWQK-C_twgtpV9yWEE-WSqZS3L49OMRREQ) and Bunkier Nauki (<https://www.youtube.com/c/bunkiernauki>) promote scientific research. The *AGH Social Responsibility Report 2019–2020 (Raport społecznej odpowiedzialności AGH 2019–2020, 2020)* highlights the university's contributions to the student community, educational initiatives, collaborations, and environmental protection. It outlines best economic, social, and environmental practices, as well as the university's principles of social responsibility. The report identifies several SDGs pursued by the university, including: SDG 3 (improving health and proper medical care), SDG 4 (related to fair, high-quality education and encouraging lifelong learning), SDG 5 (concerning gender equality), SDG 6 (responsible water management), SDG 9 (introducing innovation, promoting inclusive and sustainable industrialisation), SDG 11 (supporting responsible cities), and SDG 17 (strengthening partnerships between institutions). The university's efforts to implement sustainable development are summarised in table 2.

Krakow University of Economics (UEK)

The history of this university dates back to 1925. It offers studies in 30 fields with an economic profile, postgraduate studies, and MBA programmes (UEK, n.d.b). Units such as the Krakow School of Business (Krakowska Szkoła Biznesu, n.d.) and the Centre for Strategic and International Entrepreneurship (Centrum Przedsiębiorczości Strategicznej i Międzynarodowej, n.d.) also operate. The Centre's goals include conducting scientific research in entrepreneurship and innovation, organising conferences, and promoting entrepreneurial

Table 2

The AGH's Measures to Implement SDGs

Social Area	Environmental Area	Economic Area
Promoting science through the AGH Nauka and Bunkier Nauki channels, as well as on social media platforms like Facebook and Instagram. This involves all members of the academic community and encourages knowledge sharing.	Expanding knowledge about the natural environment among the academic community and stakeholders by organising events on ecology and environmental protection, conducting educational activities, and researching ways to reduce the harmful impact on the environment.	Collaboration between the Faculty of Management and Danone to develop innovative solutions in the field of circular economy and build synergies between science and business.

Source: author's own work based on *Centrum Zrównoważonego Rozwoju i Poszanowania Energii WGGiOŚ AGH w Miękinii*, Katedra Surowców Energetycznych, n.d. (<https://kse.agh.edu.pl/centrum-miekinia-agh/>); *Zrównoważony rozwój przedsiębiorstwa. 1 edycja studiów podyplomowych*, Wydział Zarządzania, n.d. (<https://www.csr.agh.edu.pl/>); Danone i Akademia Górniczo-Hutnicza w Krakowie rozpoczynają współpracę, K. Walkowiak, 2023, *Poradnik Handlowca* (<https://poradnikhandlowca.com.pl/artykuly/danone-i-akademia-gorniczo-hutnicza-w-krakowie-rozpoczynaja-wspolprace/>).

attitudes. An example is the Science Ninja programme, popularising science among stakeholders (Nauka. UEK, n.d.). These initiatives help to achieve SDGs 4 and 9.

As part of the university's third mission, UEK implements the Responsible UEK programme (UEK, n.d.c). The initiative involves activities in four areas:

- Art – supporting dialogue, creativity, and sensitivity to art and promoting the city's and region's cultural offerings. An example is the Ukrainian Art Festival (Odpowiedzialny UEK, n.d.).
- Helping – exchange of knowledge and experiences between stakeholders and developing social sensitivity, e.g., through a collection for an animal shelter.
- Ecology – strengthening ecological awareness and supporting social development. As part of this area, workshops for students titled *Picturebook for the Earth* were held (UEK, 2023).
- Civic Engagement – organising *Let's Talk about Kraków* meetings (Odpowiedzialny UEK, 2022) enabling discussion and knowledge exchange, and highlighting important topics for the community.

Information about activities is available on the university's and the Responsible UEK project's websites. Social media do not feature tags for sustainable development information. In 2020, a university social responsibility report titled *In Search of University Excellence* was produced, presenting the UEK's economic, social, and environmental activities (Sady, 2020). No further editions of the document were published, and activities are described in a general way. The document *Goals of the Krakow University of Economics for the Implementation of the 17 UN Sustainable Development Goals* (UEK, n.d.a) lists goals such as promoting well-being (SDG 3), ensuring quality education (SDG 4), achieving gender balance (SDG 5), fostering economic growth (SDG 8), developing innovation and infrastructure (SDG 9), ensuring sustainable consumption (SDG 12), combating climate change (SDG 13), and strengthening partnerships (SDG 17). Table 3 presents the university's sustainable development activities.

The UEK collaborates with domestic and international universities and entrepreneurs. The Department of Knowledge Transfer and International Projects provides support for implementing

innovation and knowledge sharing (UEK, n.d.e). Additionally, projects such as the Capgemini Academy (Akademickie Centrum Kariery UEK, n.d.) and the Learning Academy (Shell, n.d.) support student knowledge development in areas like team management or social responsibility. This ensures the achievement of SDGs 4 and 9.

SGH Warsaw School of Economics

The origins of the SGH Warsaw School of Economics date back to 1906. It offers bachelor's, master's, postgraduate, and MBA studies, as well as business training. The university implements projects such as the *Impact of Human Factors Research on Improving Management Efficiency in Healthcare* programme (SGH, n.d.c). The SGH Warsaw School of Economics Foundation for the Development of Managerial Education (Fundacja Rozwoju Edukacji Menedżerskiej SGH, n.d.) promotes and conducts activities to improve management quality and supports the development of entrepreneurship and innovation programmes. This helps to achieve two SDGs: ensuring quality education (4) and fostering innovation (9).

The university also supports entrepreneurial and innovative activities and cooperation with the business environment. The SGH Warsaw School of Economics Centre for Entrepreneurship and Technology Transfer (Centrum Przedsiębiorczości i Transferu Technologii SGH, n.d.) provides initial project consultations and assists in developing business models. This aligns with SDG 9, which focuses on fostering innovation.

Information about the activities undertaken by SGH Warsaw School of Economics is available on the university's website (<https://www.sgh.waw.pl>) and in the SGH Warsaw School of Economics Gazeta (<https://gazeta.sgh.waw.pl>). In 2024, the university published the *Report on the Implementation of the Declaration of Social Responsibility of Universities* (Glen, 2024a). It outlines 12 principles and 35 indicators used to assess the achievement of SDGs. Examples of social, environmental, and economic activities are presented in table 4.

University of Warsaw (UW)

The university's origins date back to 1816. UW offers undergraduate and graduate studies in 25 faculties and postgraduate studies. It has over 30 scientific and

Table 3

The UEK's Measures to Implement SDGs

Social Area	Environmental Area	Economic Area
Promoting the city's and region's cultural offerings and integrating the community, e.g., the Ukrainian Art Festival. Organising <i>Let's Talk about Kraków</i> meetings.	Organising workshops for students titled <i>Picturebook for the Earth</i> .	Collaboration on various levels: academic exchange, knowledge sharing, or innovation creation. Learning Academy project aimed at students.

Source: author's own work based on: *Learning Academy*, Shell, n.d. (<https://www.shell.com/business-customers/aviation/aviation-consultancy-services/technical-products-and-services/operating-systems/learning-academy.html>); *Warsztaty „Picturebook dla Ziemi”*, UEK, 2023 (<https://uek.krakow.pl/artikuly/studenci/warsztaty-picturebook-dla-ziemi>); *Porozmawiaj-MY o Krakowie – nowy cykl debat obywatelskich*, Odpowiedzialny UEK, 2022 (<https://odpowiedzialny.uek.krakow.pl/2022/09/19/porozmawiaj-my-o-krakowie-nowy-cykl-debat-obywatelskich/>); *Festiwal Sztuki Ukrainiejskiej*, Odpowiedzialny UEK, n.d. (<https://odpowiedzialny.uek.krakow.pl/sztuka/category/sztuka-na-uek/>); *Współpraca*, UEK, n.d.d (<https://uek.krakow.pl/wspolpraca>).

Table 4

SGH Warsaw School of Economics Measures to Implement SDGs

Social Area	Environmental Area	Economic Area
<p>The SGH Warsaw School of Economics Thursday Forum, where economic topics are discussed, expanding stakeholder knowledge.</p> <p>Scientific conference <i>Sustainable Human Resources Management – an International Perspective</i> conducted under the <i>Excellence in Science</i> programme, raising awareness of human resource management challenges and threats.</p> <p>Collaboration with the Foundation for the Campaign of 17 Goals and promoting knowledge in sustainable development.</p>	<p>The Greencoin project promoting pro-ecological behaviours among citizens, rewarding ecological attitudes and actions.</p>	<p>Activities of the SGH Warsaw School of Economics Partners Club, which brings together the university and international enterprises.</p>

Source: author's own work based on *Czwartkowe Forum SGH*, n.d. (<https://www.youtube.com/playlist?list=PLED2KqSSukbZRApCzL0tytR8wKjCYu>); *Raport wdrażania Deklaracji Społecznej Odpowiedzialności Uczelni w SGH*, P. Glen, 2024a, *Gazeta SGH* (<https://gazeta.sgh.waw.pl/meritum/raport-wdrazania-deklaracji-spolecznej-odpowiedzialnosci-uczelni-w-sgh>); *Porozumienie SGH z Fundacją Kampania 17 Celów*, P. Glen, 2024b, *Gazeta SGH* (<https://gazeta.sgh.waw.pl/wspolpraca-z-otoczeniem/porozumienie-sgh-z-fundacja-kampania-17-celow>); SGH, n.b.d (<https://www.sgh.waw.pl/en/events/sustainable-human-resources-management-international-perspective>); *Greencoin*, SGH, n.d.a (<https://www.sgh.waw.pl/projekty-i-granty-naukowe/greencoin>); *Klub Partnerów SGH*, SGH, n.d.b (<https://www.sgh.waw.pl/klub-partnerow-sgh>); *Sustainable Human Resources Management – an International Perspective*, SGH, n.d.d (<https://www.sgh.waw.pl/en/events/sustainable-human-resources-management-international-perspective>).

educational units and numerous research centres in Poland and abroad. The university has received numerous awards and distinctions, such as the HR Excellence in Research, awarded for good working conditions and anti-discrimination efforts (UW, 2022). This helps to achieve SDG 5. The integrated actions programme for UW's development has been implemented since 2018, with activities in educational programmes, doctoral studies, skill enhancement, and university management.

The Digital Economy Lab is an interdisciplinary platform for university-business collaboration, where scientific projects are conducted and specialist papers on technology development are produced (DELab, n.d.). This realises the goal related to economic growth, high-quality education, and innovation development. The *Smart Green University* programme (UW, 2024a) declared a reduction in the carbon footprint and the realisation of other goals: responsible transport (SDGs 12 and

13), nutrition (SDGs 2 and 8), consumption (SDG 12), and the use of natural resources (SDGs 13, 14, and 15).

The Open University (Uniwersytet Otwarty, n.d.) is responsible for popularising science, offering academic courses for everyone. The development of science is also supported through organising events. The Science for Business – Business for Science conference, addressing challenges and conditions for university collaboration with the business and institutional environment, facilitates the creation of a cooperation model between the academic environment and the business community (Konfederacja Lewiatan, n.d.). This enables the implementation of SDG 4 – improving the quality of education. The University of Warsaw operates the Centre for Technology and Knowledge Transfer (UW, n.d.), supporting student entrepreneurial initiatives and mediating in business contacts. Social, environmental, and economic activities are listed in table 5.

Table 5

UW's Measures to Implement SDGs

Social Area	Environmental Area	Economic Area
<p>Educational programmes including courses on sustainable development, postgraduate studies on sustainable logistics, and responsible and sustainable university management.</p>	<p>Green Day at UW, featuring lectures on environmental care, e.g., unused thermal energy issues.</p>	<p>Membership in consortia and councils supporting scientific development and environmental protection, such as the ACTRIS-ERIC consortium.</p> <p>Organising the Entrepreneur of the Year competition at the University of Warsaw and recognising companies that create innovations, engage in social activities, or operate as start-ups.</p>

Source: author's own work based on *UW członkiem konsorcjum ACTRIS-ERIC*, UW, 2023a (<https://www.uw.edu.pl/uw-czlonkiem-konsorcjum-actris-eric/>); *Zielony Dzień na UW*, UW, 2023b (<https://www.uw.edu.pl/zielony-dzien-na-uw/>); *Zwycięzcy konkursu Przedsiębiorca Roku UW*, UW, 2024b (<https://www.uw.edu.pl/zwyciezcy-konkursu-przedsiębiorca-roku-uw/>).

Sustainable Development – Information on University Activities

Table 6 presents the main sources of information on university activities related to sustainable development. Environmental and social initiatives are reported in university activity reports. Universities such as the SGH Warsaw School of Economics and the Krakow University of Economics (UEK) publish additional documents, such as *Inspirownik dla uczelni* (Inspirational Guide for Universities) (Glen, 2023). Two of these universities post information on social activities on their social media platforms.

Table 6
Sources of Information on University Sustainable Development Activities

	University Website	Social Reports	Activity Reports	Other Documents	Social Media
AGH	X	X	X		X
UE	X	X		X	X
SGH Warsaw School of Economics	X	X	X	X	
UW	X	X	X		

Source: author's own work.

Conclusion

Social, environmental, and economic measures are taken by universities due to the expectations of the community: the academic community, scientific institutions, state authorities, and businesses (Krasodsomska & Godawska, 2020).

Universities take sustainable development measures such as:

- Green Day at UW – An initiative that raises awareness in the academic community through lectures on environmental care and the issue of unused thermal energy.
- *Excellence in Science* programme – A programme aimed at raising awareness of challenges and risks relating to human resource management.
- Dissemination of scientific content – Posting content on social media, as well as on the AGH Nauka and Bunkier Nauki channels, to popularise scientific research and facilitate knowledge exchange among users.
- Collaboration with the business community – Supporting initiatives related to scientific development and environmental protection, such as the ACTRIS-ERIC consortium.

These activities enable the achievement of sustainable development goals such as improving education quality (SDG 4), gender equality in recruiting, including academic staff (SDG 5), conducting research on the circular economy (SDGs 6 and 9), using renewable energy at universities (SDG 7), and collaborating with businesses to create innovative solutions (SDGs 9 and 17).

The role of pro-environmental actions, such as workshops and training for the academic community,

which increase knowledge of environmental protection, nature care, and consumer awareness, should be emphasised. An example is the *Picturebook for the Earth* initiative by the Krakow University of Economics.

Equally noteworthy are the academic programmes offered by the universities discussed, as well as student workshops on topics such as sustainable development, the circular economy, and the use of renewable energy sources. These initiatives help introduce young people to the latest developments in these areas, ultimately influencing the operations of businesses that employ university graduates.

Supporting local communities remains a relatively underdeveloped area for universities, and the author suggests that such activities should be expanded. Companies frequently engage in initiatives such as employee volunteering, supporting charitable campaigns, and organising events for employees and their families. These forms of community engagement should also be implemented by universities. Furthermore, collaboration with businesses should be expanded to facilitate faster transfer of knowledge and scientific research results. Currently, there are concerns about intellectual property rights and funding.

Recommendations and Future Development Directions

The case study demonstrated that university-business collaboration supports the implementation of sustainable development. Projects like the Capgemini Academy and the Learning Academy with the Krakow University of Economics facilitate knowledge sharing. Organising competitions such as the Entrepreneur of the Year at UW strengthens business relationships. Various forms of academic community collaboration with the community not only achieve sustainable development goals but also create new initiatives.

Based on the case study, the following recommendations have been developed to enhance the implementation of SDGs:

1. Supporting academic values as outlined in university codes and regulations.
2. Upholding principles of tolerance, equality, and human rights.
3. Fostering a strong academic community and promoting inclusivity.

4. Engaging in partnerships with national and international research institutions to facilitate knowledge sharing.
5. Adhering to ethical principles in teaching, research, and external collaborations.
6. Raising awareness among the academic community regarding sustainable development.
7. Minimising activities that are harmful to the natural environment.
8. Encouraging creativity and entrepreneurship among all members of the academic community.
9. Strengthening relationships with the business sector and engaging in ongoing dialogue about sustainable development initiatives.
10. Developing and implementing official documents related to the realisation of sustainable development goals, such as a sustainability code, and regularly reporting on progress.

Potential future development directions for universities in the area of sustainable development include developing social initiatives such as supporting minorities or excluded groups and furthering research related to sustainable development and the circular economy. Additionally, membership in councils and associations can improve collaboration with businesses and facilitate new projects.

Summary

Climate change, increased globalisation, and technological development are just some of the new challenges facing higher education institutions (Kola & Leja, 2015). Needs of stakeholders, including local communities, are becoming increasingly important. Measures are being taken to support the natural environment and reduce the harmful effect on the climate (Guerrero & Menter, 2024).

The study achieved its goal of identifying sustainable development activities conducted by selected universities in Poland. Examples of good practices were identified and described, including collaboration with businesses. Recommendations for the future were formulated in the form of ten points, partially referring to the Declaration of Social Responsibility of Universities.

In conclusion, universities implement a sustainable development strategy through numerous activities related to the 17 SDGs. The four universities analysed pursue the goals of providing the highest quality education, enhancing academic community competence, ensuring equality, conducting research to reduce the negative impact of universities on the natural environment, and supporting innovation. Information on achieving these goals is published on websites, in social reports, or activity statements and is not systematically organised. This complicates data retrieval and comparison of sustainable development goal achievement.

The presented study is a pilot and serves as a starting point for research on stakeholder perceptions of sustainable development activities by universities: students, doctoral candidates, staff, entrepreneurs,

or other cooperating entities. The results would help universities understand market needs regarding social and environmental engagement and gather community opinions on past actions.

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Agnieszka Galarowicz is a PhD student at the Faculty of Management at the AGH University of Science and Technology in Kraków. Her research focus is sustainable development, particularly aspects of corporate social responsibility, as well as academic entrepreneurship and innovation in higher education.

WE RECOMMEND

Małgorzata Adamska-Chudzińska, Justyna Pawlak (Eds.)

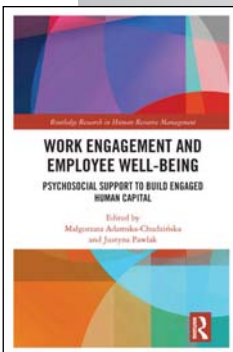
Work Engagement and Employee Well-being. Psychosocial Support to Build Engaged Human Capital

Work Engagement and Employee Well-being highlights the vital role of psychosocial support in building and stimulating work engagement. It is a response to the growing phenomenon of weakened employee attachment and engagement instability. The authors underscore the importance of creating a friendly work environment, which accommodates a variety of employee needs and elicits positive emotions, thus fostering the well-being and complete engagement of employees. An in-depth literature review and empirical research conducted using combined qualitative and quantitative methods enabled the authors to present the issue from a wide range of theoretical perspectives. With a model acknowledging the multifaceted nature of work engagement and its association with well-being, the book introduces a selection of psychosocial means to enhance it. The analysis focuses on both systemic measures, that is, promoting a supportive organizational culture and protecting work-life balance, as well as a more individualized approach that not only facilitates the recognition and respect of employee needs but also helps cultivate their development. The book places emphasis on a transformational leadership style and a high level of emotional intelligence among managers, particularly their empathy. Further attention was paid to the various ways to support specific employee groups, such as remote workers and neurodivergent members of the workforce.

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The Potential of ICT in Counteracting the Social Exclusion of Students with Mild Intellectual Disabilities

Abstract

This article addresses the issue of counteracting the social exclusion of students with mild intellectual disabilities with regard to organisational aspects, and also defines other selected aspects. In particular, this article attempts to determine whether, in the opinion of teachers co-organising education, information and communication technology (ICT) tools present an opportunity to counteract the social exclusion of students with intellectual disabilities.

The introduction provides a conceptual framework for the terms used in the article, outlining the current knowledge regarding social exclusion and modern ICT. The next section examines the social exclusion of students with mild intellectual disabilities in educational institutions. Given the ongoing economic and environmental changes, this has become a common problem. At the same time, the rapid development of ICT could be an opportunity for educators to support the inclusion of excluded students.

The article goes on to discuss various ways of organising didactic, remedial, and compensatory classes using ICT tools. The conclusions on digital tools as a means of preventing social exclusion are based on surveys conducted among a deliberately selected group of teachers co-organising the education of students with mild intellectual disabilities, the author's own experience, and a review of the relevant literature.

Keywords: information and communication technologies (ICT), digital education, mild intellectual disability, Special Educational Needs, social exclusion

Introduction

Although numerous researchers have studied the social functioning of individuals with intellectual disabilities (Blicharz, 2020; Chrzanowska, 2003; Klimczak et al., 2017; Kościelska, 1984; Panek & Czapiński, 2011; Szarfenberg, 2007), there are grounds for revisiting the issue of social exclusion among students with mild intellectual disabilities. This is particularly relevant in light of intensive societal changes brought about by digital transformation. Over the past decade, Polish schools have had to adapt to these transformations, implementing numerous modifications to align with new realities. These changes have affected teaching methodologies, curricula, and the education of students with special needs.

An exploration of the functioning of students with mild intellectual disabilities in educational institutions must begin with an attempt to define the challenges they face amidst shifting worldviews and global digital transformation. Difficulties in acquiring basic skills often make these students more vulnerable to manipulation and hinder their ability to establish and maintain peer relationships (Domagała-Zyśk, 2012, p. 14). Social exclusion is becoming increasingly common, as interpersonal bonds weaken in information societies (Pilch, 2007, p. 101). Maintaining social connections through digital tools (such as social media and communication platforms) is now regarded as one of the most important digital competencies (Jasiewicz et al., 2015, p. 18). At the same time, a notable shift in worldview can be observed, where the legitimisation of rationality and equality in all differences is gaining recognition. This includes acknowledging individuals with disabilities as possessing the same potential and rights as others (Doroba, 2010, p. 6).

Separationist behaviours also affect young people of school age (Lukasek, 2020, p. 396). One of the key causes of exclusion among students is peer discrimination, which occurs when individuals are denied equal rights and restricted from accessing key aspects of social life due to specific characteristics that neither in themselves nor due to their consequences are formally penalised (Czapiński, 2011, p. 340). Hilary Silver identified people with intellectual disabilities as one of 23 groups particularly vulnerable to social exclusion due to their low and disadvantaged social status (Silver, 1995, p. 74).

According to Fred Mahler (1993, p. 193), the characteristics of social exclusion include lack of power and limited access to decision-making, fewer rights and increased obligations, restricted educational opportunities, social stigmatisation and discriminatory practices. Students in state schools also face most of these challenges.

Ultimately, the definition of *social exclusion* adopted in *Poland's National Strategy for Social Inclusion* specifies that it is "The lack of or restriction on the ability to participate in, influence, and benefit from fundamental public institutions and markets, which should be accessible to all" (Narodowa Strategia Integracji Społecznej dla Polski, 2003, p. 23).

For the purpose of this study, a simplified definition of *social exclusion* has been adopted, according to which it refers to situations in which a student is unable to participate in classroom activities (both educational and social) and represents the opposite of classroom integration (Żuraw & Dryżałowska, 2017, p. 3).

An exploration of the use of ICT in the process of social inclusion must begin with an explanation of the term itself. ICT is an acronym for *Information and Communication Technologies*. In working with children and young people, it refers to teaching and therapeutic methods based on communication, processing, and transmitting information in electronic form. The European Commission's definition emphasises that in the face of digitalisation and the rapid development of information and communication technologies, ICT tools are crucial for enhancing Europe's competitiveness. Between 2014 and 2020, EUR 20 billion was allocated from the European Regional Development Fund to support development of ICT tools. These investments are essential to achieving the Commission's goal of preparing Europe for the digital age (European Commission..., 2022).

ICT tools primarily include various types of software, applications, platforms, and even instant messaging tools for online learning. The use of ICT helps students develop more effectively, supports traditional educational content and communication methods, significantly improves teaching quality, creates innovative learning opportunities, and effectively enhances logical thinking skills. According to researchers, ICT now plays a fundamental role in addressing deficiencies in social relationships and building a cohesive system of values (Kwiatkowska & Rola, 2015, p. 24).

The Educational and Developmental Potential of ICT

Modern technologies in communication and teaching not only help students adapt to a changing reality. More importantly, they provide equal access to education and enable the inclusion of those who may have previously experienced social ostracism. New digital technologies have a profound impact on children's motivation, making teaching and learning more effective, and transforming educational methods. This perspective is shared by many researchers (Bednarek, 2015; Furmanek, 2003; Watkins, 2013) and is also supported by the Ministry of National Education, as evidenced by its efforts to modernise educational institutions.

Digital skills are among the key competences identified by the Council of Europe in 2018 as essential for self-fulfilment, social participation, and employment opportunities. According to this regulation, effective use of digital technologies requires a reflective and critical approach to their development, along with an "ethical, safe and responsible approach to the use of these tools" (Council Recommendation..., 2018). Therefore, teachers' digital competences and their willingness to continually develop them are of great importance. Digital tools serve as additional teaching aids, while proficiency in using the internet and social media enables the exchange of experiences and materials necessary for working with students with special educational needs (SEN).

At the stage of implementing changes in the education of students with disabilities, the most crucial factor determining their effectiveness is the role of teachers. Their engagement and belief in the legitimacy of the innovations introduced determine ultimate success, whereas resistance makes reforms difficult, if not impossible, to implement (Gajdzica, 2011). As Piotr Plichta notes, in the past, special educators were primarily responsible for addressing the challenges of social inclusion for students with intellectual disabilities. However, "today, knowledge about the functioning of this and other groups of people with disabilities must also be applied by teachers working in mainstream education" (2013, p. 122).

Since the idea of integrating modern technologies into education began to develop, both their image and potential have evolved. Increasingly advanced hardware components (processors, graphics cards) have enabled remote participation in classes and the creation of more sophisticated teaching aids. This proved indispensable during the pandemic, and afterward, it greatly simplified the organisation of individual lessons. The provision of digital tools in schools is now becoming increasingly widespread (Piecuch, 2016, p. 110). However, there is a risk that in the pursuit of school digitalisation, the needs of students with intellectual disabilities may be marginalised. For this group, the increasing digitalisation of education may become an insurmountable barrier. Thus, the needs and capabilities of students with intellectual disabili-

The Potential of ICT in Counteracting the Social Exclusion...

ties must not be overlooked in plans for integrating modern technologies (Plichta, 2012, p. 69).

However, when adapted to the individual needs of children with intellectual disabilities, modern technologies can serve as a bridge connecting them with other students, providing them with a chance for educational success. To achieve this, students with intellectual disabilities often require increased support, curriculum adaptations, and an individualised approach (Gajdzica, 2011, p. 60). Therefore, children who struggle with learning due to developmental limitations or dysfunctions can benefit from computer equipment that is easy to use and provides an alternative way to grasp even complex concepts. The use of smartphones and tablets is intuitive, and many students already possess these skills before beginning their formal education.

Information technologies can also support the social and emotional development of students with intellectual disabilities by facilitating remedial classes that enhance their social competences (e.g. SST or ART¹ programmes). Lessons incorporating ICT are particularly engaging for students, encouraging active participation. Since motivation is a key factor in working with students with SEN, digital tools provide a natural and effective means of support. Given that using digital technologies is second nature to young people, they are increasingly being integrated into individual educational and therapeutic programmes (IPET).

According to research conducted by the Educational Research Institute (Białek, 2013, pp. 32–35), teachers believe that lessons using modern technologies offer many benefits to students with intellectual disabilities, including:

- Enhancing students' autonomy,
- Unlocking the potential of students with communication difficulties,
- Enabling educational success,
- Allowing tasks to be adapted to students' abilities and interests,
- Increasing intrinsic motivation for learning,
- Reducing feelings of isolation,
- Allowing students to learn at their own pace.

Computers and software tailored to students' abilities undeniably support their learning process and boost their self-esteem by providing opportunities to participate in peer groups and school communities. According to Dobrowolska "By using available educational programmes, children can improve visual-motor coordination, precision, perceptiveness, attention shifting, and concentration. Modern technologies thus promote better development of their educational

potential and help overcome limitations resulting from disabilities" (2018, pp. 17–18).

Integrating computers into the learning process enlivens lessons and motivates students to engage in their work. For students with SEN, tasks such as writing, reading, or counting might be extremely challenging—or even impossible—without the use of modern technology. ICT can also be effectively used with students experiencing difficulties in social interactions.

Students with mild intellectual disabilities may sometimes struggle with motivation, experience fatigue due to their learning difficulties, or have shorter attention spans than their peers. ICT tools, which combine text, sound, music, and animations, prove highly effective in remedial classes. These stimulating multimedia elements help students with intellectual disabilities to focus for longer periods. For this reason, it is worth incorporating applications that support the work of teachers and specialists (Dobrowolska, 2018).

Thanks to new technologies, children with SEN can participate more actively in interactions and communication with their environment. Digital tools help students complete school tasks, improve information retrieval and processing, and help them play a greater role in the classroom community. Some researchers suggest that ICT is an element of both technology and culture (Bober, 2008).

Many students with mild intellectual disabilities find ICT motivating, as it encourages them to take an active part in lessons, supports the development of their passions and interests, and enhances cognitive abilities and visual and auditory perception (Siuda, 2015). For some children with SEN, ICT in education also serves a therapeutic function, helping them overcome limitations related to their disability.

Warschauer (2003, p. 38) states "Just as literacy was essential for participation in industrial society, ICT skills are now crucial for full engagement in the digital era".

ICT in Didactic, Remedial, and Compensatory Classes

Many researchers have highlighted the social disadvantages faced by students with intellectual disabilities in inclusive classrooms (Chodkowska, 2004; Maciarz, 2001). This may indicate the low effectiveness of inclusion efforts in educational institutions. Research by Grzegorz Wiącek suggests that children with intellectual disabilities are significantly less liked by their peers and, as a result, experience fewer

¹ SST (Social Skills Training) is a group-based approach designed for individuals experiencing social hardship. During these sessions, participants develop essential social skills necessary for everyday functioning.

ART (Aggression Replacement Training) is a cognitive-behavioural method for behaviour modification, developed in the 1980s by Professor Arnold Goldstein at Syracuse University (USA). The theoretical foundation of the programme is based on learning theory, which assumes that aggression is primarily a learned behaviour acquired through observation, imitation, direct experience, and repetition.

positive emotions and more negative reactions from other children in the class (Wiącek, 2008, p. 59). The risk of social exclusion is therefore a real and pressing issue.

With modern technologies becoming increasingly accessible, they are being introduced into teaching from the earliest school years. As a result, many students are already familiar with digital tools that can be effectively used in both remote and in-person lessons. Many schools now have interactive whiteboards, which enrich lessons by enabling screen sharing for both in-class and distance learning. Additionally, textbook publishers are increasingly including educational applications that align with curricula at various educational levels. Similar software is being developed for remedial, corrective-compensatory, and social-emotional skills training classes, as well as speech therapy. Joanna Zielińska notes that “What matters is not only the educational aspect but also the support for integration, meeting students’ needs, fostering faster and more comprehensive development in various areas, encouraging social interaction, and strengthening their connection with the wider society” (Zielińska, 2014, p. 80).

The structure of subject-based lessons in inclusive classrooms, where students with intellectual disabilities learn alongside their neurotypical peers, differs from that of special education classes, where all students have a disability statement. Since the national curriculum applies the same educational requirements to all students, teachers must seek innovative solutions to adapt the programme to the child’s abilities. Lesson planning for a student with intellectual disabilities should begin by defining clear objectives, as these will determine the teaching methods used during the lesson. Short-term and long-term goals will require different approaches. During in-person classes, when using computers or tablets, teachers can assign several students to one device, encouraging teamwork and collaborative learning. A long-term goal in this approach is to integrate students with intellectual disabilities into the classroom community. As Sobocha and Pietrzak observe, teachers working with this group of students “must fully commit themselves in order to achieve, at times, extraordinary things—things that may seem trivial, insignificant, or unremarkable to most of society” (2017, pp. 298–299).

Another opportunity to integrate ICT into working with children with intellectual disabilities is through remote lessons, which are most effective when based on close collaboration with parents. Therefore, lessons should have clearly defined objectives, formulated in a way that is easily understandable for parents. A detailed lesson plan and specific teaching techniques should be established for each objective. When planning remote learning, it is helpful to identify reinforcement strategies that can be used during lessons. It is essential to determine which reinforcements parents already use, as all pedagogical interventions must be tailored to the individual needs and capabilities of the student. Teachers and caregivers should

jointly decide which reinforcement techniques can be applied, as well as when and how they should be provided. This decision should not be solely based on previous teaching methods, as the specific nature of distance learning requires different strategies and techniques.

During therapeutic sessions, it is also important to agree with parents on the number and duration of reinforcement techniques used with the student. The best approach is to draft a contract that clearly defines the methods and techniques of therapy used in remote work, as well as the extent of parental support. Many teachers use intensive teaching methods, following a fixed pattern: stimulus/instruction → prompt → student response → reinforcement. This approach requires cooperating with parents with respect to the reinforcement techniques to be used, ensuring that a consensus is reached as to the type of reinforcement technique used, as well as who will administer it and to what extent.

A crucial element in remote education for students with intellectual disabilities is the proper organisation of the learning environment. The study space should be consistent and free from distractions. It should be located in a quiet area where the child is not disturbed by other people. Toys and unnecessary items should be removed, and attention should be given to appropriate lighting and a comfortable seating position when using a computer.

The duration of lessons (e.g., remedial sessions) should be adjusted to the student’s abilities and interspersed with breaks. During these breaks, the child should be encouraged to step away from the screen, get fresh air, or take a short walk. It is also beneficial to plan free time after lessons, allocated for play or household tasks. One of the key teaching strategies for students with intellectual disabilities involves proactive techniques, which focus on reducing or preventing challenging and undesirable behaviours. To implement proactive strategies effectively, it is essential to understand the child well, including their interests, needs, and abilities. With parental support, a list of socially acceptable alternative behaviours can be created to replace non-functional ones. For example, instead of walking away from the computer or turning it off, the child can be encouraged to use the phrase *I don’t want to do this right now*. Proactive planning should also be incorporated into lesson preparation. If a parent informs the teacher that the child is tired, hungry, unwell, or had a sleepless night, it is advisable—where possible—to avoid assigning particularly difficult tasks during that lesson.

In remote education for students with intellectual disabilities, the Natural Environment Teaching (NET) method can be employed effectively. This approach is also based on structured and goal-oriented activities, but stems from the child’s natural motivation. Motivation is the primary stimulus for learning and acquiring skills and experiences (Arends, 1995, p. 136). Unfortunately, in inclusive schools, students with intellectual disabilities are often demotivated by competition in

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grading and school contests. Such comparisons can be harmful, leading to conflicts and peer rejection of weaker students. Studies confirm that excessive competition discourages learning and leads to students pursuing knowledge solely for the sake of grades (Covington & Teel, 2004, p. 27). As a result of these practices, students with intellectual disabilities are often labelled as weaker or less capable, making it very difficult to shed this stigma in later educational stages. Swiss research conducted by Haeberlin and colleagues on students with intellectual disabilities in mainstream schools revealed that these students are among the most disliked and rejected in their classes (cited in Speck, 2005, p. 418).

Enabling students with intellectual disabilities to achieve educational success can help reduce the gap between them and their neurotypical peers. Motivation for learning increases when lessons are linked to students' interests and incorporate elements of play-based pedagogy. Visually appealing educational platforms can also serve as an additional incentive. One effective motivation tool is Eduelo.pl, which offers quizzes across all subjects taught at the primary and lower secondary levels. To assess students' knowledge acquisition, platforms such as Kahoot! and Quizlet can be used. Additionally, LearningApps, Wordwall, and Genially allow teachers to create customised exercises and puzzles using templates, making learning more engaging and tailored to individual needs.

Another remote teaching method for students with intellectual disabilities is situational learning. This approach focuses on capturing the moment, requiring teachers to be flexible in adapting to students' needs and abilities while also preparing lessons in advance. The teacher must create a situation that sparks the student's interest and encourages active participation in either acquiring new knowledge or reinforcing previously acquired skills. The primary challenge in using situational learning is the need for an immediate response to the child's fluctuating motivation and spontaneous needs.

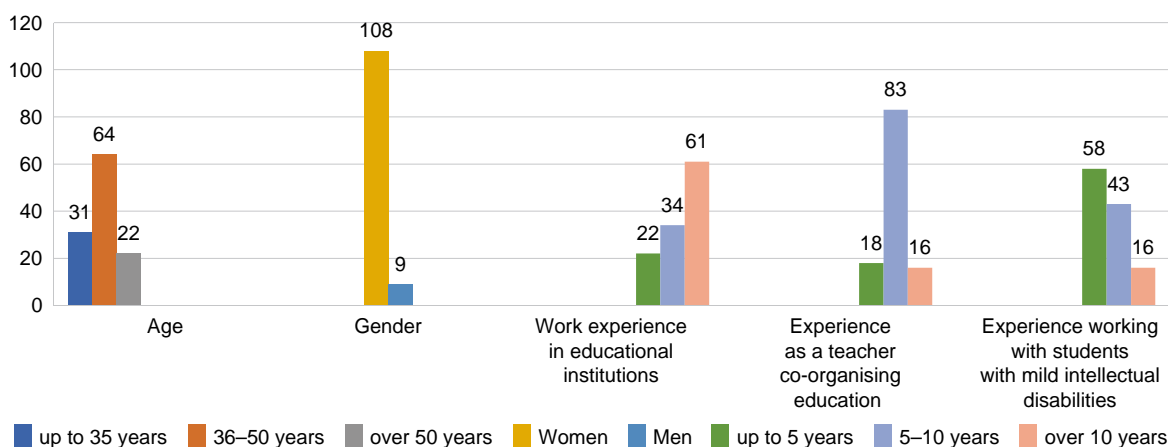
The Potential of ICT in Counteracting Social Exclusion – Findings from the Study

The aim of this study was to highlight the issue of social exclusion among students with mild intellectual disabilities and explore ways to prevent it. The main research question focused on whether, according to teachers co-organising education, the use of information and ICT tools could help counteract the social exclusion of students with mild intellectual disabilities. To address this question, it was necessary to select an appropriate research group consisting of teachers who had previously worked with this student group and to define specific research problems: *What methods and tools have the respondents used so far in remote teaching for students with mild intellectual disabilities and what, in their opinion, are the main difficulties faced by students with mild intellectual disabilities in social functioning?* The opinions expressed in responses collected from the participants could, in the future, be used to promote the broader implementation of ICT in the work of teachers co-organising education and to enhance its role in counteracting the social exclusion of students with mild intellectual disabilities.

A survey conducted in the first half of 2023 using an online questionnaire (Computer-Assisted Web Interviewing – CAWI), provided insight into the perspectives of a diverse group of teachers on the potential of ICT in supporting the social inclusion of students with mild intellectual disabilities. All respondents were employed in public primary schools at the time, teaching grades III–VII. The majority of participants had been working in their current positions for five to ten years.

Respondents who are actively employed teachers co-organising the education of students with SEN ($n = 117$) were asked about the functioning of students with mild intellectual disabilities in educational institutions, their use of ICT in teaching and educational processes, and the potential for social inclusion of these students. The research was inspired by Marta

Figure 1
Characteristics of the Study Sample

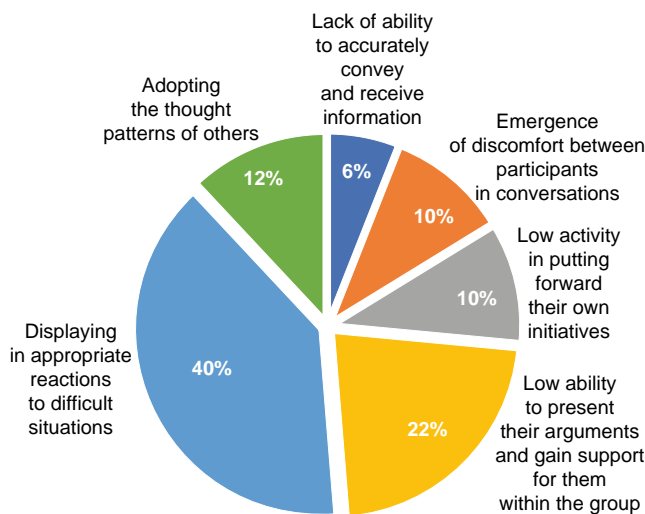


Source: author's own work.

Niemiec’s analysis on deficits in selected social competences among students with intellectual and sensory disabilities (Niemiec, 2019, pp. 173–174). Niemiec conducted an exemplary, synthetic overview of the most common deficits in specific social skills in individuals with intellectual and sensory disabilities. The results of her study served as the basis for developing the survey questionnaire, which respondents completed online via CAWI.

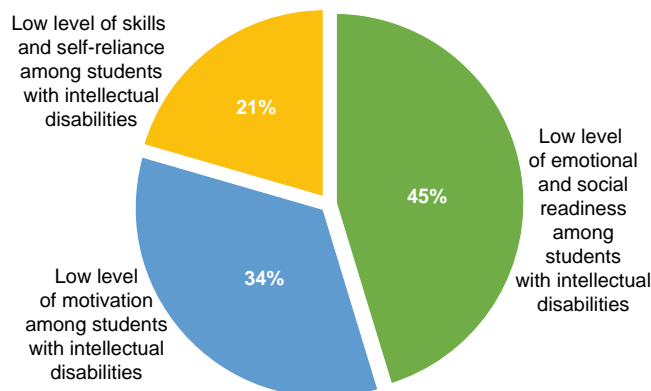
The surveyed teachers identified the most frequently observed difficulties in social interactions among students with intellectual disabilities. These included an inability to effectively convey and receive information, a low level of ability to present arguments and gain group support, and exhibiting inappropriate reactions to challenging situations. The respondents’ answers to the question *What difficulties do you observe in the social functioning of students with mild intellectual disabilities?*, are summarised in figure 2.

Figure 2
Difficulties in Social Functioning of Students with Intellectual Disabilities Perceived by Teachers Co-Organising Education



Source: author’s own work.

Figure 3
Causes of Peer Exclusion of Students with Mild Intellectual Disabilities



Source: author’s own work.

Respondents also pointed out the main reasons for the exclusion of students with mild intellectual disabilities by their peers. The most frequently mentioned causes were a low level of emotional-social readiness (45%), low level of motivation (34%), and a low level of skills and self-reliance (20%) (figure 3).

At the same time, as many as 106 respondents (representing 92% of the surveyed group) declared that in their opinion ICT tools could serve as instruments for counteracting social exclusion among students with mild intellectual disabilities. These tools could be used to achieve this by creating equal educational opportunities, making rehabilitation and therapeutic activities more appealing, motivating and engaging students in the learning process, and fostering integration within the classroom environment.

The respondents were also asked about the greatest benefits of using digital tools in their work with students with mild intellectual disabilities. The respondents observed that dexterity games and graphic editing programs enhance the manual and graphomotor skills of students (59%). Independently searching for images and information on assigned topics allows them to enrich their knowledge about the world and their socio-natural environment (28%) and take responsibility for their own education (13%). According to the respondents, this results in the development of a sense of agency among students with intellectual disabilities.

Teachers who agreed that ICT tools could serve as instruments for counteracting social exclusion were additionally asked which skills developed through these tools they considered most important. The responses are presented in figure 4.

According to the respondents, one of the key skills developed through the use of ICT in lessons is teaching students the principles of navigating social media and netiquette (44%), as well as raising awareness of the risks associated with internet use (32%) and the legal consequences of inappropriate behaviour on electronic media (24%). Individuals with intellectual disabilities have a lower capacity than their neurotypical peers for in-depth critical analysis of ambiguous and complex content, making them more likely to copy inappropriate behaviours and susceptible to media manipulation (Chudnicki & Mielczarek, 2018).

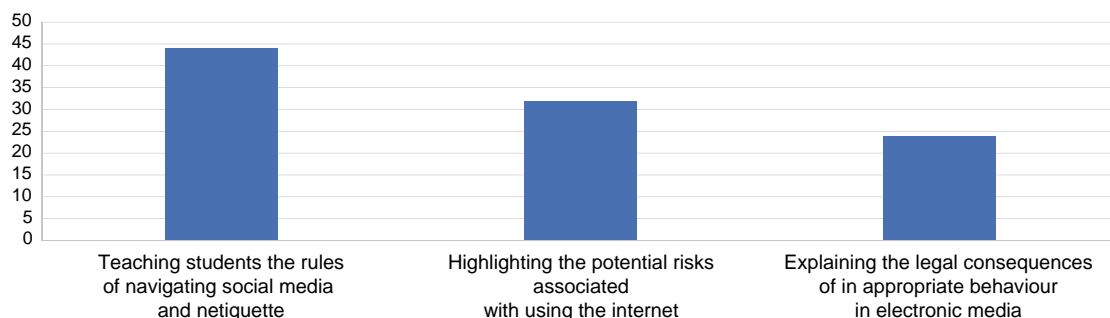
The respondents were also asked which ICT tools they had used in their work with students with mild intellectual disabilities. A breakdown of their responses is provided in figure 5.

During remote teaching, the primary tool in most schools remains the MS Teams platform, as indicated by 116 respondents (99% of the surveyed group). Through this

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Figure 4

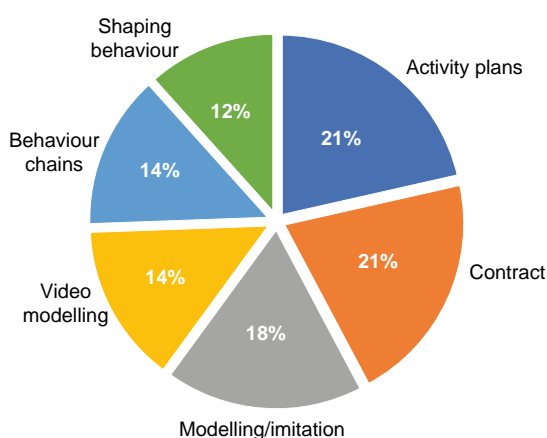
Key Skills Taught Through the use of ICT in Working with Students with Mild Intellectual Disabilities



Source: author's own work.

Figure 5

Tools used to Date by Respondents in Working with Students with Mild Intellectual Disabilities



Source: author's own work.

- Modelling/imitation (18%) – A crucial skill in teaching games, physical exercises, and speech.
- Video modelling (14%) – Using video materials to teach various skills, such as gross and fine motor skills, art, self-care, or social interactions.
- Behaviour chains (14%) – A procedure where smaller components of a behaviour occur in sequences. The target behaviour is the student's ability to complete all parts of the task without prompts.
- Shaping behaviour (12%) – Based on the principle of small steps, this involves providing a step-by-step instructional guide to achieve a desired outcome. It is an excellent method for introducing students with intellectual disabilities and their parents to working with a computer and using educational platforms and applications.

platform, respondents employed various techniques for working remotely with students with mild intellectual disabilities, including:

- Activity plans (21%) – A set of pictures or words that serve as a ready-made guide for performing specific sequences of actions. Activity plans can take various forms. For younger children, visual plans with a schedule of tasks arranged in a specific order work better. The plan shows the student the sequence of tasks, providing a sense of safety and control. It also helps them check how many tasks are left before a break or a favourite activity, thus acting as a motivator. Activity plans can be used for learning, leisure, self-care, or daily routines.
- Contract (21%) – A method for preventing undesirable behaviours. It is a proactive agreement made before undesirable behaviour occurs, rather than a reaction to an existing situation. Depending on the student's age and abilities, the contract should be tailored to their needs and can be presented in picture form, for example. Contracts contain positive phrasing, e.g., *Speak quietly* instead of *don't shout*. The level of detail must be adapted to the child's needs.

Summary

The conducted study demonstrated that according to the overwhelming majority of respondents, ICT tools have the potential to counteract the social exclusion of students with mild intellectual disabilities. The surveyed teachers incorporate these tools into therapeutic and remedial sessions, although the study did not indicate the use of the latest platforms or AI-based applications. Notably, respondents did not mention any specialist programs, such as *Niepełnosprawność intelektualna i ASD* by Eduterapeutica, which facilitates memory and concentration training, *Cognitomniac* by Harpo, which uses games to develop operational thinking, abstraction, association, and categorisation skills, and *Wspomaganie rozwoju* by Nowa Era, a series of programs for early therapy of cognitive and perceptual-motor disorders and multi-sensory stimulation support. These and similar programmes could be used not only in therapeutic settings but also in didactic processes. The lack of references to such tools may indicate that the surveyed teachers are unaware of their existence, although this issue requires further investigation in the future.

The methods used by respondents place a strong emphasis on education and cognitive development among students with mild intellectual disabilities.

Since these students follow the same national curriculum as their neurotypical peers, they often struggle to achieve educational success. ICT provides teachers with tools to make learning more engaging and to adapt content to the individual needs of each student. Modern technologies offer opportunities to support the learning process and enable students with intellectual disabilities to acquire new competencies. This, in turn, provides them with the skills and resources necessary for full participation in economic, social, and cultural life, ultimately fostering social inclusion. Developing social skills in students with intellectual disabilities significantly enhances their quality of life—helping them understand societal norms, regulate emotions, and communicate more effectively with peers. Additionally, it nurtures their sensitivity to the needs of others. It is important to remember that a key aspect of integration efforts is ensuring greater participation of individuals at risk of exclusion from decision-making processes that affect their lives (European Commission..., 2002).

The social inclusion of children with intellectual disabilities remains a significant challenge for modern Polish schools. There is a lack of training and up-to-date publications on this issue. However, the knowledge and experience of teachers regarding the daily school life of children with intellectual disabilities enable the development of comprehensive support to ensure their optimal functioning according to their abilities. As Jolanta Rafał-Łuniewska points out “Educational and social inclusion cannot be introduced through a single declaration or regulation. It is a long process, and its course and level will vary in each school” (2010, p. 17).

For many teachers, this surely presents a challenge, as it requires adapting teaching methods and integrating rapidly evolving digital tools. However, Grądzki (2021, p. 139) notes that “during the COVID-19 pandemic, remote learning (e-learning) and blended learning, combining online education via educational platforms, gained particular significance”. The experience gained during this period has led to the creation of tools and platforms that are now used in both classroom and individual learning sessions. Given the need to develop future-oriented skills, introducing students with intellectual disabilities to modern technologies in both education and daily life is essential, despite the risks. Equally crucial is the training of current and future teachers in integrating ICT into teaching and collaborating effectively with parents. As Lukasek (2020, p. 404) highlights, “during the pandemic, systematic cooperation with parents became especially important, as it was often difficult to support children in remote learning without their involvement”. This remains relevant even today in post-pandemic education, where digital technologies continue to be widely used.

A coherent system of therapeutic and educational interventions equips children with intellectual disabilities with the skills needed to navigate everyday challenges. The use of modern digital tools supports them in achieving greater independence and autonomy in the future.

In today’s information society, there is a growing postmodern perspective on developmental, intellectual, and cultural differences—one that promotes tolerance and support for students with intellectual disabilities. This shift makes social inclusion possible, with a strong emphasis on equal opportunities, supporting individuals at risk of exclusion, and actively combating social exclusion.

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Hanna Lewandowska is a doctoral candidate at the WSB in the field of pedagogy, a research and teaching staff member at the WSGE University of Applied Sciences, and a primary school teacher. For several years, her scientific and research work has focused on teaching methodology for children and adolescents. She is currently conducting research into the professional prestige of teachers in the context of their competencies.

Yağmur
Üral

Sema Altun
Yalçın

Paşa
Yalçın

Compilation of Augmented Reality Studies Conducted with Teacher Candidates

Abstract

The aim of this paper is to determine the level of teachers' readiness to use AR technology in teaching based on a systematic analysis of studies on the use of augmented reality (AR) in education. The study included research focusing on pre-service teachers, with no year limitation, and based on the following databases: Google Scholar, National Thesis, Eric, Scopus, Ebscohost, Web of Science, PsycInfo, JSTOR, ProQuest, Education Research Complete and Education Source. A systematic review was conducted based on the PRISMA model, with eleven keywords such as 'AR technology and pre-service teacher education' searched in Turkish and English. The process highlighted 47 studies, with 42 studies meeting the inclusion criteria set. The included studies were analysed in terms of years, keywords, branch, purpose, method, sample size, results and recommendations, resulting in a compilation and presentation of studies on AR involving pre-service teachers.

Keywords: AR technology, augmented reality, augmented reality in education, teacher candidates, systematic review model


Introduction


The rapid development of technology has led to a change in the way technology is used in education, with technology standing out as a new tool that facilitates learning, and technological tools used for educational purposes increasingly integrated into classroom learning and teaching processes (Ekiçi, 2021). One such area of technology use in education is augmented reality. Augmented reality (AR) is an information technology in which real and virtual objects are combined in the same space and time, in a three-dimensional environment in a way that appeals to the five senses through devices such as tablets and phones (Klopfer & Sheldon, 2010; Ünal & Şimşir, 2023; Wu et al., 2013; van Krevelen & Poelman, 2010).


AR's feature of bringing real and virtual environments together has attracted the attention of educational researchers, with widespread use in educational environments (Seyhan & Küçük, 2021). It is the responsibility of teachers and other stakeholders to keep up with the development of technology in education and apply such technologies in classroom environments (Çelik, 2019). In order to fulfil this responsibility, knowledge about the problems, ideas and concerns of teachers about the use of technology in teaching could be a guide for training 21st century prospective teachers (Ürün Arıcı, 2022).

There are many studies in the literature on the use of AR applications in education (Altıntaş, 2018; Belda-Medina & Calvo-Ferrer, 2022; Fidan & Tuncel, 2018; Görgülü Arı & Sivri, 2020; Grinshkun et al., 2021), which show that the use of AR applications in education provides significant contributions to teaching processes regardless of the sample group (Carmigniani et al., 2011; Çakır & Çelik, 2019).

One of these contributions is the fact that AR facilitates the understanding of complex subjects by making abstract concepts concrete (Yalçın Çelik, 2019), while another

Yağmur Üral, Erzincan Binali Yıldırım University, Türkiye,  <http://orcid.org/0000-0002-7416-5372>

Sema Altun Yalçın, Erzincan Binali Yıldırım University, Türkiye,  <http://orcid.org/0000-0001-6349-2231>

Paşa Yalçın, Erzincan Binali Yıldırım University, Türkiye,  <http://orcid.org/0000-0002-8085-7914>

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one is that it increases students' interest in the lesson with three-dimensional elements (Ürün Arıcı, 2022). In addition, AR provides a different dimension to textbooks by showing spatial relationships between concepts, which contributes to the development of students' cognitive and psychomotor skills (Kapucu & Yıldırım, 2019).

Although these features increase the importance of AR technology in education, to benefit from these contributions effectively teachers need to know how to integrate AR technology into lessons (Devran et al., 2021).

The literature includes studies examining the use of AR in education and the pre-service teacher sample group (Aydın & Şahin, 2021; Figueroa et al., 2021; Hursen & Beyoğlu, 2020; Risdianto et al., 2021; Sáez-López et al., 2020; Wahyu et al., 2020). However, it has been stated that the limited number of sample groups in such studies makes it difficult to reveal the effect of AR on pre-service teachers holistically (Mena et al., 2023).

According to Akarçay Ulutaş and Boz (2019), gathering the results of studies on similar topics under a single title can contribute to the progress of social sciences by revealing different perspectives on the subject. In this regard, a review study was conducted to determine the level of integration of AR into pre-service teachers' education and to guide other studies to be conducted on this subject.

In this study, research on the use of AR in education were examined and studies focusing on pre-service teachers were discussed. For this purpose, the following questions were asked:

1. In which teaching branch were the studies in the field of AR, the sample group of which consists of pre-service teachers, predominantly conducted, and what is their distribution?
2. What is the distribution of the studies in the field of AR, the sample group of which consists of pre-service teachers, over the years?
3. What is the distribution of the studies in the field of AR, the sample group of which consists of pre-service teachers, according to keywords, sample size, method, result and purpose?
4. What suggestions did the sample group make in the studies conducted in the field of AR consisting of pre-service teachers?

Method

This study utilised the systematic review method, which is a research approach in which more than one research on the same subject is synthesised in a comprehensive and detailed way by experts according to selection criteria (Karaçam, 2013; Küçükaydın, 2020; Yılmaz, 2021). A systematic review is a detailed and extensive review of the literature on the selected topic (Gülpınar & Güçlü, 2013). The internationally recognised checklist developed by PRISMA was used to write a good review, as it is widely accepted as the most appropriate procedure in systematic reviews

(Mena et al., 2023). The study was based on 6 items out of 12 in the checklist, namely: determination of inclusion criteria, identification of information sources, screening, specifying the study selection, explaining the data collection process and synthesising the results.

Determination of Inclusion Criteria

A single inclusion criterion was used in the study, determined to include studies that examine AR applications in education and in which the sample group consists of pre-service teachers. The purpose for choosing this criterion is to more clearly examine the effect of AR technology on the education of pre-service teachers in the field of education. Pre-service teachers were included in these studies as a group that experienced the use of these technologies in education and evaluated the potential benefits in education as a result of these experiences, which enabled a more in-depth analysis of pre-service teachers' AR experiences and their impact on teacher education. Clearly defining the inclusion criterion increased the methodological validity of the study, while at the same time strengthening its replicability and reliability. Considering the determined criterion, 11 keywords were created in English, but also searched in Turkish. The determined keywords were teacher candidates with augmented reality, AR and prospective teachers, augmented reality education and pre-service teachers, AR use in teacher training, augmented reality & teacher training, AR technology & pre-service teacher education, pre-service teachers' AR experiences, augmented reality applications in teacher education, Innovation in AR and teacher education, augmented technology training of pre-service teachers, methods of training teachers with AR. The keywords were chosen in both Turkish and English in order to broadly cover the scope of the subject. This allowed for scanning all relevant studies in the international literature and providing access to the data source without a language barrier.

Identification of Information Sources

To determine the keywords in information sources, 10 databases were used as the source and a subsequent search was made. The databases searched were Google Scholar, National Thesis, Eric, Scopus, Ebscohost, Web of Science, PsycInfo, JSTOR, ProQuest, Education Research Complete and Education Source, with the identified databases searched at regular intervals. Advanced search was used without language and time limitations, with the last scan performed in November 2023.

Scanning

As a result of the search, 47 studies were identified in the Google Scholar, National Thesis, Eric, Scopus, Ebscohost and Web of Science databases, which were selected because they provide reliable and comprehensive academic resources. Google Scholar provides access to a wide range of literature, while Ulusal Tez

includes master's and doctoral studies in Türkiye. Eric focuses on educational sciences, Scopus covers multi-disciplinary studies, Ebscohost offers journal access in the field of social sciences, while Web of Science provides access to peer-reviewed academic publications. These databases provide a comprehensive search on the use of AR technology in education and collect data from different disciplines. However, no studies were encountered in databases such as PsycInfo, JSTOR, ProQuest, Education Research Complete and Education Source. The review process showed that studies on AR practices with pre-service teachers in these sources were limited, with the intensity of the literature varying depending on the subject. This rigorous method increases the reliability and validity of the study.

Indication of Study Selection

Following a short preliminary examination of 47 studies, 5 studies were eliminated based on the sample group not consisting of pre-service teachers. One of the studies was eliminated because the sample group consisted of 321 students from the Faculty of Mechanical Engineering, Faculty of Civil Engineering, Faculty of Electrical Engineering and Information Technology, Faculty of Architecture, Faculty of Technology and Metallurgy, Faculty of Furniture, Interior Design and Technology and 12 university teachers, while another was eliminated because the sample group consisted of 21 science teachers, 16 female and 5 male, working in public schools. Other studies were eliminated due to conducting a methodological evaluation of studies from different sample groups, a systematic review, and a meta-analytic and thematic comparative analysis. A further 42 studies included in the research were analysed in detail. The studies included in the research are shown in Appendix 1.

Explaining the Data Collection Process

The inclusion criteria were determined as the first step in the study. The second step was determining Turkish and English keywords, while the third step was determining the information sources to be searched. The databases were then searched regularly at specific intervals until November 2023. The data obtained through the searches was pre-examined and the studies with a sample group not consisting of pre-service teachers were excluded from the data. After a detailed examination of the remaining data by year, keyword, branch, purpose, method, sample size, results and recommendations, the obtained findings were synthesised.

Synthesising the Results

The studies that met the inclusion criteria were examined in detail in terms of year, keyword, purpose, method, number of samples, branches of pre-service teachers in the sample, results and recommendations, with the findings obtained from the analyses synthesised and presented in different figures, tables and texts.

Validity and Reliability Measures

Various measures were taken in this study to ensure validity and reliability. Firstly, the studies selected from reliable sources were meticulously analysed and the sample size and participant characteristics were evaluated. More than one researcher was involved in the data collection process, with a cross-validation method applied and the steps in the review process regularly reviewed and discussed. In addition, the database selection and screening process was meticulously determined and only 10 reliable and comprehensive databases were used, which broadened the scope of the study to include different perspectives. The literature search was conducted with common and valid keywords, and the most recent data was accessed without language limitation. The search results were cross validated by more than one researcher, and only studies that met the valid criteria were selected. These steps increased the reproducibility and reliability of the study.

Results

Table 1 presents the frequency distribution of the studies in the data set according to years. As seen in Table 1, the first of the studies on AR in education, the sample group of which consists of pre-service teachers, was published in 2014. Three studies were published in 2016, three in 2017, four in 2018, eight in 2019, seven in 2020, eight in 2021, three in 2022, and five in 2023. It was observed that the most studies on the subject were conducted in 2019 and 2021, with 8 publications each, and the least studies were conducted in 2015 and 2014, respectively.

Table 2 shows the codes and frequency distribution of the sample number, branch, method and result categories of the studies in the data set, showing that there were 21 studies with a sample size between 1 and 50, 14 studies with a sample size between 51 and 100, and 7 studies with a sample size of

Table 1
Frequency Table by Year

Year	Frequency
2014	1
2015	0
2016	3
2017	3
2018	4
2019	8
2020	7
2021	8
2022	3
2023	5

Source: authors' own work.

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Table 2

Codes and Frequencies for Sample Number, Branch, Method and Result Categories

Category	Code	Frequency
Number of samples	1–50	20
	51–100	14
	101 and above	7
Branch	Primary school mathematics teaching	3
	Science teacher	4
	Classroom teaching	7
	Social teaching	5
	Physics Teaching	1
	Chemistry Teaching	1
	Biology Teaching	1
	Computer and Instructional Technologies Education	6
	English teacher	1
	Pre-school teaching	2
	Guidance and Psychological Counselling	1
Other	11	
Method	Quantitative	8
	Qualitative	11
	Mixed	19
	Application development	2
	Case study	1
Result	Positive	30
	Negative	14
	Neutral	5

Source: authors' own work.

101 and above. It was observed that the sample size was mostly between 1 and 50, with the smallest number of samples in the studies is 101 and above. The data obtained was also evaluated according to the branches of the pre-service teachers in the sample group as seen in Table 2. It was seen that there were 3 studies on elementary mathematics teaching, 4 studies on science teaching, 7 studies on classroom teaching, 5 studies on social teaching, 1 study on physics teaching, 1 study on chemistry teaching, 1 study on biology teaching, 6 studies on computer and instructional technology education, 1 study on English teaching, 2 studies on preschool teaching, 2 studies on guidance and psychological counselling and 11 studies on education faculty students in general. Most of the studies were conducted with students from different branches of the faculty of education, followed by classroom teaching, and computer and instructional technology education. The least studies were conducted with physics, chemistry, biology, English language teaching, guidance and psychological counselling. Analysing the obtained data accord-

ing to these methods showed that 19 of the studies were mixed, 11 were qualitative, 8 were quantitative, 2 were application development and 1 was a case study. While the most studies were conducted using mixed methods, the least concerned case studies and application development, respectively. Analysis of the studies in terms of their results showed that 30 studies had positive results, 14 studies had negative results, and 5 studies had neutral results.

Figure 1 shows the word cloud of Turkish and English keywords of the studies in the dataset. The reason for giving the keywords as a word cloud is to show how the density changes.

Coding was made by examining the aims of the studies conducted for prospective teachers, with the created codes shown in Table 3.

Table 3 shows codes and frequencies related to the aims of the studies in the data set. Aims of the studies: usefulness of AR, determination of intention to use, determination of satisfaction, multimedia, determination of awareness levels about AR, determination of their opinions, examination of their acceptance

Figure 1
Keywords



Source: authors own work using the WordArt programme.

Table 3
Codes and Frequencies for the Purpose Category

Code	Frequency
Mobile application development with AR	6
Determining the effects of AR	4
Determining the impact on academic success	6
Determining the effect on academic motivation	1
Determining the impact on perceptions	2
Determining the impact on scientific literacy	1
Determining the impact on trends in using information technologies	1
Determining the effect on cognitive load	1
Determining the impact on their digital competence	1
Determining the effects on developing critical thinking skills	1
Effect on epistemological belief	1
Effectiveness of AR	1
Determining the impact on their interests	1
Determining the effect on misconceptions	1
Determining the impact on their anxiety	1

Code	Frequency
The usefulness of AR	1
Determining the intention to use	1
Determination of satisfaction	1
Multimedia	1
Determining awareness levels about AR	1
Determining opinions	20
Examining the acceptance of technology	1
The need to use AR in training	2
Systematic review on using AR in teacher education	1
Effect on self-efficacy	4
Determining the effect of virtual reality on education	1
Determining its limitations	1
Examining system quality	1
Determining the effect on attitude	7
Examining the effect on reflective thinking	1
Determining the benefits	1
Determining the effect on creative skills	1

Source: authors' own work.

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of technology, need for using AR in their education, systematic review on using AR in teacher education, effect on their self-efficacy, determination of the effect of virtual reality on education, determination of its limitations, examination of system quality, determination of its effect on attitude, examination of its effect on reflective thinking, determination of its benefits, determination of its effect on creative skills. As can be seen in Table 3, the researchers mostly asked pre-service teachers for their opinions about AR, followed by an investigation of the effects of AR on pre-service teachers' attitudes and academic achievement and studies on AR mobile application development.

The suggestion titles of the obtained studies were also analysed, and later grouped under two headings and itemised as follows.

Suggestions for Researchers

- Similar studies can be repeated with teacher candidates from different departments, on different socioscientific subjects, in different age groups, at different education levels, in different courses or laboratory applied courses.
- Longer-term experimental studies on AR applications can be carried out using control and experimental groups.
- The process of integration of AR technology into education faculties can be examined in terms of different variables (student, teacher, administrator, university, educational environment, etc.).
- Cognitive and affective features of AR applications (e.g. higher order thinking skills, attitude, success, well-being, anxiety, cognitive and affective load), spatial ability, learning opportunities, level of knowledge, problem-solving skills, permanence of learned information, creative thinking. The effects of different variables such as learning strategies and learning strategies can be examined.
- Research can be conducted on the use of AR applications by teachers.
- AR applications can be integrated with different learning approaches suitable for course content (e.g. problem-based learning, project-based learning, inquiry-based learning, game-based learning, collaborative learning, individual teaching methods), and comparative experimental studies can be conducted to determine which approach is more effective on learning.
- AR applications can be used to concretise abstract concepts and elements that are less likely to be observed in daily life.
- Different types of AR applications (e.g. location-based, etc.) can be developed to determine their contributions to education.
- The possibilities of using AR applications in out-of-class learning environments can be determined, and their potential contributions can be identified.
- More advanced data collection tools can be developed and utilised.

- Detailed scales regarding AR applications can be developed by expert academics in the field.
- The perception of AR applications from different disciplines and stakeholders can be determined.
- In Türkiye, the concepts of Virtual Reality and Augmented Reality are often confused. Detailed studies can be conducted to prevent this confusion.
- It has been identified that some students do not interact sufficiently with AR tools or do not enjoy using them. Qualitative research can be conducted to determine the reasons for these results and to increase the effectiveness of these students in the teaching process.
- New studies can be conducted on how AR tools can be organised or integrated into teaching in large groups.
- Intercultural applications can be conducted to discuss the impact of the provided education.

Recommendations for Practitioners

- AR based teaching applications can be developed for various subjects and concepts to support the educational process.
- Making AR applications compatible with daily life scenarios can make the applications more attractive.
- Researchers planning to improve teaching effectiveness with AR may prefer to initially use freely available software.
- Interdisciplinary collaboration among software development experts, educational technologists and teachers can lead to the creation of AR applications with richer Turkish language support, suitable for gains and student development, with minimised technical issues.
- Attempts can be made to develop self-learning skills using AR technology.
- Different forms of AR learning materials (videos, 3D models, 3D animations) can be prepared and compiled into a content library to be freely accessible on platforms such as the Education Informatics Network (EBA) for students, teachers and teacher candidates, especially for subjects containing abstract concepts such as physics, chemistry and biology, or for situations where fieldwork and technical excursions are not possible.
- Virtual screens and AR glasses can be used, or sound and detailed information can be added to AR applications to create a more realistic effect for the developed 3D models.
- Everything that needs to be known about the use of new educational technologies, including how to prepare AR materials and which educational activities they can be used in, as well as the benefits and risks of new technologies, can be conveyed to teachers and teacher candidates through seminars, workshops, TÜBYTAK projects, or in-service training. For example,

they can receive training in online environments through the Distance Education Center (UZEM) or face-to-face training sessions on Information Technologies and Digital Literacy.

- To enhance individuals' digital literacy and information culture, a digital literacy course can be given face-to-face as a compulsory course at all universities, especially in education faculties.
- Elective courses covering both technological and pedagogical aspects of new technologies, such as virtual reality, augmented reality and artificial intelligence, can be added to the curriculum or integrated into courses at universities, especially in education faculties.
- AR learning material can be integrated with infographics and concept maps to serve as pointers.
- AR applications that are compatible with all software platforms (Android, iOS, etc.) can be designed.
- Infrastructure can be established in schools to address the need for technologies like AR, as not all school districts have the economic means to utilise such technologies.
- Facilitative measures (such as allowing the use of mobile technological devices in classrooms) and decisions supporting school costs can be made by the Ministry of National Education (MEB) and school administrators to increase the applicability of technologies like AR.
- Incentive financial support can be provided to encourage teachers to use technologies like AR more frequently during teaching.

Analysis of the study suggestions pointed out that similar studies could be conducted with pre-service teachers from different departments, on different socio-scientific issues, in different age groups, at different educational levels, in different courses or in laboratory applied courses. In addition, the researchers stated that the integration process of AR technology into faculties of education could be examined in terms of different variables, and that the effects of AR applications on different variables such as cognitive and affective characteristics could be examined. They also suggested that AR applications could be integrated with different learning approaches suitable for the course content, and support could be provided to the education and training process by developing AR-based course applications related to different subjects and concepts. In addition, in order to minimise technical problems, software development experts, instructional technologists and teachers suggested that AR applications could be created by conducting interdisciplinary studies together. They also suggested that teachers and prospective teachers could be trained on how to prepare AR materials and in which educational activities they could be used, and that digital literacy could be taught as a course. Finally, it was seen that the necessary infrastructure could be created and AR applications compatible with all software could be designed.

Conclusions

Analysis of the data collected in this study by years shows that a significant increase in the number of studies on augmented reality (AR) applications in education was observed in recent years, with the peak of this increase in 2019. This situation shows that AR technologies have started to be adopted more in the field of education and are frequently used in studies conducted with pre-service teachers. AR, which is increasing day by day in the field of education, just as it is in every field, has the potential to renew our perspective on education by addressing multiple sensory organs to improve knowledge and skills (Ozarslan, 2016). For this reason, teachers, who make the greatest contribution to the education process, should be able to use this technology effectively (Değirmenci & İnel, 2020). The familiarity with this technology of future teachers will enable AR applications to be used more effectively in lessons (Özçakır & Aydın, 2019).

It was determined that most of the studies were carried out with small sample groups, and that the studies with a sample number of 101 or more were quite limited, which creates limitations in generalising the findings obtained to a wider universe and reduces the generalisation power. It has also been observed that studies on AR are concentrated in certain branches, with a limited number of studies conducted in some branches, and no studies found in some branches. This situation shows that technological developments are not equally integrated into different branches, with some fields neglected.

In terms of research methods, it was determined that most of the studies were conducted with mixed methods, although application development and case study methods were less preferred. In addition, the number of qualitative studies is higher than quantitative studies, with the preference for qualitative methods providing more in-depth data on AR issues; however, the limited number of application development studies may limit the use of these technologies in education.

While the majority of the analysed studies yielded positive results, some of them yielded negative results and others yielded neutral results, which shows that AR materials do not always produce positive results. Positive results can be called advantages of AR applications, while negative results can be called disadvantages. Some of the advantages of AR applications are that they provide students with a 3D learning environment (Zainuddin et al., 2010), that learning can be done in any desired environment (Satpute et al., 2015), that they arouse a sense of curiosity (Delello, 2014), that students are active and interactive (Baysan & Uluyol, 2016), and that abstract concepts are concretised and students' understanding of the subject is facilitated (Abdüselam & Karal, 2012). The disadvantages of AR applications are that such applications can create technology addiction (Akkuş & Kapidere, 2015), that not every student has access to mobile

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devices and the internet, and that the development of such applications is difficult and requires expertise (Yalçın Çelik, 2019), and that there is no AR application suitable for every subject and outcome (Bodur et al., 2016). When using AR applications in education, this diversity should be taken into consideration, and the possible effects of the applications should be carefully evaluated.

The keywords of the reviewed studies show that the effects of AR applications on pre-service teachers have become an important research topic in the field of education, and that the interest in the use of these technologies in different educational fields is increasing. Analysis of the objectives of the studies found that the most common one was to determine the opinions of pre-service teachers about AR applications, followed by examining the effects of AR on pre-service teachers' attitudes, academic achievement and self-efficacy. In addition, studies on developing mobile applications with AR and determining the general effects of AR in education also held a noticeable position. These findings reveal that there is an intensive effort to understand the different effects of AR applications on pre-service teachers and the integration of these technologies with mobile platforms continues to be investigated. In the recommendations section of the research, various suggestions are presented in order to increase the effectiveness of AR applications in education and to enable teachers to use this technology more efficiently.

Recommendations

In order to increase the efficiency of education, it is believed that it would be a good idea to include AR applications in the development of teacher candidates. It was concluded that it is necessary to further develop the research on this subject, because it is thought that it will contribute to a better understanding of the effect of AR, dissemination, etc. However, while conducting dissemination studies, it is foreseen that the necessary infrastructure should be created for students to reach sufficient technological equipment, and that applications suitable for each subject and acquisition suitable for the use of AR technologies should be developed together with experts, with the interfaces of the applications simplified. In addition, it is thought that providing necessary training for teachers and pre-service teachers to be competent in AR technologies will further contribute. It will be important to conduct these studies with larger sample groups in terms of validity and generalisability of the data obtained. In order to better determine the advantages and disadvantages of AR, the research topics and applications suggested in the research available in the literature should be taken into consideration.

The appendix is available in the online version of the journal.

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Yağmur Üral is currently works as a lecturer at the Erzincan Binali Yıldırım University. She continues her doctoral education in the field of science education at the same university.

Sema Altun Yalçın is currently works as a faculty member at the Erzincan Binali Yıldırım University. She is the author of numerous scientific papers published in Türkiye and worldwide. Areas of interests include social sciences and humanities, physics education and teacher education.

Paşa Yalçın is currently works as a faculty member at the Erzincan Binali Yıldırım University. She is the author of numerous scientific papers published in Türkiye and worldwide. Areas of interests include social sciences and humanities, physics education and teacher education.

WE RECOMMEND



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The 6th BPM Symposium will take place from April 24 to 26, 2025, at the Eureka Hotel (Emilii Plater Street 7/9/11) in Sopot, Poland. The symposium is organized by Gdansk University of Technology and the University of Gdansk as part of the Fahrenheit Universities.

The BPM Symposium in Sopot continues the series of scientific meetings previously held at the AGH University of Science and Technology in Krakow, the University of Warsaw, and the University of Economics in Katowice. It provides a unique opportunity for researchers interested in Business Process Management (BPM) to connect. We hope the event will once again foster the exchange of scientific ideas, the presentation of the latest research findings, and the establishment of new collaborations. Additionally, it will be an excellent occasion to invite participants to the International BPM Conference, which will take place in Seville in 2025.

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Bombol

Rafał
Kasprzak

Michał Jan
Lutostański

Dualism of Attitudes Towards the Metaverse as a Challenge for Online Consumer Behaviour Researchers

Abstract

The aim of this study is to identify the different attitudes towards the metaverse among consumers who use it. The authors consider this issue particularly important due to the multifaceted and often abstract nature of the metaverse, which combines various experiences that shape attitudes. The metaverse is not only about creativity, hedonism, work, entertainment, social services, education, leisure, and shopping. It also encompasses areas that raise concerns related to ethics, data security, regulations, and potential harmful psychological impacts on users.

The study analysed the attitudes described in a survey of 625 users of the metaverse. The analysis was conducted using factor analysis. The conclusions drawn from the analysis focus on two perspectives, namely that of the management of organisations that want to use the metaverse commercially, e.g. for sales or to transfer some responsibilities to virtual worlds, and that of a social science researcher. From the first perspective, the most relevant element is to nullify the risks that may arise in the minds of the users—namely those concerning loneliness, alienation, addictions, or mental health. From the perspective of a social science researcher, the metaverse presents significant challenges for philosophy, psychology, sociology, economics, finance and management.

Keywords: metaverse, customer behaviour, generations, virtual reality, attitudes


Definitions


Each of the metaverse characteristics mentioned above can potentially shape user attitudes which, if insufficiently identified, may significantly endanger the creation of offerings and business models within this environment. Dwivedi et al. (2022) makes an important point that the metaverse is a tool for solving problems and overcoming challenges in the real world (e.g., work, social life, education, healthcare) while also being profit-oriented (e.g., gaming, blockchain-based business, virtual real estate, and monetised role-playing through avatars). For this reason, research on user activities within the metaverse and their attitudes is an interesting area of study.

In the literature, an attitude is defined as an “internal affective orientation explaining an individual’s action” (Reber, 1985, p. 65) and is composed of three components: cognitive, affective, and behavioural (e.g., Karpiński & Hilton, 2001; Wojciszke, 2011). These components require a brief explanation, as they influence to some extent the proposed research hypotheses. The cognitive component of an attitude is defined as beliefs formed as to the properties of the object of the attitude, while the behavioural component concerns actions towards the object of the attitude. In turn, as noted by Greenwald and Banaji (1995) and Wojciszke (2011), the affective element relates to emotional dispositions towards the object of the attitude. Thus, attitudes towards the metaverse are primarily formed based on beliefs, emotions, or behaviours.

It is worth bearing in mind the lack of awareness of sources of attitudes, and the automatic nature and duality of attitudes. The duality of attitudes refers to the situation where the same object is evaluated differently on two levels—automatic (implicit) and controlled (explicit) (Wilson et al., 2000, p. 104). An implicit attitude is a record of

Małgorzata Bombol, SGH Warsaw School of Economics, Poland,  <https://orcid.org/0000-0002-9509-805X>

Rafał Kasprzak, SGH Warsaw School of Economics, Poland,  <https://orcid.org/0000-0001-8208-6159>

Michał Jan Lutostański, SGH Warsaw School of Economics, Poland,  <https://orcid.org/0000-0001-7298-5249>

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past experiences that evoke favourable or unfavourable feelings (Greenwald & Banaji, 1995). Moreover, Wilson et al. (2000), in defining implicit attitudes, find that the sources of implicit attitudes are not consciously recognised, that implicit attitudes are activated automatically, and that they cause unconscious, uncontrolled reactions and behaviours through which the individual unconsciously expresses their attitude and which they do not attempt to control. Implicit attitudes are evaluative dispositions towards social objects that are not necessarily subject to introspection, and as a result, an individual may be unaware of their existence (Madhavaram & Appan, 2010).

Explicit and implicit attitudes towards the same object do not have to be identical (Devine, 1989; Wilson et al., 2000). As Wielicka-Regulska et al. (2011) point out, in studies, attitudes resulting from conscious processing were measured using direct methods, where respondents performed a self-assessment of their attitudes, typically being aware of the study's purpose. However, due to the weak correlation between attitudes measured in this way and actual behaviour, the use of attitudes as predictors of behaviour has become limited (Hughes et al., 2011; Maison, 2004). In the literature, this dichotomy between explicit attitudes and behaviour is explained by the difficulty of defining one's stance using traditionally employed scales. Respondents may not have an explicit attitude at the time of the study or may have trouble recalling or refreshing it. This leads to ambiguous responses, answers invented for the sake of the study, or no response at all.

Respondents may also be unwilling to disclose their true explicit attitude, for example, due to subconsciously succumbing to the effect of social expectations (Gattol et al., 2011). Greenwald and Banaji's (1995) approach remedies this. They proposed a concept of implicit attitudes as "introspectively unidentified or inaccurately identified traces of past experience that mediate favourable or unfavourable feeling, thought, or action toward social objects" (p. 6). As a result, it is possible for two different attitudes towards the same object to exist simultaneously (Wilson et al., 2000). Greenwald and Banaji's concepts are still used in research and have stood the test of time, although with different emphases (Bar-Anan & Vianello, 2018).

Wielicka-Regulska et al. (2011) emphasise that explicit attitudes are those measured directly, most often through questionnaires or interviews, where deliberate and carefully considered judgments and opinions are obtained. Implicit attitudes, on the other hand, are measured using indirect methods.

Research Problems

This article poses the following main research question: Can the generational affiliation of a broad range of metaverse users, and the experiences they have accumulated throughout their lives have an unconscious effect on their behaviours and attitudes towards the metaverse? The hypothesis adopted is that the younger the generation, the more open they

will be. The selected analytical method for revealing implicit attitudes was factor analysis.

In factor analysis, a dependency model is considered in which observations concern only dependent variables, while independent variables are generated during the analytical procedure. Hence, observed variables are referred to as *real variables*, while independent variables, not recorded in reality, are referred to as *common factors* or simply *factors*. The factor analysis model thus assumes the existence of relationships between a set of real variables and a (smaller) set of unobservable factors. (Rószkiewicz, 2002, p. 194)

The hidden feature examined using other declarative indicators was the **attitude of openness towards the metaverse**. The following variables from a questionnaire based on a symmetrical Likert scale, where 5 means *strongly agree* and 1 means *strongly disagree*, were selected as declarative indicators: The metaverse is a space for more frequent social interactions; The metaverse is an ideal space for making new acquaintances; I believe virtual realities can reduce inequalities in access to certain content for people living in small towns or rural areas; The metaverse is an ideal space for engaging with culture; I believe virtual realities can reduce inequalities in access to certain content for older or lonely individuals; The metaverse is an ideal space for shopping; Contact with other people online is just as valuable as offline; The metaverse leads to loneliness and alienation; The metaverse is addictive; The metaverse will increase the likelihood of mental illnesses; The metaverse is for those who are afraid to approach others in real life; The metaverse is only for young people; The metaverse is just entertainment.

The metaverse, often incorrectly equated with virtual reality, is one of many contemporary technologies that first emerged in the works and minds of visionary writers and later, thanks to technological advancements, became permanently embedded in economic practice. In 1935, Weinbaum, in his short story *Pygmalion's Spectacles*, presented the first vision of virtual reality. Subsequent stages in the development of this technology have enabled the transition from a set of independent virtual worlds to a network of virtual worlds characterised by immersion in virtual experiences, easy access, and the ability to build identity, interoperability, and scalability (Dionisio et al., 2013). Today, the metaverse enables not only access to virtual reality but also interpersonal interactions, work, the development of passions, entertainment, leisure, and economic activities.

The development of the metaverse involves not only the use of virtual reality (Horoch, 2023; Schlichting et al., 2022; Tayal et al., 2022) but also platforms for conducting marketing communication (Buhalis et al., 2023; Hollensen et al., 2022; Sarna et al., 2024) and the provision of social services (Allam et al., 2022; Jenifer et al., 2023; Mystakidis, 2022; Uluba Hamurcu,

2022). Nowadays, this type of environment is increasingly recognised as a space for work (Koochang et al., 2023; Ning et al., 2021), entertainment and leisure (Demir et al., 2022; Ioannidis & Kontis, 2023; Tsai, 2024), education (Jagatheesaperumal et al., 2022; Kaddoura & Hussein, 2023; Kye et al., 2021; Lin et al., 2022), and social development (Aljanabi & Mohammed, 2023; Bale et al., 2022), although it is not free of legal problems (Szpringer, 2023).

This environment provides a broad space for potential users through the synergy of immersive digital experiences and a rich array of socio-economic activities. In the context of the challenges faced by consumers exploring the metaverse, issues such as privacy and security in virtual spaces are frequently highlighted (Abdulsattar Jaber, 2022; Fernández & Hui, 2022; Kumar, 2008; Wang et al., 2023; Zhao et al., 2023). Nevertheless, it remains an open space for new business models and customer acquisition strategies (Cheng et al., 2022; Papagiannidis & Bourlakis, 2010; Spajić et al., 2022; Surma, 2023).

Consumers in the metaverse are often subject to in-depth analysis aimed at perfecting product offerings (Kovacova et al., 2022; Nica et al., 2022). For this reason, recognising hidden attitudes and factors influencing their socio-economic behaviours is crucial in helping to build customer value (Du et al., 2022; Lee & Park, 2023). Research into customer behaviours in the metaverse focuses on several dimensions, including the impact of virtual reality and the *Internet+* environment on buyer behaviours (Busse & Strauss, 2023; Jiang & Ye, 2019); identifying challenges and factors that encourage SMEs to implement solutions within the metaverse (Gil-Cordero et al., 2024); identifying and developing models and methodologies for analysing e-customer behaviours to understand the factors underlying decision-making in the metaverse (Kwan et al., 2005; Sheth & Mittal, 2003).

Another significant area of analysis involves identifying hidden attitudes in the context of consumers' economic choices. An intriguing aspect is the connection between interest in the metaverse and its relatively limited impact on purchasing decisions (Breiter & Siegfried, 2022). However, this scientific area remains underexplored and requires further analysis (Toraman, 2022). Together, these studies highlight the complexity and multidimensionality of customer behaviour in the metaverse and the need for a comprehensive understanding of its various aspects.

Empirical Study

The research section utilised quantitative analysis conducted as part of a grant, on *The Metaverse as an Environment for Implementing Sustainable Development Strategies – Opportunities, Risks, and Challenges*, carried out by the Institute of Value Management, Collegium of Business Administration, SGH Warsaw School of Economics. The study was conducted between 20 November and 7 December 2022 by IQS using an online panel and the CAWI method, based on

a purposive sample of broad range of $N = 625$ users of the metaverse.

Using factor analysis calculations with IBM SPSS command files, applying the maximum likelihood extraction method and Oblimin rotation, a model matrix was obtained that explained 41% of the variance from the sample using three factors. Despite the limitations of the research tool (quantitative method), efforts were made to identify attitudes towards virtual worlds, which would only indirectly reveal the respondents' hidden beliefs. Nevertheless, comparing the components in the factor analysis yielded interesting results regarding implicit elements.

The results of the factor analysis, specifically the factor loading matrix, are presented in table 1. For ease of data interpretation, values below 0.3 were excluded from the table.

The obtained matrix indicates three hidden, uncorrelated traits explained by the selected variables—where initially, only one was assumed, which is **openness** towards the metaverse. In this case, however, three hidden traits (2 and 3) were identified. They are explained by their respective groups of indicators.

Let us tentatively name the first trait **openness to opportunities**.

The second trait can be referred to as **awareness of negative effects**.

The third trait can be named **distance**.

The conclusion from the analysis emerges when examining the factor loadings of the indicators forming the factors. The strongest indicators for *openness to opportunities* are:

- the metaverse is a space for more frequent social interactions (0.757),
- the metaverse is an ideal space for making new acquaintances (0.698).

For *awareness of negative effects*, the three strongest indicators are:

- the metaverse leads to loneliness and alienation (0.674),
- the metaverse is addictive (0.657),
- the metaverse will increase the likelihood of mental illnesses (0.595).

The next step in the analysis was an attempt to create three indices to measure the three discussed hidden traits. The indices were constructed in an identical manner—as the sum of all Likert scale values (1–5) of the indicators, divided by the number of indicators, resulting in continuous indices on a scale of 1 to 5.

The created indices showed the following average levels in the studied population: openness to opportunities: 3.23, awareness of negative effects: 3.25, and distance: 2.97. To verify the hypothesis posed at the beginning of the text, Pearson's correlation was calculated between the generational variable and each index (table 2). The generational variable was derived by transforming the age variable based on the following intervals: Baby Boomers – 1945–1964, Gen X – 1965–1979, Gen Y – 1980–1994, Gen Z – 1995–2009 (McCrimble, 2014, p. 7).

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Table 1

Factor Analysis – Results

Statements	Factor		
	1	2	3
The metaverse is a space for more frequent social interactions	0.757		
The metaverse is an ideal space for making new acquaintances	0.698		
I believe virtual realities can reduce inequalities in access to certain content for people living in small towns or rural areas	0.681		
The metaverse is an ideal space for engaging with culture	0.669		
I believe virtual realities can reduce inequalities in access to certain content for older or lonely individuals	0.632		
The metaverse is an ideal space for shopping	0.571		
Contact with other people online is just as valuable as offline	0.454	-0.362	
The metaverse leads to loneliness and alienation		0.674	
The metaverse is addictive		0.657	
The metaverse will increase the likelihood of mental illnesses		0.595	
The metaverse is for those who are afraid to approach others in real life		0.350	
The metaverse is only for young people			0.583
The metaverse is just entertainment			0.307

Source: authors' own work.

Table 2

Correlations between the Generational Variable and the Indices

Generation	Openness to opportunities	Awareness of negative effects	Distance
Pearson's correlation	-0.25	-0.11	0.063
Significance (two-tailed)	0.53	0.786	0.115

Source: authors' own work.

The results of the correlations between the generational variable and the indices derived from factor analysis do not confirm the hypothesis, and thus it has been disproven. It turns out that generation does not influence hidden attitudes towards the metaverse. To

further examine how the population may differ in this regard, correlations with variables related to gender, education, and the size of the place of residence were examined. The results are presented in tables 3, 4 and 5.

Table 3

Correlations between the Gender Variable (1 – Female, 2 – Male) and the Indices

Gender	Openness to opportunities	Awareness of negative effects	Distance
Pearson's correlation	-0.06	-0.115**	-0.088*
Significance (two-tailed)	0.13	0.00	0.03

Note. ** Correlation significant at the 0.01 level (two-tailed).

*Correlation significant at the 0.05 level (two-tailed).

Source: authors' own work.

Table 4

Correlations between the Education Variable and the Indices

Education	Openness to opportunities	Awareness of negative effects	Distance
Pearson's correlation	-0.065	0.136**	-0.028
Significance (two-tailed)	0.104	0.001	0.479

Note. ** Correlation significant at the 0.01 level (two-tailed).

Source: authors' own work.

Table 5*Correlations between the Size of the Place of Residence Variable and the Indices*

Size of place of residence	Openness to opportunities	Awareness of negative effects	Distance
Pearson's correlation	-0.025	0.080*	-0.016
Significance (two-tailed)	0.525	0.044	0.696

Note. *Correlation significant at the 0.05 level (two-tailed).

Source: authors' own work.

Table 6*Average Level of the Awareness of Negative Effects Index Across Groups with Different Education Levels*

Education	Awareness of negative effects – average
Primary	3.16
Secondary	3.26
Higher	3.38

Source: authors' own work.

Statistically significant correlations were primarily found for the second index, related to awareness of negative effects. The strongest, though weak, correlation was observed with the education variable.

The obtained averages for groups with different education levels show that if there is any relationship between hidden attitudes towards the metaverse, the most interesting factor appears to be the awareness of risks associated with new technologies. This awareness increases with the level of education of users. However, this relationship is rather weak.

The issue was also examined of whether hidden attitudes are in any way related to consumers' declared behaviours. First, respondents with a very strong particular hidden trait were selected from the population, choosing individuals who scored 4–5 on the scale. This resulted in the following groups:

open to opportunities ($N = 97$), aware of negative effects ($N = 104$), and distance ($N = 86$). Next, their responses to the question: Which of the following situations best describes your experiences with the Internet over the past three months? were analysed.

Particular attention should be paid to the differences in the last four rows of the table. It is evident that individuals open to opportunities in the metaverse are much more likely than those aware of negative effects or distant to visit virtual worlds, socialise in them, create avatars, or work in them. Thus, hidden attitudes translate into real behaviours.

Conclusions

Summarising the analyses conducted on empirical data, while there are some correlations between demographic data and hidden attitudes towards the metaverse, these correlations are very weak or insignificant. This suggests that a hidden attitude towards the metaverse is not a matter of generational affiliation or gender but rather a state of mind, norms, and attitudes that are not defined by demographic factors.

From the perspective of organisational management aiming to utilise the metaverse commercially—whether for sales or to transfer certain responsibilities to virtual worlds—the most critical aspect is mitigating risks that may arise in users' minds, particularly those related to loneliness, alienation, addiction, and mental health.

Table 7*Declared Online Behaviours of Metaverse Users by Different Types of Hidden Attitudes*

	Openness to opportunities $N = 97$	Awareness of negative effects $N = 104$	Distance $N = 86$
Using social media services	82%	82%	79%
Watching VoD films, YouTube, etc.	77%	80%	67%
Writing emails	73%	76%	69%
Purchasing something in virtual worlds	62%	68%	78%
Listening to music/podcasts	70%	67%	59%
Socialising (e.g., playing games in virtual worlds, chatting, meeting people)	45%	32%	28%
Visiting virtual worlds (e.g., virtual museum, exhibition, city)	32%	25%	27%
Using an avatar (e.g., creating a character in a game)	24%	20%	15%
Working in virtual worlds	20%	10%	16%

Source: authors' own work.

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The most effective way to address this is by leveraging the strongest indicators from the first index, as the advantages of openness to opportunities may simultaneously serve as barriers for some users. Therefore, the metaverse should be positioned as a space for frequent social interactions and forming new relationships.

The metaverse demands a new perspective for social sciences. It is not an area where all research methodologies from the real world can be applied on a 1:1 scale. It presents a significant challenge for philosophy, psychology, sociology, economics, finance and management.

Looking at the studies presented, it is worth outlining several key research directions as a final reflection, which could be explored through in-depth dual attitude testing. First and foremost, such tests should be integrated into the analysis of the effectiveness of various metaverse user interfaces. It is essential to remember that the current entry barrier to this space involves the costs and effort required to obtain and use Augmented Reality (AR) and Virtual Reality (VR) devices.

Another important aspect concerns attitudes towards Artificial Intelligence (AI) and intelligent agents, which play an increasingly significant role in the metaverse. Will AI-developed tools that communicate with consumers in a natural and effective manner be a source of explicit attitudes with positive overtones? Or will explicit attitudes remain favourable while, at the same time, negative implicit attitudes emerge as a result of experiences? This issue is particularly important in communication, where identity is already constructed, revealing internal motivations, beliefs, values, memories, and episodic memory.

Narrowing the scope of research directions to management and marketing, duality of attitudes will influence the creation of user interactions and how they are experienced. This is due to the novelty value of a solution that captures attention, how users perceive the items on offer to be useful, and virtual aesthetics in the broad sense. Considering the technical aspects of participation, such as avatar design, artefacts, and Non-Fungible Tokens (NFTs), these areas also provide opportunities for studying duality of attitudes. How do elements that engage users in the metaverse impact how real and psychological ownership of virtual products is perceived?

Another challenge is the need to redefine the customer journey map and the purchasing process within the metaverse. Each stage of interaction with a product, service, or brand is devised within completely personalised experiences and *touchpoints*. The customer is continuously accompanied by a virtual sales assistant, adjusting tools and communication methods. This scenario presents an opportunity where knowledge about duality of attitudes can be leveraged to develop new approaches to customer persona building and insight generation. Additionally, comparing attitudes will help sellers understand whether virtual products in the metaverse influence the perception and purchase of real-world products, and vice versa. Acquiring insights into attitudes will help to optimise influencer strate-

gies, which may be free from traditional real-world constraints. Furthermore, brands can focus not only on image and communication but also on designing the metaverse in a way that delivers the expected experiences, thereby eliminating barriers hindering the development of virtual worlds.

One of the most important aspects of the metaverse revealed in the empirical study is inclusivity. This becomes apparent not only in the elimination of geographical, gender, racial, age, and health-related barriers to employment but also in the elimination of limitations (such as time, space, or financial constraints) in accessing cultural services. The inclusivity of the metaverse also supports education, where transportation challenges and safety risks for certain age groups cease to be relevant. Additionally, minors voluntarily enter the labour market within the metaverse. Thanks to their creativity, they are able to monetise ideas that would be difficult to implement in the real world. These aspects of inclusivity contribute to a rapid shift in human attitudes, making them a worthy subject of further research.

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Małgorzata Bombol is an advisor and expert in consulting firms and market research companies, as well as a member of investment committees. She specialises in research on individual and institutional clients. Her expert work focuses on market potential analysis for start-ups, as well as the design, supervision, and analysis of market research. Her academic interests and research centre around consumer behaviour theory, market relationship building, and professional customer service. She has authored over 140 scientific publications, including studies on customer behaviour, lifestyle trends of Poland's middle and upper class, experience marketing, digital consumption, and Web 3.0. She is also a science communicator, a conference speaker, and a commentator for both traditional and digital media. She serves as the Head of the Postgraduate Programme in Music Career Management and lectures at universities in Genoa, Munich, Porto, and Lisbon.

Rafał Kasprzak is the Head of the Value Marketing Department at the Institute of Value Management and holds a Doctor Habilitatus degree in Economics. He is a Professor at the SGH Warsaw School of Economics. He has initiated and coordinated numerous research and economic projects focused on innovation and fostering collaboration between academia and business. His professional experience includes business consulting for organisations implementing innovations and managing innovative projects. He has authored numerous publications on creativity, creative industries, design thinking, and public funding implementation. He also coordinates research and educational projects. His academic passion lies in cultural and creative industries, their connection to innovation, and measuring the economic impact of culture on regional economies. He holds a Master of Business Administration (MBA) degree from Ecole Supérieure de Commerce de Rennes (France).

Michał Jan Lutostański holds a Doctorate in Social Sciences and is an Assistant Professor at the Institute of Value Management at the SGH Warsaw School of Economics. He was named the Graduate of the 25th Anniversary of SWPS University in the Business category. From 2016 to 2020, he was a board member of the Polish Society of Market and Opinion Researchers (PTBRIO) and served as Vice President from 2020 to 2024. Since 2024, he has been the President of PTBRIO. Since 2008, he has been active in the market research industry, having worked at CBOS, TNS OBOP, TNS Polska, 4P Research Mix, Millward Brown, and Kantar Polska, where he currently serves as Head of Knowledge & Thought Leadership. He has received both the Audience Award and the 25th Anniversary Award from PTBRIO for delivering the highest-rated presentation in the 20-year history of the Market Research Congress. In 2023, he was listed in ESOMAR Insight250, an international ranking of global leaders in the data and insights industry. His academic focus is on consumer behaviour and generational marketing.

Robert
Pawlak

Paweł
Wyrozębski

Ilona
Pietras

Joanna
Parys

The Use of Machine Learning in Enhancing Data and Information Management Processes in the Context of Knowledge Management

Abstract

The aim of this article is to describe how machine learning, including neural networks, is used in improving data and information management processes in the context of knowledge management in organisations. In the Polish literature, research on this topic tends to be fragmented. The empirical study presented in this article addresses the identified research gap concerning the use of machine learning methods in enhancing data and information management processes. The research makes use of critical literature analysis and the author's own research concerning the application of recurrent neural networks. The novel contribution made through this research in Poland was demonstration of the relationship between use of machine learning and the enhancement of knowledge management processes within organisations.


Keywords: data science, machine learning, neural networks, knowledge management, project management


Introduction


In an environment where information and technology solutions are increasingly important and data volumes are growing rapidly, enterprises need to continually adapt their data, information, and resulting knowledge management strategies to remain competitive in the markets. The application of advanced data mining and data science techniques, such as *Recurrent Neural Networks* (RNNs), is becoming not only a necessity but also a pivotal element of an organisation's success. The objective of this paper is to analyse how RNN models are used to forecast company stock prices, particularly the role of such models in enhancing data, information, and resulting knowledge management processes in organisations.

A critical literature review constitutes an essential element of this paper, providing an introduction to the research topic, making it possible to outline the theoretical context and formulate the main research objectives and questions. In the next step, the practical aspects of employing RNN models for stock price forecasting are discussed, illustrated using the example of Alphabet Inc. (Google). This analysis involved making use of the TensorFlow and Keras libraries, as well as the Python programming language, for implementing machine learning models, thereby enabling the forecasting of stock price trends based on historical data.

The digital era is driving the continuous growth of data volumes in organisations (Duque et al., 2022; Duque et al., 2023). With globalisation, competitiveness intensifies, compelling organisations to continuously adapt their management of the organisational knowledge that supports decision-making processes (Miller, 2014; Orad, 2020). Furthermore, data are an indispensable source for generating information and knowledge within enterprises (Chen et al., 2012; Report, 2018) – particularly in an environment where all aspects of the modern world, related to information and communication technologies,

Robert Pawlak, SGH Warsaw School of Economics, Poland,  <https://orcid.org/0000-0001-7228-4530>

Paweł Wyrozębski, SGH Warsaw School of Economics, Poland,  <https://orcid.org/0000-0002-6193-0055>

Ilona Pietras, SGH Warsaw School of Economics, Poland,  <https://orcid.org/0009-0000-0659-5162>

Joanna Parys, SWPS University, Poland,  <https://orcid.org/0009-0006-6453-5452>

contribute to their exponential growth. Data mining (Chen et al., 2012; Report, 2018) is a method for delving into and extracting data, as well as searching for knowledge in Business Intelligence systems, big data environments with large and variable data, and data warehouses. Patterns discovered during extraction and processing are regarded as information and knowledge, and should thus be viewed as representations of the same (Hevner & Chatterjee, 2010).

In a knowledge-based economy, there is a low capacity of enterprises to learn from undertaken projects, despite the wide availability of practical methods and tools (Ajmal et al., 2010; Paver & Duffield, 2019; Pawlak, 2021; Schindler & Eppler, 2003; Shergold, 2015; Williams, 2007; Wyrozębski, 2014). Many organisations lack the ability to learn from historical data, which forces them to reinvent the wheel (Paver & Duffield, 2019). Knowledge management processes in companies involve collecting information, data, and experiences (APM, 2019; OGC, 2017; PMI, 2017), but questions about the results delivered and the effectiveness of the process are continually being examined in research in the fields of management and quality sciences (Paver & Duffield, 2019; Wiewiora & Murphy, 2015; Williams, 2008; Wyrozębski, 2012). Paver and Duffield (2019) claim that the fundamental challenge lies in the appropriate and correct execution of actions in response to accumulated knowledge. They suggest that the answers can be found in the data collected by organisations and our ability to interpret them, rather than in the application of a specific procedure or method.

Knowledge management, much like the concept of knowledge itself, can be defined in many different ways. The absence of a cohesive description of knowledge management prompts further scholarly reflection. According to Wiig (1997), knowledge management is the systematic, explicit, and deliberate construction, renewal, and utilisation of knowledge to maximise organisational performance. In contrast, Probst et al. (2002) view it as a collection of practices that an organisation employs to create, store, utilise, and share knowledge.

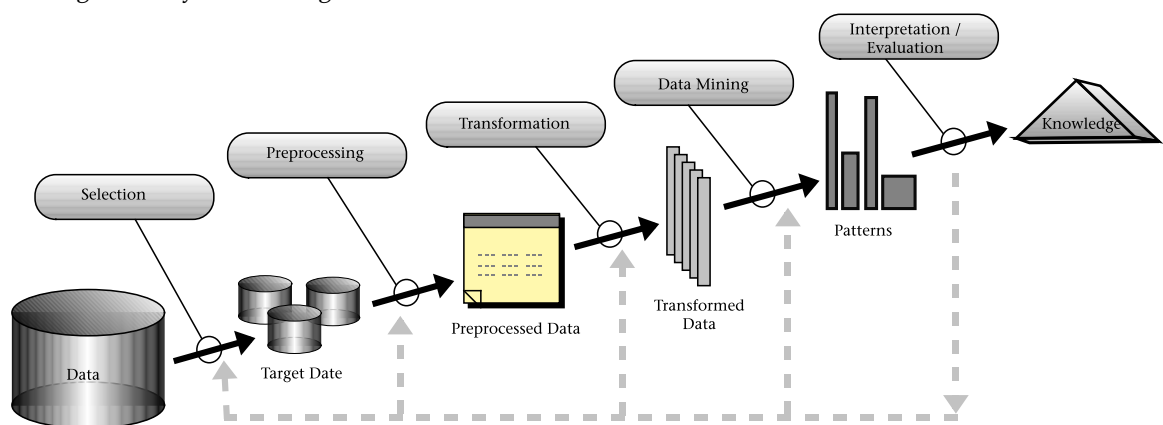
Kotnour and Vergopia (2005) are of the opinion that it is a set of proactive activities that aid the organisation in the creation, acquisition, dissemination, and utilisation of knowledge. The definition that best aligns with the authors' perspective is that of Romanowska, who describes knowledge management knowledge as a method of managing an enterprise that encompasses the entirety of processes enabling the creation, dissemination, and utilisation of knowledge to achieve the enterprise's objectives (Romanowska, 2004, p. 702).

In the case study described in this article, it was possible to examine the subsequent phases of the knowledge discovery process. The gathered data provided information for a machine learning process implemented using neural networks, illustrating how enterprises can be supported in data and information management processes in the context of organisational knowledge management (Drucker, 1995; Łobejko, 2004; Nazarko, 2018).

Theoretical Aspects of Using Data Mining and Data Science Solutions in Data and Information Management Processes in Organisations

In order to identify elements of the process related to data mining that are critical for data and information management in organisations, a review of databases such as Scopus, Science Direct, Web of Science, and Elsevier was conducted. As a result, a single, coherent definition of data mining was established. The meaning of this phrase, most commonly translated into Polish as *eksploracja danych*, is described as a process leading to the analysis and use of large datasets to extract valuable insights and the resulting knowledge (Duque et al., 2023; Fayyad et al., 1996). There are five main phases of knowledge discovery in organisations (Fayyad et al., 1996): selection, preprocessing, transformation, data mining, and evaluation and interpretation (figure 1).

Figure 1
Knowledge Discovery Process in Organisational Databases



Source: "From data mining to knowledge discovery in databases", U. Fayyad, G. Piatetsky-Shapiro, & P. Smyth, 1996, *AI Magazine*, 17(3), p. 37 (<https://doi.org/10.1609/aimag.v17i3.1230>).

According to Fayyad et al. (1996) and Maimon and Rokach (2010), the process of knowledge discovery consists of five main stages. Selection involves defining the objectives and choosing the data to be analysed in the knowledge discovery process. Preprocessing, in turn, enhances the reliability of data through processes such as filtering and cleaning. The transformation element enables the development of the most effective data model to ensure high-quality feedback. Data mining facilitates the discovery of trends and recurring patterns within the data. The final stage, involving evaluation and interpretation, serves to uncover new knowledge and/or update the process if necessary.

The data mining process is a vital component of the holistic data orchestration framework within organisations, as depicted in figure 2. Data orchestration is portrayed in the literature (Schwe, 2023) as a process that outlines the sequence of all activities related to data management within organisations. Data, information, and the resultant knowledge become pivotal resources for enterprises, upon which they base their decision-making in business operations. In such an environment, data orchestration processes are the prevailing method of managing data flow within an organisation, enabling decision-making based for example on the predictive outputs of machine learning models (Schwe, 2023).

The initial stage of the data orchestration process is dedicated to data ingestion, and involves the collection, importing, and processing of data from various sources for further analysis, storage, or presentation. Data can be extracted using methods such as Extract,

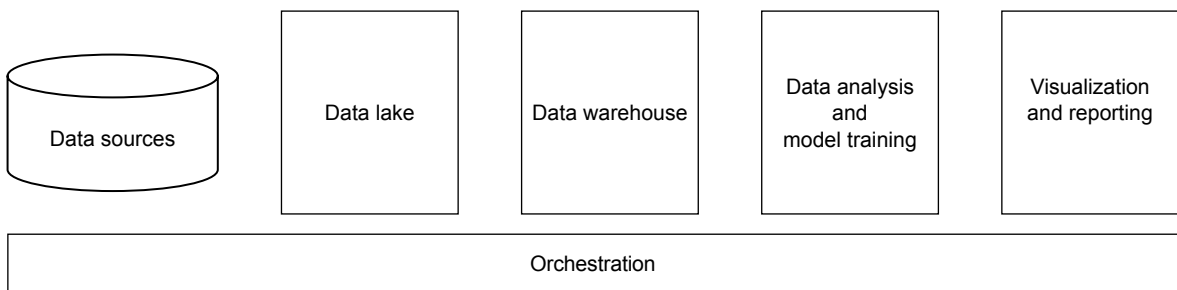
Transform, Load (ETL), which involve obtaining and then transformation and loading of the data into the target system. Data can be ingested in real time (streaming) or through batch processing.

As illustrated in figure 2, data can be stored in a data lake or data warehouse depending on their format, namely structured, unstructured, or semi-structured. Data lakes are a type of architecture that facilitate the collection, storage, and analysis of diverse data types in their original format. Data warehouses, on the other hand, are digital storage systems that integrate and harmonise large volumes of data from a variety of sources.

During the data analysis and modelling stage of the process, the solution most frequently referenced in scholarly literature on the subject of data science is the Machine Learning Operations (MLOps) model, which is a collection of principles and practices that define data management methods within machine learning processes and can serve as one of the key elements in enhancing data and knowledge management processes within organisations (Schwe, 2023).

As demonstrated in figure 3, this model comprises seven primary steps. These are collecting, validating, and curating data, followed by analysing the data, training the model, evaluating the obtained outcomes, and finally deploying the model within the organisation. These MLOps model steps evidently form a loop and result in a recursive process, which organisations internalise within their business operations, thereby refining their data, information, and resulting knowledge management processes (Schwe, 2023).

Figure 2
Data Orchestration Process within Organisations



Source: authors' own work.

Figure 3
Machine Learning Operations (MLOps) Model



Source: authors' own work.

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In the final stage of the data orchestration process, the practice of discovering patterns and making decisions based on them is accompanied by the emergence of trend lines, cycles, and/or seasonality (Nazarko, 2018). The aim of data mining and orchestration processes is to identify unexpected dependencies and patterns (Adeniyi et al., 2016; Duque et al., 2023). The objectives of data processing as part of data mining can be divided into two main categories and further into subcategories, as illustrated in figure 4.

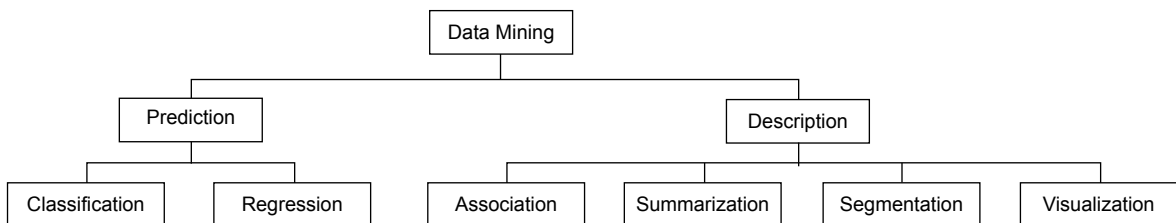
In figure 4, two subcategories for prediction analysis are presented, namely classification and regression. Conversely, the description category comprises the following subcategories: association, summarisation, segmentation, and visualisation (Adeniyi et al., 2016; Duque et al., 2023). Classification is the process of assigning classes to objects based on their attributes. Regression enables the attribution of specific values to various variables, e.g. predicting the probability of surviving a disease based on the results of diagnostic tests. Association, in turn, is a means of exploring relationships between variables, for example, through the placement of products together in a shopping cart (commonly known as *market basket analysis*). Summarisation is the most advanced method, stem-

ming from additive rules, visualisation techniques, and the discovery of relationships between variables. Segmentation (also referred to as *clustering*) allows for heterogeneous division of a population into several homogeneous segments, where data are grouped according to similarity. The results of data mining are presented using charts and diagrams (a subcategory of visualisation), which enable the identification and presentation of patterns and trends in the analysed data in graphic format (Easterby-Smith & Lyles, 2003).

One of the approaches to knowledge management in organisations is presented by Easterby-Smith and Lyles (2003), who describe the interrelations between organisational learning, organisational knowledge, learning organisation and knowledge management from the perspectives of process and content, as well as theory and practice. Figure 5 illustrates the interconnections and mapping of these four related terms.

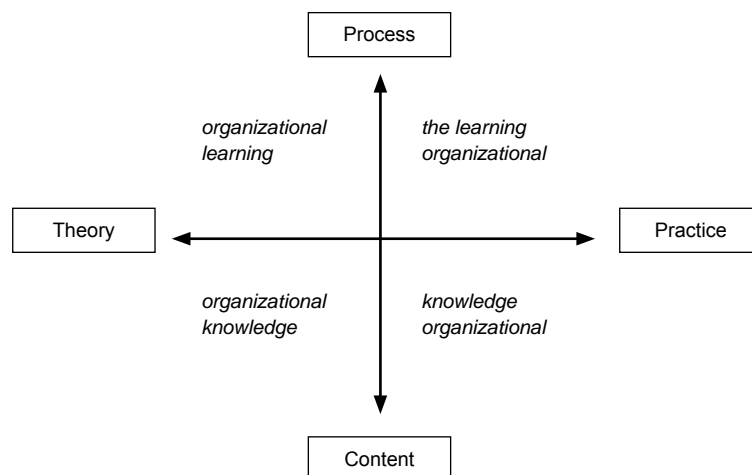
Initiatives related to developing, disseminating, and utilising knowledge help organisations internalise the acquired knowledge, leading to improvements in operational efficiency. In turn Dixon (1994), describing the organisational learning cycle, suggested that ac-

Figure 4
Categories and Subcategories in Data Mining Processes



Source: "Data mining applied to knowledge management", J. Duque, F. Silva, & A. Godinho, 2023, *Procedia Computer Science*, 219, p. 456 (<https://doi.org/10.1016/j.procs.2023.01.312>).

Figure 5
Interdependencies Between Organisational Learning, Learning Organisation, Organisational Knowledge, and Knowledge Management



Source: *The Blackwell handbook of organizational learning and knowledge management* (p. 17), M. Easterby-Smith & M. Lyles, 2003, Blackwell.

cumulated knowledge holds less significance than the processes required for its ongoing pursuit and creation. The described processes are directly related to Nonaka's Socialisation, Externalisation, Combination, Internalisation (SECI) model (Dixon, 1994).

An analysis of these considerations might lead to the research question of how data mining and data science solutions enhance data and information management processes in the context of knowledge management in organisations? This topic is widely discussed in the literature (Duque, 2023; Jifa & Lingling, 2018; Raschka & Mirjalili, 2021; Shaeffer & Makatsaria, 2021), particularly regarding the increasing interest in the use of machine learning in data and information management processes in organisations.

Using Machine Learning in Knowledge Management in Organisations

When exploring the connections between definitions of concepts such as data, Data, Information, Knowledge, Wisdom (DIKW), big data, and data science, the model of knowledge creation in organisations discussed in the literature is also relevant (Jifa & Lingling, 2018) (figure 6).

DIKW is explained further in literature (Ackoff, 1989). *Data* is defined as the most fundamental model, followed by *information*, which provides context to the data. The next level is *knowledge*, acquired by organisations based on the collected information, while *wisdom* is meant as a guide to when and why the acquired knowledge should be applied. Within the DIKW model, data is a fundamental fact and a raw material, which will only become useful if we allow it to evolve into information, knowledge, and wisdom. At the data and information levels, various methods can be employed, such as data mining, text mining, web mining, and specialised tools including databases, data marts, and management information systems (Leondes, 2010). In the progression towards the third level, namely *knowledge*, organisations implement Knowledge Discovery in Databases (KDD) solutions and knowledge engineering methods

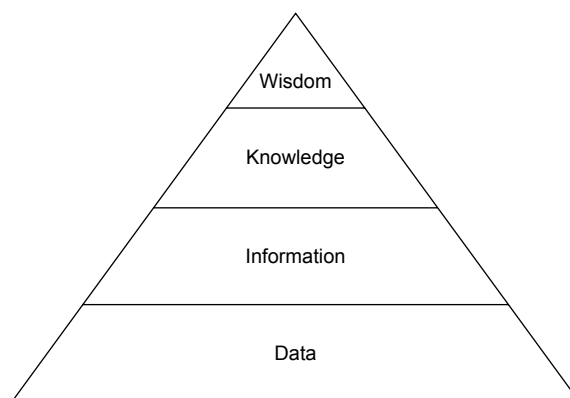
(Leondes, 2010). In intelligent knowledge management processes, organisations use what is referred to as *domain-driven data mining* (Cao and Zhang, 2006). This is a method that involves generating expert knowledge, termed an *intelligent knowledge base* (Zhang, 2009).

Organisations implementing machine learning models (machine learning is a subset of artificial intelligence), are undergoing a transformational revolution in knowledge management practices (Dalkir, 2017; Larose & Larose, 2015; Schwe, 2023). Machine learning algorithms excel at processing large volumes of data both quickly and accurately. By leveraging ML, organisations can uncover previously unknown patterns within the collected data. A neural network-based analytics approach facilitates a deeper understanding of complex relationships among the variables under investigation and can encourage more informed decision-making.

In the field of intelligent knowledge discovery, machine learning algorithms can also promote discovering new knowledge, for example by automating information retrieval processes. *Natural Language Processing* (NLP) techniques enable intelligent search systems to understand and interpret the context, intent, and sentiment behind the queries being analysed. Automated knowledge capture using machine learning algorithms also helps to enhance the discovery of trends and patterns in data obtained from distributed source systems (Dalkir, 2017; Larose & Larose, 2015; Schwe, 2023).

Conversely, intelligent content recommendation techniques (Adeniyi et al., 2016) – available through neural networks – enable the provision of personalised content recommendations based on the preferences of the enterprises' customers, their interests, and past interactions (e.g. purchasing preferences). In such a scenario, ML algorithms help to predict future customer behaviour in a rapidly changing market, enabling businesses to anticipate potential challenges and seize emerging opportunities (Dalkir, 2017; Larose & Larose, 2015; Schwe, 2023).

Figure 6
Data, Information, Knowledge, Wisdom (DIKW) Model



Source: "Data, DIKW, Big Data and Data Science", G. Jifa & Z. Lingling, 2018, *Procedia Computer Science*, 31, p. 815 (<http://dx.doi.org/10.1016/j.procs.2014.05.332>).

Case Study: Using a Recurrent Neural Network to Forecast Company Stock Prices

In the theoretical framework of methodological assumptions underlying neural network models, it is possible to predict stock prices based on historical data (Li et al., 2018; Raschka & Mirjalili, 2021; Saud & Shakya, 2020; Zhu, 2020; Zhu et al., 2022). Nevertheless, it is impossible to precisely determine all the factors that may influence stock prices and how these factors will impact the stock markets. One reason for this is the assumption that a forecasting model should be capable of addressing non-linear problems, and stock price forecasting is strongly non-linear. The use of RNNs is appropriate for forecasting because stock prices exhibit time series characteristics (Li et al., 2018; Raschka & Mirjalili, 2021; Saud & Shakya, 2020; Zhu, 2020; Zhu et al., 2022), and the purpose of RNNs is to process sequential data.

The literature (Zhu et al., 2022) provides examples of neural network models such as *Long Short-Term Memory* (LSTM) used to predict stock prices based on closing prices. The LSTM model proposed by Hochreiter and Schmidhuber (1997) was modified based on the RNN structure, which addresses the limitation of RNN models in representing the long-term memory of time series (Staudemeyer & Morris, 2019). The application of this modified LSTM model – which can pass data to each layer – ensures the existence of short-term memory during the training of long-term memory. Furthermore, LSTM also mitigates the problem of vanishing gradients that occurs in recurrent neural networks when processing long sequences of data (Hochreiter & Schmidhuber, 1997). In LSTM models, short-term

memory is responsible for retaining information from the most recent time steps, enabling the model to swiftly adapt to current changes in the data.

In contrast, long-term memory accumulates significant patterns from prior data, assisting the model in understanding and predicting long-term dependencies and trends. In LSTM, short-term memory is managed by the cell state, which retains current information between time steps, whereas long-term memory uses a gating mechanism. This enables the LSTM to model both short-term dependencies and long-term patterns while mitigating the vanishing gradient effect.

Using RNNs to forecast corporate stock prices is a common and recommended approach within the examined body of literature (Raschka & Mirjalili, 2021; Saud & Shakya, 2020; Zhu, 2020; Zhu et al., 2022). TensorFlow and Keras libraries enable the application of deep learning mechanisms, which help to speed up the processing of machine learning tasks.

The analyses conducted for the purposes of this research, using the Python programming language, were performed using Anaconda package version 2.3.2. Jupyter Notebook software suite version 6.5.2, provided within the Anaconda package, served as the *Integrated Development Environment* (IDE). In the initial step of data preparation, the Pandas, Numpy, and Matplotlib libraries were used, as demonstrated in figure 7. Publicly available data on Google's (Alphabet Inc) stock prices from the Kaggle platform was downloaded and used (Google Stock Price, n.d.).

As presented in figure 7, the data retrieved for analysis consists of Google's (Alphabet Inc.) stock prices from 2012 to 2016, specifically the opening and closing prices as well as the highest and lowest

Figure 7
Python Scripts – Part 1.
Data Processing

```
In [1]: import numpy as np
import matplotlib.pyplot as plt
import pandas as pd

In [2]: dataset_train = pd.read_csv('Google_Stock_Price_Train.csv')
training_set = dataset_train.iloc[:, 1:2].values

In [3]: print(dataset_train)

      Date  Open  High  Low  Close  Volume
0  1/3/2012  325.25  332.83  324.97  663.59  7,380,500
1  1/4/2012  331.27  333.87  329.08  666.45  5,749,400
2  1/5/2012  329.83  330.75  326.89  657.21  6,590,300
3  1/6/2012  328.34  328.77  323.68  648.24  5,405,900
4  1/9/2012  322.04  322.29  309.46  620.76  11,688,800
...      ...      ...      ...      ...      ...
1253 12/23/2016  790.90  792.74  787.28  789.91  623,400
1254 12/27/2016  790.68  797.86  787.66  791.55  789,100
1255 12/28/2016  793.70  794.23  783.20  785.05  1,153,800
1256 12/29/2016  783.33  785.93  778.92  782.79  744,300
1257 12/30/2016  782.75  782.78  770.41  771.82  1,770,000

[1258 rows x 6 columns]

In [4]: print(training_set)

[[325.25]
 [331.27]
 [329.83]
 ...
 [793.7 ]
 [783.33]
 [782.75]]
```

Source: authors' own work.

prices, alongside transaction volumes for each respective day. For the purposes of the present analyses, two data sets were collected: one stock price set served as the training set, while the second contained test data. The aim of the analyses was to forecast Google's stock price trend for the year 2017 and subsequently compare it with the dataset of real-world data (comprising verified data for that period) to evaluate the quality of the outcomes (forecasts). According to the predictions of the Brownian motion theory (Heller, 2023; Mandelbrot & Taylor, 1967), future stock price variations are independent of past data, indicating the non-linear nature of the relationship between the variables. Thus, in line with the predictions based on this theory, stock prices cannot be predicted accurately, and only trends (rise or fall) can be foreseen. For the purpose of this analysis, and to also minimise the complexity of the study, only the opening stock price was used for forecasting.

The next step in the analyses was to map the stock prices to the range (0, 1) to prevent overfitting of the model (particularly when using the sigmoid activation function¹), as illustrated in figure 8 (see Appendix 1). The `MinMaxScaler` method from the Scikit-learn (Sklearn) library was used for the purposes of this normalisation².

In the subsequent step, a dedicated data structure encompassing 60 time stamps was prepared, based on which the RNN would predict the 61st stock price of the enterprise under analysis. The number of preceding time stamps was determined to be 60 on the basis of previous experimental observations (Zhu et al., 2022). As a result of these activities, the variable `X_train` was transformed into a nested list containing lists of prices spanning 60 time stamps. Conversely, the variable `y_train` is a list of stock prices containing the prices for the following day that correspond to the variables within the `X_train` list.

Figure 9 illustrates a section of the `X_train` and `y_train` set of variables (see Appendix 1). Each row in the `X_train` set, containing 60 rescaled stock prices, is subsequently used to predict the corresponding next day's opening stock price within the `y_train` outcome set.

During programming, three LSTM layers were built as an initial step. A Dropout layer with a rate of 0.2 was inserted between the three prepared layers, to minimise model overfitting. The fourth LSTM layer is a fully connected layer, comprised of a single neuron, designed to predict the future price of a single share of Google. To estimate parameters, the *Adam* optimiser was used. The maximum number of iterations was set to 50, and the *Mean Squared Error* (MSE) method was employed to minimise loss until a value

of zero was reached (see figure 10 in Appendix 1). The authors of this article recommend considering, for similar analyses, the *Mean Absolute Error* (MAE) function, which is less sensitive to large errors, or the *Huber Loss* function, a combination of MSE and MAE, to better manage outliers. In the authors' view, both error functions can help to formulate more stable and robust forecasts in time series models.

In these analyses, the primary model used for predicting continuous values in the LSTM model is a neural network regressor. In the first step, we initialise the model using the *Sequential* function. Next, we add LSTM layers and configure the optimiser and loss function, which allow the model training to commence. The *Units* parameter specifies the number of LSTM neurons in the layer. A count of 50 neurons provides high model dimensionality, a means of forecasting upward and downward stock price trends. Setting the *Return Sequences* parameter to *True* enables the addition of another LSTM layer to the previously created layers. The *Input Shape* parameter corresponds to the number of time stamps and the number of indicators. In turn, the *Dropout* parameter – with a value set to 0.2 – implies that 20% of the 50 neurons will be randomly omitted during each training iteration (as illustrated in figure 11 – see Appendix 1).

In the subsequent step, the RNN was compiled using the *Stochastic Gradient Descent* (SGD) algorithm³, along with the loss function and optimiser previously described. Then, the model training process was initiated, aimed at forecasting the opening stock prices of the analysed company.

The network is fitted to the training set over 100 epochs – see figure 12 in Appendix 1. Its weights are updated for every 32 stock prices. The batch size is set to 32.

As a result of the training process, the loss value reached was 0.0018. In the subsequent step, test data is retrieved to conduct forecasts and, ultimately, to present a visualisation of the results (figures 13 and 14 in Appendix 1).

The training and test datasets are combined for the forecasting process since we use closing prices from the previous 60 days to predict the next day's price. In other words, we need stock prices from the 60 days preceding the first date in the test dataset, as illustrated in figure 14 (see Appendix 1).

The final step is the visualisation of the results of the analysis, to provide a graphic representation of the final findings to as an aid for interpretation (figure 15).

As illustrated in figure 15, the predicted stock price curve diverges from the real-world values because the model cannot adequately respond to non-linear changes in real-world variables. Nonetheless, the

¹ The sigmoid activation function is a concept used in artificial intelligence to define the function by which the output value of neural network neurons is calculated.

² Scikit-learn is a Python library that helps implement machine learning algorithms, such as regression, classification, clustering, model evaluation, and numerous others.

³ *Stochastic Gradient Descent* (SGD) is an optimisation algorithm used to minimise the cost function. The cost function serves to measure how closely the model's predictions align with the real-world values.

Figure 15

Python Script – Visualisation of Results

```
In [26]: plt.plot(real_stock_price, color = 'red', label = 'Real Google Stock Price')
plt.plot(predicted_stock_price, color = 'blue', label = 'Predicted Google Stock Price')
plt.title('Google Stock Price Prediction')
plt.xlabel('Time')
plt.ylabel('Price')
plt.legend()
plt.show()
```



Source: authors' own work.

model responds correctly to smooth transformations. The stock price forecasts presented in figure 15, which exhibit a discontinuous nature, have a detrimental effect on the model, resulting in deviations from real-world stock prices. The smooth nature of changes contributes to the accuracy of stock price forecasts generated by the model – as demonstrated in the analysed example – appropriately reflecting upward and downward trends in stock prices.

Summary and Discussion of Research Results

When attempting to interpret the obtained analysis results, one must agree with the referenced literature (Balicka, 2023; Chen et al., 2012; Drucker, 1995; Duhon & Elias, 2008; Duque et al., 2023; Jifa & Lingling, 2018; Łobejko, 2004; Milton, 2010; Raschka & Mirjalili, 2021; Report, 2018; Saud & Shakya, 2020; Schindler & Ep-

pler, 2003; Shaeffer & Makatsaria, 2021; Wiewiora & Murphy, 2015; Williams, 2007; Williams, 2008; Wyrozębki, 2014; Zedwitz, 2002; Zhu, 2020; Zhu et al., 2022) that exploring the application of machine learning methods to enhance data and information management processes in the context of knowledge management within organisations is of particular interest from a research perspective, especially in the era of the digital revolution and the exponentially increasing volume of data available in organisations.

In the example cited from the literature (Zhu et al., 2022), the closing prices of company stocks were analysed, whereas for the purposes of analysis in the present study, the opening price of Google stocks was chosen as the forecast price. Similar results were obtained in both instances, indicating that RNNs employing the LSTM model can accurately predict stock price trends. However, they are unable to forecast the precise stock price for a specific date (figure 16).

Figure 16

Comparison of Forecast Stock Prices with Real-World Values (20-year period)



Source: "Predicting Google's Stock Price with LSTM Model", T. Zhu, Y. Liao & Z. Tao, 2022, *Proceedings of Business and Economic Studies*, 5(5), p. 85 (<http://dx.doi.org/10.26689/pbes.v5i5.4361>).

Addressing the research question posed in this paper regarding the effectiveness/efficacy of the selected model, the observation cited in the literature proved to be correct, that only the trend line (either increase or decrease in stock prices) can be accurately forecast. This is primarily due to the fact that the RNN model employing the LSTM method cannot react swiftly to non-linear changes in the real-world variable. In accordance with the theory of Brownian motion (Mandelbrot & Taylor, 1967) – as discussed in this paper – it is not possible to accurately reflect future stock price changes solely based on historical data. However, the model does accurately forecast upward and downward trends in the stock prices of the analysed company.

Zhu (2020) compared RNN models with classical regression models and simple predictive methods in the context of the task of forecasting stock prices. He demonstrated that RNNs outperform linear models in detecting non-linear patterns in stock market data, although RNNs encounter difficulties in accurately predicting sudden changes in stock prices. In contrast, Saud and Shakya (2020) compared the effectiveness of RNN, LSTM, and simple autoregressive models. The results of their analyses revealed that deep learning models, such as LSTM, handle non-linear dependencies more effectively, while simpler autoregressive models are more efficient in terms of time and resources, which can be advantageous for shorter prediction horizons. In their study, Zhu et al. (2022) compared the LSTM with traditional statistical models, such as the Autoregressive Integrated Moving Average (ARIMA), demonstrating clear advantages of the LSTM in detecting long-term trends and patterns, although in the short term, ARIMA offered similar effectiveness at a lower computational cost.

Using various machine learning techniques described in the present study – ranging from knowledge discovery and capture algorithms to intelligent content recommendation, and predictive analytics facilitating decision-making – can enhance data and information management processes in the context of knowledge management and lead to more efficient dissemination and assimilation within companies endeavouring to employ machine learning methods. Improved data and information management processes in the context of knowledge management are part of the suite of data orchestration processes within organisations. Such solutions include processes aimed at acquiring data from numerous distributed data sources. Enhancements in such data acquisition processes can help to improve the data quality and – subsequently – the accurate identification of appropriate source systems. Another process that can be optimised is the data analysis and modelling process. Using machine learning techniques can enhance the quality of analyses and the resulting output data.

The conclusions drawn from the analyses conducted in this article – in light of the literature review – confirm the increasing significance of data mining and data science solutions in data and information

management processes in the context of knowledge management in organisations. Moreover, it has been demonstrated that the techniques and methods of data mining and data science constitute an integral part of organisational activities and facilitate organisational learning in the processes that assimilate new knowledge into business operations. Through the presentation of practical applications of the chosen machine learning model – as an example of use of data mining and data science solutions – it was possible to illustrate how the presented model helps to improve knowledge management processes in organisations, while simultaneously enabling an in-depth exploration of data and information.

When indicating potential directions for future research, the use of GRU, Vanilla, and Convolutional Neural Networks should be recommended as alternatives to the LSTM (GitHub, 2024), for forecasting stock prices based on historical data. Including more than just the opening or closing prices of a stock in the analysis is also advisable. The attempt to employ different machine learning techniques could help to enhance and broaden knowledge in the context of improving data and information management processes in learning organisations.

The appendix is available in the online version of the journal.

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Robert Pawlak holds a PhD in social sciences in the field of management and quality sciences, the SGH Warsaw School of Economics, and is an experienced project manager. His research interests revolve around knowledge management in organisations and learning from experiences in knowledge management, with a particular emphasis on machine learning methods.

Paweł Wyrozębski is a Professor at the SGH Warsaw School of Economics, a co-organiser and long-term lecturer in Postgraduate Studies in Project Management and Postgraduate Studies in Project Evaluation and Audit at the SGH Warsaw School of Economics. He specialises in project management, particularly in project management methodologies and standards, strategic project management and the operation of Project Management Offices (PMOs), project planning and control, IT support and tools for project management, and project organisation.

Ilona Pietras is a data engineer active in data processing design and implementation, cloud migration, and data modelling and visualisation. Her research interests pertain to a holistic approach to data-driven practices in enterprises.

Joanna Parys lectures at SWPS University in Warsaw and holds managerial roles at the consultancy firm EY Global Delivery Services. For years, she was affiliated with the banking and financial institutions sector, where she oversaw areas of project management, corporate governance, and organisational development. Her research interests centre on intellectual capital management in enterprises and on project management, with a specific emphasis on evaluating projects in terms of their profitability and effectiveness.

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Digital Transformation in Family Businesses

Abstract

Digitalisation has become a top priority of the European Commission, aimed at enhancing digital skills, securing digital infrastructure, and advancing the digitalisation of businesses and public services. The European Commission envisages that small and medium-sized enterprises will achieve at least a basic level of proficiency in using digital technologies. Existing research shows that digitalisation is not considered a priority by family businesses, as they tend to defer investments in this area. This article discusses the challenges associated with the conceptual framework, as the meaning of the term *digitalisation* and its derivatives is not straightforward. Polish equivalents have also been proposed, based on English terminology, making reference to the sphere of the enterprise and giving examples.

The main aim of this article is to discuss and systematise the conceptual framework, and to analyse the degree of digitalisation in Polish family businesses. The special nature and degree of digitalisation in family businesses were discussed using the systematic literature review method. To date, few articles addressing this topic have been published, which should encourage researchers to delve deeper. Polish family businesses have declared that greater digitalisation efforts will be made over the next year, which could provide an impetus for conducting research and tracking progress in this area.

Keywords: digitalization, digitization, digital transformation, family business, systematic literature review

Introduction

Nowadays, vast amounts of data are generated which can be used for various purposes, such as scientific, business, medical, and others. Public authorities often make some of this data available to the public. The immense volume of data is evident from the words of Eric Schmidt, Google's former executive chairman, who stated that between the dawn of civilization and 2003, five exabytes of data were created; currently, that amount is generated every two days (Smolan & Erwit, 2012). The availability of vast data resources and the development of IT technologies based on them, particularly artificial intelligence, big data, and blockchain, have had a significant impact on every aspect of life, including the economy – triggering a revolution in industry known as 4.0.

Over the past decade, digital technologies have helped transform business practices (Nambisan et al., 2019). There are numerous examples of enterprises that have successfully undertaken this transformation (Teece, 2018). If they aim not only to survive but to thrive, family businesses should also adapt their operations to the new market conditions (Garzella et al., 2021).

Digitalisation has become a significant challenge for businesses, as highlighted by the pandemic, during which they were compelled to shift to working remotely. Various institutions and organisations play a role in shaping and supporting digitalisation; for the European Commission's activities, this has become a priority and should lead to the achievement of the goals set out in *2030 Digital Compass: the European way for the Digital Decade* (European Commission, 2021). According to the *European Declaration on Digital Rights and Principles for the Digital Decade* (European Commission, 2022), this transformation affects every aspect of life, offering considerable potential for improving its quality, economic growth, and sustainable development. The implementation of advanced digital technologies in businesses contributes to the success of the entire economy, which is crucial in an unstable economic environment, a factor in disruption of supply chains.

Polish companies rank low in digitalisation charts. Moreover, there is limited interest on the part of researchers in this issue, as demonstrated by an analysis of bibliographic and online resources. A significant portion of companies are family-owned, and in many respects these companies are seen as more efficient and focussed on long-term operations; however, digitalisation is not considered a priority for them.

Currently, there is no doubt that the development of digitalisation impacts the economy, but it is difficult to clearly determine the scope and outcomes (Degryse, 2016). In examining this trend, context is crucial, as the effects depend on the intensity and absorptive capacity of the economic sector or the country's policy in general (Bouncken et al., 2018). Furthermore, the likelihood of failure when businesses implement new digital technologies can be very high at the current stage of development, and can even range between 66% and 84% (Libert et al., 2016). Given the profound technological changes taking place, a new way of thinking about business and employee skills is required (Schallmo et al., 2017).

Evidently, the impact of new technologies extends to Polish businesses as well, including family-run ones. Given the substantial role of family-run businesses in the Polish (and global) economy, it seems reasonable to investigate whether they adapt more effectively to the new reality than their non-family counterparts. Rankings now emerging, or existing rankings, take digitalisation criteria into account, which may help answer the above question. For example, the European Investment Bank (EIB) incorporates this criterion into the European Investment Bank Investment Survey (EIBIS) (EIB, n.d.). Unfortunately, Poland ranks near the bottom among the most digital enterprises, while the top spots belong to companies from Denmark, the Netherlands, the Czech Republic and Finland. Therefore, it is worthwhile to address this topic, pointing out the barriers and potential ways to improve the existing situation. Also, European companies lag behind their American counterparts, despite the EU's efforts aimed at supporting digitalisation. The largest disparities (21%) occur in the construction sector (EIB, 2020), while the smallest are in the infrastructure sector (11%).

The topic of digitalisation, and particularly the use of digital communication tools and remote working, became essential for maintaining business continuity during the pandemic. Companies finally stopped seeing remote work as a utopia (Lipiec, 1998) and started looking for ways to implement it and maintain their business operations while travel restrictions and lockdown were in effect. The pandemic led to a general realisation that we are living in times of great volatility, uncertainty, complexity, and ambiguity (VUCA). This compelled companies to seek the best way to operate in such an environment, which came to be known as *business excellence in a volatile, uncertain, complex, and ambiguous environment* (BEVUCA) (Saleh & Watson, 2017). As a result, enterprises are engaging in various activities, focusing primarily on adapting digital tools.

At present, it is difficult to say definitively whether implementing digital transformation in businesses helps to create a stable, certain, simple, and unambiguous economic environment. However, the steps being taken by various institutions and organisations are indeed moving in that direction. As mentioned, numerous initiatives are being launched by the European Commission. For the most part, family businesses have not yet embraced the challenge of digitalisation (Xie et al., 2022), although they are becoming increasingly aware of its impact on their operations (Correani et al., 2020; ZPP, 2023).

The author was prompted to address the subject of digital transformation in family businesses for three reasons. Firstly, there are ambiguities in the terms used to translate fundamental English terms related to digitalisation. Secondly, light needs to be shed on the actions being taken by the European Commission in this area. Thirdly, it is necessary to analyse the level of digitalisation in businesses, with particular focus on family-owned enterprises.

The aim of this article is to systematise the conceptual framework and illustrate how digitalisation processes should be understood in the context of entrepreneurship, as well as to analyse the extent of digitalisation in family businesses.

The author attempted to answer the following research questions:

1. How should the concept of digitalisation and its derivatives be understood in the context of entrepreneurship?
2. To what extent and in what ways are family businesses undergoing digital transformation?

To address the first question, dictionary sources were used, whereas for the second one, a systematic literature review method was employed.

Theoretical Perspective

Method

Systematic literature review methodology, originally used in medical sciences (Bala et al., 2015; Davis et al., 2014) and later used in economic sciences (Stępień, 2023), including management science (Cabała et al., 2023; Snyder et al., 2016; Więcek-Janka et al., 2024; Witell et al., 2016), was employed. This is a method that enables transparent and structured selection and assessment of available literature resources. It consists of four stages: (1) identification, (2) searching, (3) evaluation and (4) synthesis of the most significant scientific evidence obtained in the first three stages (Fink 2019; Mazur & Orłowska, 2018; Thorpe et al., 2005; Tranfield et al., 2003). These stages, along with the corresponding procedure, are presented in the PRISMA diagram (Liberati et al., 2009).

Publications were identified based on queries using equivalent Polish and English terms (Mengist et al., 2020) related to the concepts of 'digitization' and 'family firm'.

- 'family firms' AND 'digitization' ($n = 3$)

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- 'family firms' AND 'digitalization' (n = 13)
- 'family firms' AND 'digital transformation' (n = 9)
- 'przedsiębiorstwa rodzinne' AND 'ucyfrowienie' (n = 0)
- 'przedsiębiorstwa rodzinne' AND 'cyfryzacja' (n = 0)
- 'przedsiębiorstwa rodzinne' AND 'transformacja cyfrowa' (n = 0)
- 'firmy rodzinne' AND 'ucyfrowienie' (n = 0)
- 'firmy rodzinne' AND 'cyfryzacja' (n = 0)
- 'firmy rodzinne' AND 'transformacja cyfrowa' (n = 0)

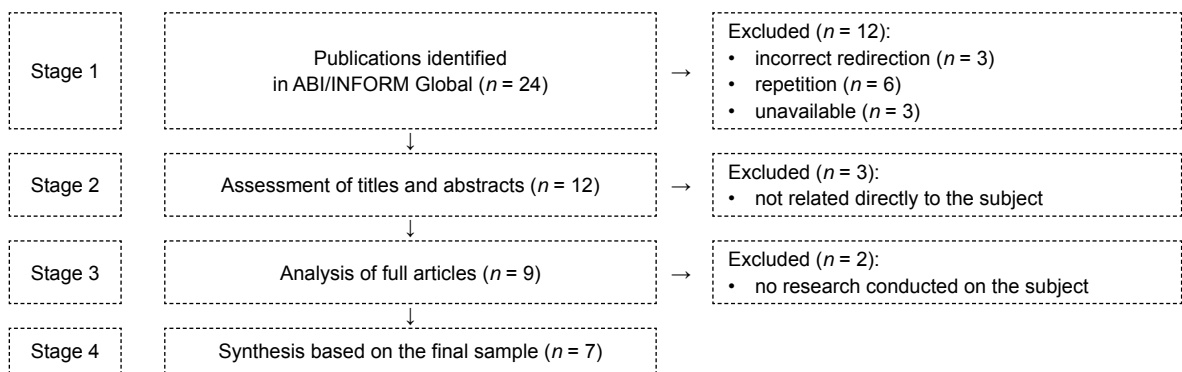
Subsequently, duplicates, erroneous redirects, and unavailable articles were eliminated (Figure 1). In the second stage, the titles and abstracts were reviewed and articles not directly relevant to the topic were excluded. In the third stage, a full-text analysis was conducted, rejecting those articles in which no research was performed.

In the final stage, full articles were analysed, the applied methods and research sample were highlighted, and the main conclusions from the research were presented (table 1).

There are few scholarly articles that address the topic of digitalisation in family businesses. Such

Figure 1

The Procedure Employed for the Systematic Literature Review



Source: own work based on the PRISMA statement for reporting systematic reviews and meta-analyses of studies that evaluate health care interventions: Explanation and elaboration, A. Liberati, D. G. Altman, J. Tetzlaff, C. Mulrow, P. C. Gøtzsche, J. P. A. Ioannidis, M. Clarke, P. J. Devereaux, J. Kleijnen, & D. Moher, 2009, *Annals of Internal Medicine*, 151(4), W-65 (<https://doi.org/10.7326/0003-4819-151-4-200908180-00136>).

Table 1

Conclusions from Previous Research

Research	Method	Sample	Conclusion
Pöschl & Freiling (2020)	<ul style="list-style-type: none"> • multiple case study • interviews 	Small and medium-sized enterprises in the DACH region (340)	Current and incoming owner-managers focus on enhancing the level of digitalisation during succession processes. Digitalisation is undervalued and postponed for the long term.
Škare & Soriano (2021)	<ul style="list-style-type: none"> • dynamic panel models 	Data from 28 EU Member States as well as Japan and the US	Agility in family businesses is heavily dependent on the national or industry level of digitalisation and investment in intangible assets.
Ano & Bent (2022)	<ul style="list-style-type: none"> • case study • epistemological phenomenology • partially structured interviews 	French family firms (5)	Five key determinants for digital transformation: 1) change management associated with long-term sustainability 2) emotional attachment to the company 3) legacy impact 4) involvement of family members 5) owners' focus on employees.
Barile et al. (2022)	<ul style="list-style-type: none"> • case study 	Italian start-up (1)	Implementation of digital solutions in various functional areas of the company.
Bouncken & Schmitt (2022)	<ul style="list-style-type: none"> • inductive method • partially structured interviews 	Managers (19) from family businesses in Germany, Liechtenstein, and Switzerland (a total of eight companies)	Limited focus on digital transformation and a lack of competencies among management board members in this area.

Table 1 – continue

Research	Method	Sample	Conclusion
Pi-Hui Chung & Cheng-Yu Lee (2024)	<ul style="list-style-type: none"> descriptive statistics correlation matrix 	Family-run publicly-traded companies from Taiwan	Family-run companies do not attach importance to digital transformation.
Bürgel & Hiebl (2024)	<ul style="list-style-type: none"> conflict theory in-depth interviews 	German family firms (85) and 13 interviews	The selected strategies can help to increase the level of digitalisation, but their effectiveness depends on the distribution of ownership shares across the different generations.

Source: author's own work.

research has primarily been conducted in German-speaking countries, with a few instances in France, Taiwan, and Italy – the latter involving a case study of a single selected company. The conclusions indicate that family-run businesses do not consider digitalisation a priority, and tend to defer it. The competencies of management board members in this area are also quite limited.

Scope of Definition

Terms related to digitalisation are understood and translated in various ways from the English sources. For this reason, the conceptual scope was refined first, and the topic is further expanded upon in the subsequent sections of the work.

The three core English terms encountered in the subject area are digitisation, digitalisation, and digital transformation. They are translated in various ways, and therefore it is essential to clarify them. In Polish dictionaries, dictionaries of foreign words and technical English-Polish dictionaries, the terms digitisation and digitalisation are often used interchangeably, which may cause conceptual confusion. For the purposes of this article, the following Polish equivalents are adopted: *ucyfrowienie*, *cyfryzacja* (*digitalizacja/dygitalizacja*), and *transformacja cyfrowa*. The first term, *ucyfrowienie* (digitise), may be translated as *to convert (something, such as data or an image) into digital form* (Merriam-Webster, n.d.). In the context of a business, to *digitise* thus means creating a digital reflection of documentation that exists in paper form, but it does not contribute to creating added value. The term *digitalizacja* (less commonly *dygitalizacja*), on the other hand, refers to *the process of rendering written and printed data into digital form as stored on magnetic or other types of media* (Dubisz, 2008, p. 278). These terms are commonly translated as synonyms, which is why the term *cyfryzacja* has been adopted as an extension of the concept *ucyfrowienie*. Table 2 provides a more detailed conceptual distinction, taking into account various parameters and illustrating examples in relation to enterprises.

Digital transformation should be understood as “a change in how a firm employs digital technologies, to develop a new digital business model that helps to create and appropriate more value for the firm” (Verhoef et al., 2021, p. 889). Digitalisation can impact existing business processes or contribute to the

development of new ones, such as the introduction of a new online customer service channel. While this may be challenging, it increases businesses' chances of achieving market success and should therefore be considered within business strategies. Digital transformation can lead not only to reshaping the business model of a company, but also the entire industry. When a company achieves success due to digital transformation, it becomes a model for others to follow.

The analysis indicates that family businesses are becoming increasingly aware of the potential of digitalisation, but they are yet to take appropriate action, and defer such measures. This thesis can also be verified using the Google Trends tool. The verification was carried out on a global scale and for Poland, using the three discussed terms in English for the worldwide research (Figure 2) and their Polish counterparts for the Polish research (Figure 3).

Globally, there is significant and increasing interest in digital transformation, while there is less interest in the remaining terms. However, in recent years in Poland, there has been scant interest in concepts such as *cyfryzacja*, *digitalizacja* and *transformacja cyfrowa* (Figure 3). In the case of *ucyfrowienie*, a message indicating insufficient data was displayed, and therefore the term has not been included in Figure 3.

The Polish part of the research reveals that interest in the discussed phenomenon is quite low, except for two periods. The increase in interest in 2004 might be attributed to the planned implementation of the Act on Computerisation of the Activities of Entities Performing Public Tasks (Journal of Laws of the Republic of Poland, 2005). The act established the State Computerisation Plan and introduced, among other things, IT standards, electronic exchange of information within public registers, and electronic communication. Therefore, in accordance with the terminology adopted in the publication, it contributed to the digitalisation of public administration activities. The second period of heightened interest in these terms likely resulted from the establishment of the Ministry of Administration and Digitalisation in 2011 (Journal of Laws of the Republic of Poland, 2011) following the transformation of the former Ministry of the Interior and Administration and the Ministry of Infrastructure. After this event, interest in the terms was and remains somewhat negligible.

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Table 2

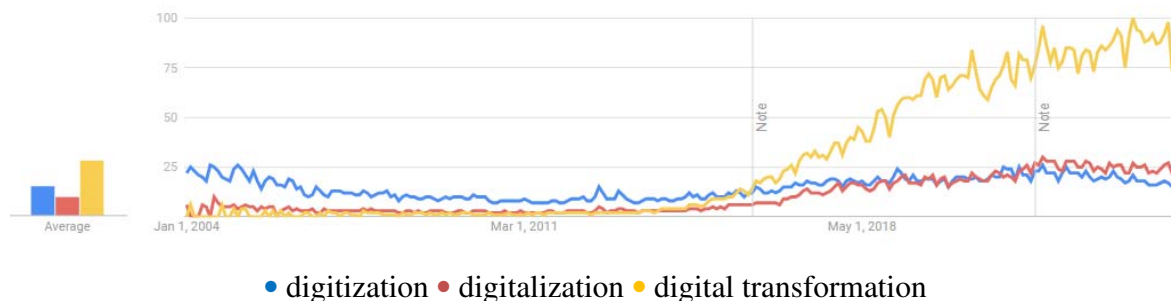
The Differences between the Concepts of ucyfrowienie, cyfryzacja and transformacja cyfrowa

Parameter	Description
DIGITISATION (UCYFROWIENIE)	
Goal	Cost savings: More efficient utilisation of resources within current operations
Digital resources	Digital assets
Organisational structure	Standard hierarchy
Metrics	Standard key performance indicators (KPIs): Cost-to-Serve, Return on Investment (ROI), Return on Assets (ROA)
Digital growth strategies	Market penetration (product-based), market development, product development
Examples	Automated procedures and tasks; conversion of information from analogue to digital form
DIGITALISATION (CYFRYZACJA)	
Goal	Cost savings and increased revenues: More efficient production through the redesign of business processes; enhanced customer experience
Digital resources	(as above) + digital agility, digital networking capability
Organisational structure	Separate, agile units
Metrics	Traditional and digital key performance indicators (KPIs): User experience, unique clients/users, active clients/users
Digital growth strategies	(as above) + platform-based market penetration, co-creation platform
Examples	Use of robots in production; adding digital components to the product or service offerings; introducing digital distribution and communication channels.
DIGITAL TRANSFORMATION (TRANSFORMACJA CYFROWA)	
Goal	New cost-revenue model: Reconfiguration of assets to develop new business models
Digital resources	(as above) + the ability to analyse big data sets
Organisational structure	Separate units with flexible organisational forms, internalization of IT and analytical functional areas
Metrics	Digital key performance indicators (KPIs): Digital share, magnitude and momentum, co-creator sentiment
Digital growth strategies	(as above) + platform diversification
Examples	The introduction of new business models such as product-as-a-service, digital platforms, and pure data-driven business models

Source: author's own work based on *Digital transformation: a multidisciplinary reflection and research agenda*, P. C. Verhoef, T. Broekhuizen, Y. Bart, A. Bhattacharya, J. Qi Dong, N. Fabian, & M. Haenlein, 2021, *Journal of Business Research*, 122, pp. 889–901 (<https://doi.org/10.1016/j.jbusres.2019.09.022>).

Figure 2

Global Term Searches: Digitization, Digitalization, Digital Transformation



Source: Google Trends.

Figure 3

Searches in Poland for the Terms: *cyfryzacja, digitalizacja and transformacja cyfrowa*



Source: Google Trends.

A Family Firm in the Face of Digital Transformation

EU Context

Implementing any changes within an organisation poses a significant challenge (Deline, 2018), especially business transformation. Typically, the process is slow (Wright et al., 2004), and most attempts end in failure (Barrett & Stephens, 2016). The European Commission has made digitalisation a priority, aiming to facilitate this process and enhance the competitiveness of businesses. EU undertakings are much less competitive than their American counterparts, thus making this task even more crucial. Polish businesses do not rank among the EU’s leaders in digitalisation, and there is also little interest in this matter, thus measures to raise overall awareness are imperative.

The European Commission considers digitalisation a priority and has set ambitious targets for businesses to achieve by 2030 (European Commission, 2021)¹:

- a) 75% of European enterprises have taken up:
 - Cloud computing services (2020 baseline: 26%)
 - Big data (2020 baseline: 14%)
 - Artificial Intelligence (AI) (2020 baseline 25%)
- b) More than 90% of European SMEs reach at least a basic level of digital intensity (2019 baseline: 60.6%)

- c) Europe will grow the pipeline of its innovative scale ups and improve their access to finance, leading to doubling the number of unicorns (2021 baseline: 122).

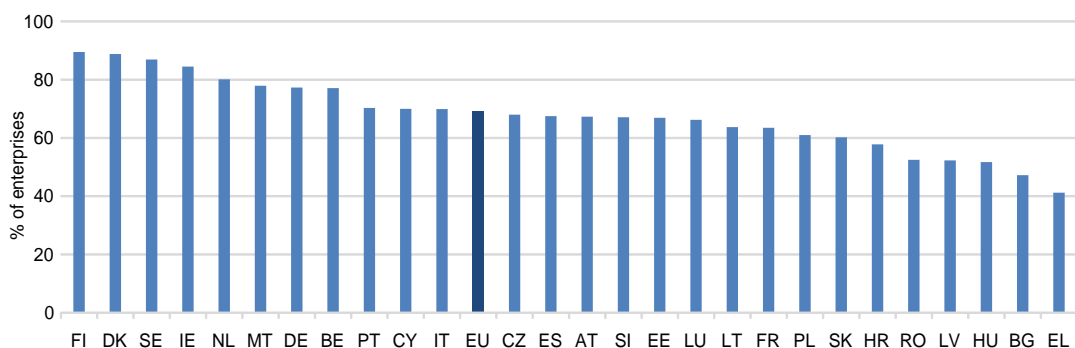
The Commission is preparing reports on the achievement of these targets, reviewing the progress made by Member States and presenting the Digital Economy and Society Index (DESI), which will be submitted to the European Parliament and the Council. According to the latest report, the greatest progress has been made in the use of cloud computing services (45% of European companies use these services), whereas the least progress has been recorded for the implementation of artificial intelligence (11%) (European Commission, 2023). By comparison, 15% of American companies and 16% of Chinese companies use artificial intelligence. A relatively high number of unicorns are being created in EU countries. The report shows that at the beginning of 2023, 249 unicorns were established in the EU, which was as much as half of the projected total, and it is highly likely that this growth rate will enable the target to be achieved by 2030.

Significant progress has been reported in the use of digital technologies within the SME sector (an average of 77%), yet there are considerable disparities between the Member States (Figure 4).

Polish SMEs are in the bottom quartile of this classification, with no distinction made between family and

Figure 4

SMEs with a Basic Level of Digital Intensity Excluding the Financial Sector, Based on 2022 Data



Source: DESI indicators, European Commission, n.d. (<https://tiny.pl/5by-05y5>).

¹ The EU’s target for 2030 in relation to the baseline level.

non-family businesses (a definition for this distinction has not yet been adopted in the European Union). However, many countries recognise the distinct nature and role that family firms play in the economy (Opinion of the European Economic and Social Committee..., 2016). Therefore, it is reasonable to analyse them in terms of digitisation.

The Family Business Perspective on Digital Transformation

The contribution of family businesses to the global economy is significant (Chua et al., 2004), as they help generate jobs and national wealth (Mallon et al., 2018; Randerson et al., 2015). They differ from non-family businesses in many contexts, including in terms of innovation and digitalisation (De Massis et al., 2013; Werner et al., 2018). The key distinction between family and other enterprises stems from the overlap of two systems: family and business (Tagiuri & Davis, 1996).

A family can have a positive or negative effect on the process of succession, ownership, and the management of a company. Researchers have begun to use various theories and concepts to understand the nature and dynamics of this effect. The most commonly applied theories for this purpose include the agency theory (Chrisman et al., 2004; Surdej & Wach, 2010), stewardship (Davis et al., 1997; Le Breton-Miller & Miller, 2009), the resource-based view (Habbershon & Williams, 1999; Pfeffer & Salancik, 1978), and socioemotional wealth (Gomez-Mejia et al., 2007). Based on the above-mentioned theories, it can be assumed that digitalisation will find fertile ground in a family business and be swiftly implemented if the principal and the agent are one and the same – the owner, or if the principal's and agent's interests align. In that case, the company will allocate appropriate resources and will strive to achieve the highest possible efficiency. However, this is merely a theoretical and idealised model depicting a family business facing digitalisation, which may not necessarily hold true in practice, as suggested by the earlier literature review.

The current literature, which is the outcome of research in this field, contains scarce information on the impact of digital technologies on the functioning of family businesses. Most often it is assumed that the older generation is less inclined to use new technologies compared to the younger generation (Calabr et al., 2019; Lambrechts et al., 2017). In some papers, it is argued that family businesses are able to adapt their operations to the needs of digitalisation (Eller et al., 2020; Leppäaho & Ritala, 2022), and that a high level of employee engagement contributes to effective implementation (Bruque & Moyano, 2007). Contrary conclusions can also be found. For example, it has been shown that a family can have a negative impact on the development of the Internet of Things within a company (Ceipek et al., 2021). However, there is still a lack of sufficient research to fully explain this (Daskalopoulos & Machek, 2023). This subject is scarcely explored in Poland, thus it is worth focusing

on it by presenting insights from research conducted by non-academic institutions, such as the European Investment Bank, the Union of Entrepreneurs and Employers, and Mastercard.

The European Investment Bank evaluated the readiness of companies for the new digital era. The study considered the criterion of being a family-run business, but in a very narrow scope – limited to the management practices employed. A study conducted across 28 countries, including Poland, suggests that digitally-oriented companies generally show a higher level of strategy monitoring and place greater emphasis on rewarding individual performance, yet they are less frequently overseen by the CEO or a family member. The opposite is true in Poland, which may imply that it is in fact family enterprises that are more focused on digitalisation. The EIB ranks Polish companies towards the bottom of the list among the countries with a moderate level of digitalisation, with one exception – they are placed above the EU average in terms of drone technology application. Moreover, over half of Polish digital firms have increased their workforce in the last three years, but salaries have risen only marginally and remain well below the EU average. There are slight differences in salaries between digital and non-digital companies, favouring the former. Enterprises point to several investment barriers, such as a lack of qualified staff, business regulations, labour laws, and taxes (EIB, 2020).

The context of business digitalisation is addressed in Mastercard research (Mastercard Europe, 2023). The latest survey was conducted among ten thousand employees from companies, primarily micro and small-sized, both family-owned and others, across fifteen countries, including Poland. It is worth starting by emphasising that family is perceived as an integral factor in the success of a business in the vast majority of cases. Half of those surveyed, who do not own or work for a family business, would consider the possibility in the future. The study highlights the advantages of family businesses, such as closer relationships between family members and with customers, and a higher degree of adaptability compared to non-family companies.

In fact, 37% of all family businesses declare readiness for operating in the digital economy, and it is similar for Poland (38%). In many sectors, these firms demonstrate a lower level of use of digital tools compared to non-family ones: family firms have a much greater preference for traditional forms of payment – by cash (45% vs 25%; 34% in Poland) or by debit/credit card (25% vs 14%; 36% in Poland). However, there are notable positive changes – there is an increase in the use of digital payments, as well as messaging applications and software for invoicing and financial management.

The digital transformation presents a greater challenge for family businesses compared to other enterprises (20% vs 12%; 17% for Polish businesses) (Mastercard, 2023). The pandemic forced them to turn to digitalisation to continue their operations. This is confirmed by the Mastercard research, which shows that more than half of family businesses use IT

tools related to project management. However, there are still many obstacles to digitalisation – primarily concerns related to security, privacy policies, and internet connectivity. Security concerns are predominantly raised by the younger generation (aged 25–44) in family firms.

The Union of Entrepreneurs and Employers conducted a survey on digitisation in the SME sector in Poland (ZPP, 2023), which shows that one in three small businesses does not use digital tools at all – this percentage is even higher among micro-enterprises (39%). Digitally-focused enterprises primarily use social media platforms and online payments (38%) – a figure similar to the Mastercard survey discussed above. The use of cloud computing services or artificial intelligence by these entities remains well below the European average. The greatest obstacle to implementing digital tools is the high cost of such operations, with legal and regulatory factors and employee skills playing a less significant role.

Insights from available research and analyses paint a picture of family businesses encountering the challenges of digital transformation. In terms of digitalisation, companies – particularly small and medium-sized enterprises – are lagging behind Europe's leaders and still favour a traditional approach to conducting business. However, they demonstrate openness to digitalisation comparable to that of non-family companies.

The process of digitalisation gained momentum during the COVID-19 pandemic. It is worth noting that the barriers hindering digitalisation are not linked to being a family business but rather result from business conditions and the regulatory environment. Conversely, for the SME sector, the biggest hurdle is the cost of implementing new technology.

Summary

Digitalisation is one of the European Commission's priorities. The moderate progress in this area indicates that it will be challenging to achieve the Commission's targets without further intensified actions and investments, despite those already undertaken, such as: The Data Act (Regulation..., 2023) and the Data Governance Act (Regulation..., 2022).

There are few studies and analyses addressing issues related to the digitalisation of family businesses. The operational characteristics of family businesses are different to those of non-family enterprises, which is why the digitalisation context should interest researchers in the field. Researchers, in turn, need to determine whether a separate support policy is needed for such entities.

A systematic literature review shows that the topic of digitalisation in family businesses is addressed in only a few articles. Unfortunately, they reveal that digitalisation is not considered a priority within these companies, and decisions are often deferred. There is also a lack of competence among the family members in charge to undertake such a transformation.

The Mastercard survey is one of the few (non-scientific) reports that highlights family businesses in the context of digitalisation. It reveals that one in five Polish family businesses is unable to identify which digital tools would most effectively support their business operations. A certain group of respondents (40%) believe that possessing the skills to use digital tools would enable them to implement a more effective digital transformation, but one in five is unable to select the appropriate ones.

Despite the challenges associated with digitalisation, positive trends are noticeable, as both family-run and other businesses are making progress in the implementation of digital tools. However, as demonstrated by the Mastercard study, in Bulgaria, Spain, Portugal, and Serbia non-family businesses are best prepared to face these challenges.

Polish family businesses declare the following digitalisation-related actions envisaged over the next year: (1) greater use of social media (35%), starting to accept digital payment (32%), starting to accept electronic payment (21%), launching online sales (19%), and participating in the online market (17%). These actions are generally aimed at supporting business operations.

Opting for digitisation brings other benefits to companies. It turns out that those that have digitalised their operations have increased their workforce over the past three years, whereas others either decreased or maintained the same level of staff. Moreover, such companies are better managed, invest more in research and development, and are more productive.

Daskalopoulos and Machek (2023) assert that digital transformation has contributed to the emergence of hybrid family businesses, that is those which, on the one hand, are aware of the new era and inclined to embrace transformation, yet on the other hand remain respectful of traditions and somewhat conservative. In their work, they highlight that it is difficult to definitively assess these entities due to insufficient research and the heterogeneity of this population of companies. Such research is also lacking in Poland.

However, there is substantial potential for further digitalisation of enterprises. To achieve this, technical actions (such as enhancing online security), financial initiatives (financial support primarily for small and medium-sized enterprises), and regulatory measures are necessary. It is also useful to improve employees' digital competencies. In addition, researchers should address this subject more frequently. The present article may serve as a contribution to the research and analysis in the field of digitalisation of family businesses.

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Jacek Lipiec is a professor at the SGH Warsaw School of Economics. He specialises in the issues of family entrepreneurship, particularly in the context of family governance, environmental protection, and digitalisation.

WE RECOMMEND

George F. Luger, *Artificial Intelligence: Principles and Practice*

This book provides a complete introduction to Artificial Intelligence, covering foundational computational technologies, mathematical principles, philosophical considerations, and engineering disciplines essential for understanding AI. *Artificial Intelligence: Principles and Practice* emphasizes the interdisciplinary nature of AI, integrating insights from psychology, mathematics, neuroscience, and more. The book addresses limitations, ethical issues, and the future promise of AI, emphasizing the importance of ethical considerations in integrating AI into modern society. With a modular design, it offers flexibility for instructors and students to focus on specific components of AI, while also providing a holistic view of the field. Taking a comprehensive but concise perspective on the major elements of the field; from historical background to design practices, ethical issues and more, *Artificial Intelligence: Principles and Practice* provides the foundations needed for undergraduate or graduate-level courses. The important design paradigms and approaches to AI are explained in a clear, easy-to-understand manner so that readers will be able to master the algorithms, processes, and methods described. The principal intellectual and ethical foundations for creating artificially intelligent artifacts are presented in Parts I and VIII. Part I offers the philosophical, mathematical, and engineering basis for our current AI practice. Part VIII presents ethical concerns for the development and use of AI. Part VIII also discusses fundamental limiting factors in the development of AI technology as well as hints at AI's promising future. We recommended that PART I be used to introduce the AI discipline and that Part VIII be discussed after the AI practice materials. Parts II through VII present the three main paradigms of current AI practice: the symbol-based, the neural network or connectionist, and the probabilistic. Generous use of examples throughout helps illustrate the concepts, and separate end-of-chapter exercises are included. Teaching resources include a solutions manual for the exercises, PowerPoint presentation, and implementations for the algorithms in the book.

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Ilona
Lipowska

Effects of the Reference Price in the Context of the Extended Information Obligation under the Omnibus Directive – Seller’s Perspective

Abstract

This article aims to describe the impact of the information obligation provided for in the Omnibus Directive on how sellers provide information concerning prices. The theoretical objective is to expand the terminology related to the concept of the reference price. The reference price effects are assessed from the seller’s perspective, who has a real influence on the price level communicated to consumers.

This article is a theoretical study based on the issue of the reference price, derived from the field of behavioural economics. The main part of this article introduces an original proposal for expanding the terminology regarding the concept of the reference price—specifically, the introduction of a *primary* and *secondary* reference price. Additionally, three reference price effect scenarios (positive, negative, and neutral) are presented, occurring depending on the bilateral relationship between the promotional price, the mandatory omnibus price, and the voluntary regular price. Sellers are undoubtedly aware of the significance of the reference price in shaping a positive perception of prices and recognise the significant limitations arising from the implementation of the Omnibus Directive into national legislation in this regard. The extension of the information obligation when announcing price reductions has generated new reference prices communicated to customers. To achieve the guaranteed positive reference price effect, two reference prices (*primary* and *secondary*) are sometimes used.

Keywords: reference price, price communication, primary and secondary reference price, price promotions, Omnibus Directive

Introduction

As of 1 January, 2023, new regulations under the Omnibus Directive (European Parliament, 2019) came into force in Poland, strengthening consumer protection. The Omnibus Directive imposes a legal obligation on businesses to state the lowest price applied over the 30-day period prior to a price reduction when announcing a reduced (promotional) price. The Omnibus Directive amends four consumer protection directives, one of which is Directive 98/6/EC on consumer protection in the indication of the prices of products offered to consumers (European Parliament, 1998; EY Polska, 2022). These legislative changes are part of the *New Deal for Consumers*—an initiative aimed at strengthening EU consumer protection laws and modernising EU consumer protection regulations in response to market developments. The initiative was adopted by the European Commission on 11 April, 2018 (European Parliament, 2018).

These legislative developments reflect an effort to adapt existing rules to market conditions and the ongoing digitisation of the economy (EY Polska, 2022). The implementation of the directive into national law has resulted in new information obligations for businesses, and compliance with these obligations serves as confirmation of a given entity’s adherence to the law. Breach of the obligations resulting from implementa-

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tion of the directive into national law may lead to companies being fined. Under the Omnibus Directive, Article 8b(1) was added to Directive 93/13/EEC (European Parliament, 2019), stating that the penalties for infringements of national provisions implementing the directive, as adopted by Member States, must be effective, proportionate, and dissuasive.

One of the key changes under the Omnibus Directive concerns the requirement for transparent price reduction information – sellers are now required to state the price of the product previously applied for a specified period¹ when announcing a reduced (promotional) price. Under the Omnibus Directive, Article 6a(2) of Directive 98/6/EC clarifies that the “prior price means the lowest price applied by the trader during a period of time not shorter than 30 days prior to the application of the price reduction” (European Parliament, 2019).

The Omnibus Directive entered into force on 7 January, 2020. EU Member States were required to adopt the necessary implementing provisions by 28 November, 2021, and the implemented provisions, in accordance with the directive, were to be applied from 28 May, 2022. In Poland, as in several other Member States, the implementation of the directive was delayed (Czeladzka, 2022). Polish law was harmonised with the Omnibus Directive through an amendment to the Act on Price Information for Goods and Services (2014). Article 4(2) was revised to state: “Whenever a price reduction is announced for a product or service, alongside the information on the reduced price, information must also be displayed about the lowest price of that product or service that applied during the 30-day period prior to the reduction” (Act..., 2014). Furthermore, the amount of financial penalties for non-compliance with obligations under the directive is regulated by Article 6 of this act. Alongside the amendment to the act, the Regulation of the Minister of Development and Technology of 19 December, 2022 on the Display of Prices of Goods and Services (Journal of Laws of 2022, item 2776) entered into force on 1 January, 2023. This regulation includes, among other things, the obligation to display, alongside the price and unit price, information about the reduced price of a product or service (Regulation..., 2022).

Undoubtedly, the legislative changes were prompted by numerous unfair market practices. With regard to price communication, this involved artificially inflating prices to subsequently introduce vast discounts. This was a mechanism by which the regular price of PLN X would be increased to X+1 a few days before the ‘promotion’ so that on the day of the sale the

‘promotional price’ could be announced as PLN X. Such practices were successful due to consumers’ limited knowledge of prices – who had less knowledge than they believed (Kenning et al., 2007, p. 112; Loj et al., 2020; Mägi & Julander, 2005; Vanhuele & Drèze 2002; Vanhuele et al., 2006, p. 164). Early studies conducted by Zeithaml (1988) found that consumers’ knowledge of prices was significantly lower than necessary for them to have a precisely defined internal reference price for many products. It can be assumed that the 30 days defined in the Omnibus Directive was aimed precisely at eliminating such practices, which tend to intensify particularly when consumer shopping activity increases, on Black Friday, before Valentine’s Day, or during the holiday seasons².

This article aims to describe the effect of the information obligation under the Omnibus Directive on price communication by sellers. The theoretical objective is to expand the terminology related to the concept of the reference price. The nature of the reference price effects is assessed from the seller’s perspective, who has a real influence on the price level communicated to consumers. The nature of the reference price effect about shaping consumer behaviour has already been described in the literature (e.g., Martín-Herrán & Sigué, 2023), but the legal regulations resulting from the Directive on consumer protection on the indication of the prices of products offered to consumers (which is part of the Omnibus Directive) have led to renewed interest in the reference price.

This article adopts the seller’s perspective—when discussing the nature of the reference price effect (positive, negative, or neutral), the author refers to intangible benefits. A seller’s benefits may take an intangible (image-related) form and a tangible (financial) form—the first type may be obtained by skillfully managing the reference price(s), which ultimately may lead to achieving financial benefits of the second type. The reference in this article to benefits for the seller means the positive perception of price, thus shaping the perceived attractiveness of the price (Niedrich et al., 2001, p. 340). Price perception (evaluation of a price as high/unattractive or low/attractive) is the result of a comparison between the current price and the reference price (Oh, 2003, p. 387) and constitutes an important element of the overall price image of the retailer (store) (Hamilton & Chernev, 2013, p. 4). The price image of the retailer significantly determines consumers’ purchasing decisions, including the choice of retailer (store) (Srivastava & Lurie, 2001). Over the years, researchers have determined that price perception has a positive impact on consumer satisfaction

¹ For ease of reading, any reference to *the directive* is a reference to the Omnibus Directive, while the lowest price applied over the 30-day period preceding the price reduction is referred to in this article as the *omnibus price*.

² In a statement, the President of UOKiK (2023) remarked: “Price transparency in the case of promotions provides consumers with a real reference point when making purchasing decisions. With clear and reliable information about the price, unit price, and the lowest price over the last 30 days, consumers will know whether the offer from a given business is truly advantageous. Consumers, knowing the lowest price over the 30-day period, will no longer be misled by false discounts resulting solely from unfair business practices”.

(Voss et al., 1998) and that price perception is of even greater importance than product quality (Varki & Colgate, 2001, p. 233). Srikanjanarak et al. (2009, p. 79) emphasised both the indirect and direct impact of satisfaction resulting from price perception on customers' decision-making. Price perception is equally a subject of psychology as it is of economics (Bolton et al., 2010, p. 564).

The first part of this article addresses the nature of the reference price and its relationship with price reduction communication. Next, the author makes a proposal for expanding the terminology related to the reference price, and the reference price effect scenarios that occur depending on the relationship between the promotional price, the mandatory Omnibus Price, and the voluntary regular price. In the final part, conclusions regarding the intended and unintended consequences of harmonising national laws with the Omnibus Directive guidelines are formulated. The author's envisaged contribution of the article to the development of the discipline of management and quality sciences is the expansion of terminology related to the reference price and the update of the reference price concept in the context of current regulations, by identifying changes in price communication processes.

The Role of the Reference Price in Communicating Price Promotions

An important area of research on price as a marketing tool is the behavioural reaction of buyers to price (Kalyanaram & Winer, 2022, p. 46). Periodic discounts are one way to shape consumers' positive attitudes toward a promoted offer by presenting them with an attractive price. Price promotions are a very popular form of sales promotion, consisting of short-term actions aimed at improving the perceived value of a promoted product to achieve relatively quick sales effects (Spyra, 2013). Sales promotion can take the form of price promotions and non-price promotions (Kwiecińska et al., 2014). A key characteristic that distinguishes it from other tools of market communication is the short duration of attractive purchase conditions (increased perceived value of the offer), intended to encourage consumers to make a purchasing decision. This promotional tool has a *call-to-action* nature, as it provides an incentive (call) that triggers a customer response (action) (Vafainia et al., 2019, p. 64). Unlike permanent price reductions, price promotions, as defined by the regulatory changes discussed in this article, are now subject to a new information obligation—that is, the requirement to state the lowest price within the last 30 days before the reduction, which serves as the reference price.

The concept of the reference price has a long history of application in marketing and consumer behaviour studies (Elshiewy & Peschel, 2022, p. 496). The existence of the reference price has been theoretically confirmed, primarily within the Adaptation Level Theory (Helson, 1964) and Prospect Theory

(Kahneman & Tversky, 1979). The Mental Accounting Theory (Thaler, 1985) is also frequently referenced in this context. Behavioural economics literature highlights the usefulness of the reference price in buyers' decision-making (Anton et al., 2023, p. 104). According to Kahneman (2011, p. 373), a reference point is a prior state against which gains and losses are evaluated. In turn, the reference price is the price against which consumers compare the price of the product they are currently considering purchasing (Monroe, 1990). It represents a price standard shaped by previous price exposures (Monroe, 1973). Thaler (2018, p. 86) explained the concept of the reference price in the context of *transaction utility*, which reflects the consumer's perception of an offer's attractiveness. He defined *transaction utility* as the difference between the actual price paid and the reference price. Therefore, if the price of a given product is lower than the reference point, consumers perceive a gain, which encourages them to make a purchase. Conversely, if the product price is higher than the reference point, consumers perceive a loss, which discourages them from making a purchase (Anton et al., 2023; Lin, 2016).

Numerous academic studies have attempted to operationalise the concept of the reference price (Bolton et al., 2003; Bondos & Lipowski, 2022; Jacobson & Obermiller, 1990; Liu & Popkowski Leszczyc, 2023; Lowengart, 2002; Mazumdar et al., 2005; Mezas et al., 2002; Moon et al., 2006). However, this does not alter its role in price acceptance processes—that is, moderating consumer reactions to price (Rajendran, 2009) and, more broadly, influencing purchase intent, brand choice, the likelihood of product search, and price-related perceptions (Jindal, 2022). In the context of the information obligation introduced in the directive, the omnibus price serves as an external reference price, which is distinct from the internal reference price (Oest, 2013). The external reference price is shaped by market observations (e.g., prices seen in stores or online), whereas the internal reference price is based on prices remembered by consumers from previous shopping experiences and their internal beliefs about fair pricing (Wu et al., 2012).

An important factor determining the effectiveness of price communication is the decoding stage, in which a potential customer processes the price information conveyed to them. At this stage, the recipient must interpret the presented price in a way that aligns as closely as possible with the perception the sender intends to achieve (Bondos, 2014, p. 340). The core purpose of the reference price is to shape a positive perception of the product's price, and as such, it is typically presented as higher than the current price. No rational seller would voluntarily disclose that a previous price (recently in effect) was lower than the current price. However, under the Omnibus Directive, which has been transposed into national law, this reference price (i.e., the lowest price in the last 30 days) must always be stated, regardless of its relation to the current product price. As a result, in some cases, a negative reference price effect is created—the

current price after the reduction is higher than the lowest price recorded in the last 30 days. This effect is one of the intended goals behind the drafting of the Omnibus Directive—it represents greater transparency in communication with customers. The reference price is intended to facilitate the decision-making process (Qin & Liu, 2022).

Expansion of Terminology Related to the Reference Price

In an effort to mitigate the negative reference price effect resulting from regulatory changes following the implementation of the Omnibus Directive, retailers are expanding price communication strategies by introducing an additional (second) reference price. According to the author, since there are now two reference prices, it is advisable to distinguish between them by expanding the applied terminology. The author proposes using the terms *primary* and *secondary* reference price. The term *primary* reference price is used to mean the lowest price in the 30-day period preceding the price reduction, while the *secondary* reference price is the regular price before the discount. The second reference price corresponds to the product price before the discount period, i.e., the price that applied outside of discount periods, regardless of the duration of the price reduction. Due to its secondary role in the process of communicating price attractiveness, the author refers to it as the *secondary* reference price, in contrast to the *primary* reference price, which is the lowest price recorded in the 30-day period before the discount. The use of the adjectives *primary* and *secondary* also aligns with the legal obligation of price disclosure³ – the primary reference price is mandatory, whereas the secondary reference price is optional. From the seller’s perspective, the secondary reference

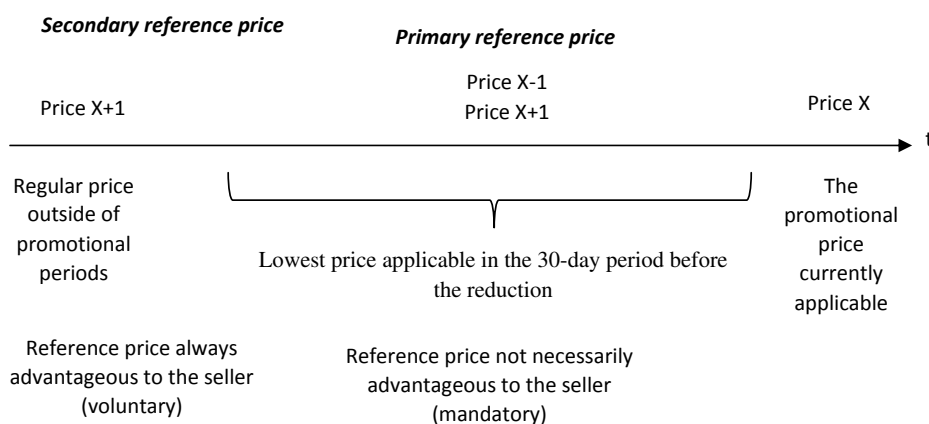
price is intended to shape a positive perception of the current (reduced) product price: the price today is X (e.g., PLN 59.90); although the lowest available price in the last 30 days was X-1 (PLN 29.90), the regular price before the discount period was X+1 (e.g., PLN 79.90). The concept of *primary* and *secondary* reference prices in the price communication process over time is illustrated in figure 1.

Regular Price vs Promotional Price vs Omnibus Price – Reference Price Effect Scenarios

The nature of the three reference price effect scenarios, from the seller’s perspective, is described in figure 2. Scenario (a) occurs when the current promotional price is lower than the legally required price (the omnibus price, i.e., the lowest price applied within the 30-day period preceding the reduction). In this case, the effect of the reference price is positive because the comparison between the current promotional price and the Omnibus Price favours the former. In such a situation, there is no need to additionally present the secondary reference price, as the positive effect has already been achieved through the primary reference price. However, the current price is not always genuinely promotional in the long term, meaning that within the last 30 days, the price of the analysed product could have been even lower.

Scenario (b) occurs when the current promotional price is higher than the omnibus price. In this scenario, the reference price effect is negative (the comparison between the current promotional price and the Omnibus Price works to the disadvantage of the former). To mitigate this negative effect, the seller supplements the price communication with an additional (third)

Figure 1
Secondary and Primary Reference Price Diagram



Source: author’s own work.

³ This obligation is provided for in the Directive on consumer protection in the indication of the prices of products offered to consumers indicated in the introduction to this article as part of the Omnibus Directive.

price—the regular price that applies outside of promotional periods (the *secondary* reference price). The objective is to create a positive reference price effect, where the comparison between the current promotional price and the price outside promotional periods favours the former. In some cases, achieving a positive reference price effect requires the voluntary presentation of a third price, i.e., the regular price outside promotional periods. Importantly, the Omnibus Directive does not apply to this price, meaning that the information about this price does not include information about a specific timeframe during which it was valid. In practice, this means that sellers can communicate this secondary reference price, which may have been in effect several weeks or even months beforehand. Since the regulations do not make this information mandatory, they also do not require the precise period when the regular price was in effect to be specified.

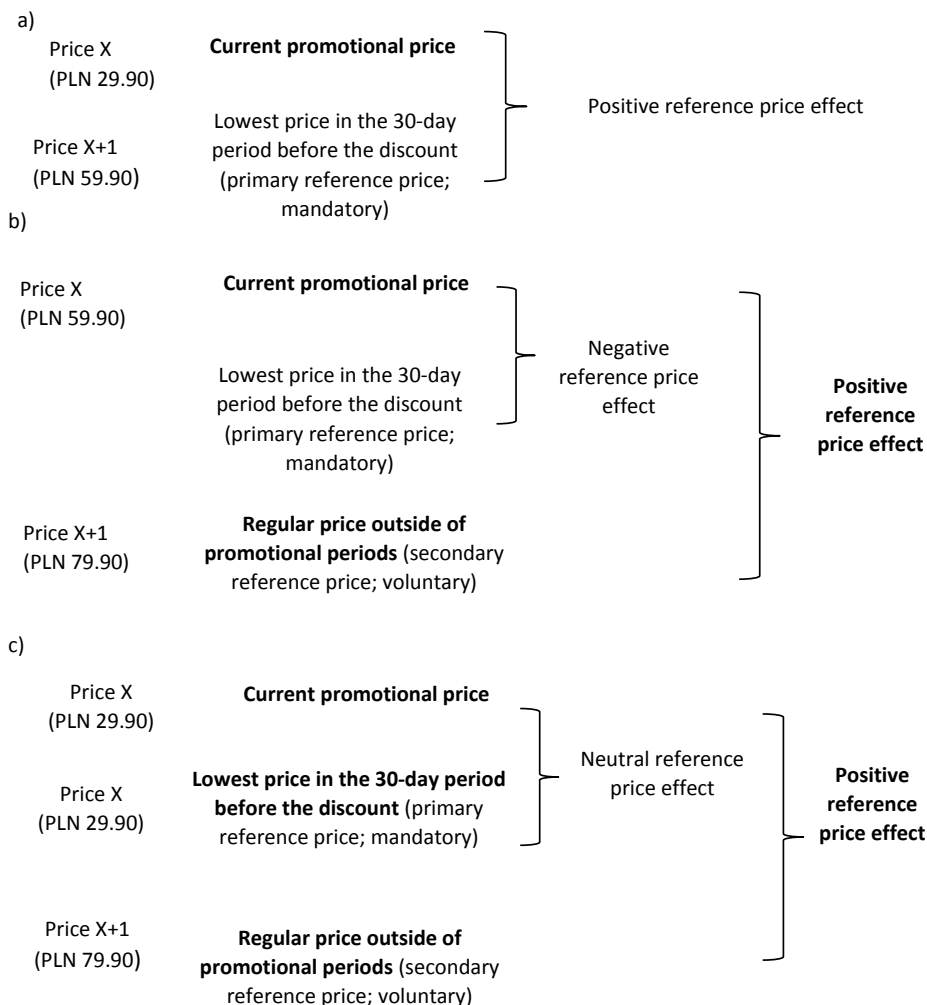
In the market, there is also a third possibility (figure 2, scenario c), which assumes that the reference price effect between the current promotional price

and the lowest price in the last 30 days is neutral. In this case, the primary reference price does not ensure the desired positive reference price effect. To achieve this effect, sellers additionally state the secondary reference price—the regular price outside the promotional period. In such a situation, the secondary reference price is indispensable for creating a positive comparison effect.

A summary is provided, organising the scenarios described in figure 2 according to the criterion of benefits for the seller in shaping the price attractiveness of the offer, assuming that both the mandatory reference price (the *primary* reference price) and the voluntary reference price (the *secondary* reference price) are used (table 1).

Another common practice for shaping the positive perception of a product's current price is the communication by the retailer (intermediary) of the *suggested* price, understood as the price recommended by the manufacturer—a neutral suggestion regarding the price level, without imposing a specific price level.

Figure 2
Positive, Negative, and Neutral Reference Price Effect – Seller's Perspective



Source: author's own work.

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Table 1

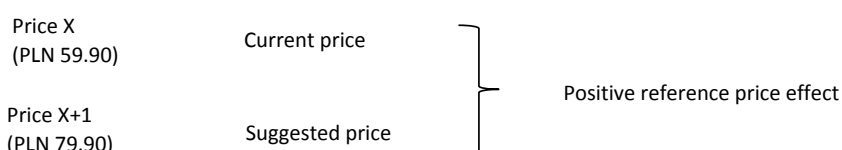
Summary and Evaluation of Possible Reference Price Effects – Seller’s Perspective

Scenario (as in Figure 2)	Reference Price Effect Depending on the Type of Reference Price	Evaluation of the Effect from the Seller’s Perspective
a)	Reference price effect for the <i>primary</i> reference price only	positive
b)	Reference price effect for the <i>primary</i> reference price	negative
	Reference price effect for the <i>secondary</i> reference price	positive
c)	Reference price effect for the <i>primary</i> reference price	neutral
	Reference price effect for the <i>secondary</i> reference price	positive

Source: author’s own work.

Figure 3

Positive Reference Price Effect if the Suggested Price is Communicated



Source: author’s own work.

The seller must be guaranteed freedom in setting prices—they may, but are not obliged to, follow the manufacturer’s suggestion. In the process of market communication, the suggested price plays an extremely important role in shaping the positive perception of the current offer. The suggested price acts as a reference price for the current price (figure 3). If the seller does not present the product price as promotional, there is no obligation to disclose the lowest level in the last 30 days, and indicating the suggested price makes the offer more attractive. The suggested price is an example of the *advertised reference price* (ARP), in contrast to the *unadvertised reference prices* (Jensen et al., 2003; Jindal, 2022).

What is important is that the suggested price can be used in the process of shaping the price attractiveness of an offer independently of the Omnibus Directive implemented into national legislation, as the directive applies specifically to the communication of price promotions. The suggested price generates a positive reference price effect without the need to reduce the current price. Thus, the current price, not being a promotional price, does not need to be accompanied by information about the Omnibus Price (thereby eliminating the risk of a negative reference price effect) and can instead be accompanied by the suggested price, which ensures a positive reference price effect.

Summary

In the initial weeks following the implementation of the new regulations under the Omnibus Directive, the Office of Competition and Consumer Protection (UOKiK) conducted inspections and identified numerous irregularities in the communication of the *omnibus price* during price promotions (UOKiK, 2023).

Importantly, most of the errors were related to the nature of the reference price—the goal of improper (unclear) communication of the promotional price was to minimise the negative comparison effect. Understanding this effect is crucial for the effective shaping of positive price perception. Sellers are undoubtedly aware of the importance of the reference price in shaping positive price perception and, since January 2023, have recognised significant limitations under the Omnibus Directive in this regard.

However, as market practice demonstrates, sellers are striving to eliminate the negative reference price effect associated with the primary reference price by shaping a positive effect using the secondary reference price. Thus, the intended outcome for sellers is a positive reference price effect—achieved either in a two-price system (promotional and omnibus prices) or only in a three-price system (in which the regular price is included). In this context, a topic worthy of further exploration would be determining the differences in the influence of the various coexisting reference price effects.

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Ilona Lipowska works at the Department of Information Systems and Logistics, Institute of Management and Quality Sciences, Faculty of Economics at Maria Curie-Skłodowska University (UMCS). Her scientific and research interests include price management and multichannel sales. Her academic publications focus on these areas. She obtained her habilitation degree in social sciences in the discipline of management and quality sciences in 2023 at UMCS, based on research on the impact of channel-based price differentiation on consumers' choice of purchasing channels. She earned her PhD in economics in 2015, also at UMCS. She is a recipient of the Scholarship of the Minister of Science and Higher Education for Outstanding Young Scientists and a member of the Polish Scientific Marketing Society.

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Piotr
Popęda

The Inherent Relationship between Knowledge, Communication, and Organisational Silos: A Review of Counteracting Silos

Abstract

The author's motivation for undertaking research to address the problem of organisational siloing stems from the impact this problem has, namely the detrimental effect on organisational performance and the tangible threat to the achievement of performance objectives. Therefore, the primary aim of this article is to review strategies for counteracting silos using knowledge and through communication within organisations. The secondary objective is to identify silos in the context of organisational deficiencies in communication and knowledge across two dimensions: diagnosing silos and assessing their causes and conditions. The research methodology is based on a thematic literature review, and drawing the most relevant scientific conclusions. The most valuable contribution of this work is the identification of strategies, including actions, tools, and mechanisms to prevent or minimise the effect of silos and organisational siloing. Additionally, this work highlights the numerous links between siloing, knowledge, and communication.

Keywords: organisational silos, organisational silo, knowledge, communication, strategies

Introduction

Organisational siloing is a significant issue that appears both in academic literature and in business practice, exerting a multidimensional impact on organisations. It is closely linked to the concept of a *silo* which refers to a storage container used for drying and storing grain or other agricultural or construction materials (PWN, n.d.). Regardless of their contents, the key characteristic of silos is that they are tightly sealed and isolated from one another, and it is due to this feature that the term *silos* is used in management studies to refer to distinct, closed organisational structures. The term *siloing* denotes the tendency to create them. The key issues the author associates with siloing—both of which are crucial for internal organisational processes—are communication and knowledge. The former is increasingly recognised as an essential aspect of modern organisations, while the latter is the foundation [of an organisation] and is undeniably linked to it. In a sense, *knowledge* represents substantive content that can be transferred between different structures within an organisation, whereas *communication* ensures that it reaches all parts of the company and even its external environment. These processes are affected by siloing, which—as demonstrated in the following sections of this article—is unequivocally identified as a barrier that hinders efficient communication and the effective accumulation, dissemination, and impact of knowledge.

The main objective of this article is to review strategies that by increasing knowledge or improving communication, can prevent the formation of silos or mitigate the detrimental effect they have on an organisation. The secondary aim of this study is to explore the relationship between siloing, knowledge, and communication by addressing the following questions: why do deficiencies in knowledge and communication contribute to the emergence of silos, and what are the causes and conditions of silo formation in the context of knowledge and communication?

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The topic addressed in this article is important, as counteracting the emergence of silos is believed to help organisations become more efficient and effective while minimising the widespread tendency to create organisational silos. This article is a review study. The primary research tool used is a literature review based on academic databases such as Scopus, Web of Science, Library of Science, and BazEkon, supplemented with the author's commentary derived from academic sources.

Research Methodology

The research approach and procedure were based on a standard literature review, performed in the following steps: identifying research gaps and objectives, searching for and collecting scientific data from electronic databases, assessing the relevance of the data in terms of scientific value and its relation to the research topic, conducting a qualitative data analysis, presenting the results, and identifying areas for further scientific exploration (Zdonek et al., 2016) due to the thematic breadth of the studied issue.

To achieve the objectives of this article, a review was conducted across two international databases: Scopus (Elsevier) and Web of Science (Clarivate Analytics) and two national databases: Library of Science and BazEkon. The selected international databases are some of the most scientifically important publication repositories, of proven validity for academic research (Wang & Waltman, 2016). The choice of national databases, on the other hand, was motivated by the desire to supplement the study with Polish language sources: Library of Science is the largest scientific database in Poland, while BazEkon is a valuable source of specialised publications on management and quality sciences. The research was conducted on 5 January, 2024 (international databases) and 22 July, 2024 (national databases). The international databases were reviewed in relation to the primary and secondary research objectives, whereas the national databases were examined with regard to the primary research objective.

As part of the research procedure, several trial searches were conducted within each database to determine the most effective search strategies, retrieve academic texts strictly related to the research topic, and simultaneously limit the results to documents of academic value and research relevance. Since the initial search attempts did not yield satisfactory results (as the retrieved information lacked conceptual coherence), a final literature review was conducted using the following contextual search fields and operators:

- 'article title, abstract, keyword' in Scopus (operator: *organisational silos AND knowledge OR communication*),
- 'topic' in Web of Science (operator: *organisational silos AND knowledge OR communication*),
- 'szukane słowa' [searched words] in Library of Science (operators: *silosowość* [siloining] and *silosy organizacyjne* [organisational silos]),

- 'temat' [topic] in BazEkon (operator: *silosy* [silos]).

To further refine the research procedure and extract relevant and closely related studies, thematic filters were applied: *Business, management and accounting, Social sciences, Psychology, and Arts and humanities* for Scopus, and *Management and Business* for Web of Science.

As a result of the database searches, 29 records were retrieved from Scopus, two from Web of Science, 12 from Library of Science, and three from BazEkon. Given the small number of results, no additional filtering was applied. A critical analysis of the texts was carried out, including a detailed review of abstracts, followed by a thorough reading of selected academic papers, which were analysed to extract key scientific conclusions. Additionally, to enrich the research material, selected bibliographic sources from the retrieved academic texts were also analysed, particularly those that were highly interesting from an academic standpoint and could contribute valuable insights. The document analysis primarily aimed to extract data or information that identified tools and strategies for counteracting siloing tendencies and to examine the cause-and-effect relationships between siloing, knowledge, and communication based on prior research and academic expertise.

Interestingly, Polish researchers had a relatively significant output in terms of strategies for counteracting silos compared to international scholars. Ultimately, 14 of the analysed publications were used to achieve the primary research objective, while 21 publications were utilised to address the secondary research objectives. Furthermore, to systematically present information on anti-siloing strategies and fulfil all of the aspects of the primary research objective, these strategies were compiled into a table. The remaining records were also examined for their scientific value; while they helped to gain a broader understanding of siloing, they were not included in the final study. This was due to either insufficient relevance to the topic or making no significant scientific contribution. From the overall analysis of the scientific material, two research questions were formulated as a methodological supplement to the study.

Diagnosis of Organisational Siloing

To identify the research gap concerning silo mentality in the context of knowledge and communication, one must first comprehend not only the phenomenon itself but also its broad cause-and-effect relationships with knowledge and communication. Although each of these concepts has been adequately defined, in the literature there are no comprehensive studies and analyses that integrate them and explain the reciprocal effects. This gap leads to the first research question: What are the relationships between organisational siloing, knowledge, and communication?

Moving to the fundamental characteristics of organisational siloing, a *silo* is an isolated unit within an

organisation—whether a department or a team—that operates individually and independently from the rest of the company (Cilliers & Greyvenstein, 2012). It is the end result of the siloing process, creating an enclosed, more or less isolated organisational space for knowledge, typically with limited or difficult external communication. Siloing, in turn, is the tendency to isolate different parts of an organisation—departments, units, and individuals—due to separate goals, communication barriers, or other differentiating factors, ultimately leading to the formation of silos.

The concepts of knowledge and communication are inherently linked to human activity. This is because knowledge is created by individuals. However, organisations play a crucial role by supporting these individuals and fostering an environment in which knowledge and communication can be developed as effectively as possible (Nonaka & Takeuchi, 1995). Knowledge-sharing and effective communication depend on the integration and combination of diverse knowledge states among people (Te'eni, 2006). Knowledge deficits arising from siloing stem from an unwillingness—whether intentional or not—of organisation members to share knowledge with others within the same organisational structure via communication processes (Mohapeloa, 2017). The concept of *knowledge* is a broad one, encompassing truths and beliefs, perspectives and concepts, judgements and expectations, methodologies and know-how (Wiig, 2004). Communication, on the other hand, serves as a vehicle for knowledge, allowing it to move between recipients, both within and beyond an organisation.

Silos, as a complex concept, can be categorised based on functional properties (Ludwig, 2017) or structural properties (Abernathy, 2008). From a functional perspective, silos do not have the coordination that is not only sufficient but necessary for the behaviours of agents in functional areas or departments to interconnect within the organisation (i.e., be interdependent). Another variation of functional siloing is the existence of silo barriers, which obstruct not only coordination and information flow but also collective behaviour within an organisation. According to this view, organisational silos are perceived as structures that hinder employee productivity because the structure itself requires reorganisation. This interpretation of siloing is typical of the Weberian model of administration, which is now considered outdated.

Siloing is a tendency against which preventative measures should be taken whenever possible, as scientific research has shown that it leads to poor organisational performance (Henman, 2020). For modern enterprises, it seems necessary not only to counteract siloing but also to support knowledge creation and dissemination through communication. In an era of persistent uncertainty and volatility in business environments, internal and external collaboration has become a fundamental competency and a factor in achieving a sustainable competitive advantage (Nordin et al., 2020). In organisations, silos signify restrictions on communication and information exchange. More

precisely, organisational silos have been recognised as barriers to open communication and information flow, with negative consequences such as the separation of employees, which poses a challenge for small and large businesses alike (Sessoms, 2021).

In the real economy, a practical example of systematised, scientifically studied organisational siloing can be found in the medical sector, particularly among healthcare service providers and their organisational structures. Through specialised knowledge, the configuration of organisational structures, time pressures, and specific competitive forces, it creates organisational barriers and obstacles. Furthermore, the sense of isolation among individual actors can be exacerbated by the use of specialised terminology (Zipperer & Williams, 2014). In fact, siloing occurs in all organisations that follow functional structures, which still include many entities in the public sector.

The author argues that siloing is closely linked to both knowledge and communication. This relationship stems from the fact that siloing is inherently a source of problems in communication and knowledge transfer. From another perspective, communication serves as a mobilising force for knowledge. If the knowledge accumulated in silos is not particularly extensive but is freely shared beyond the silos in which it was created (i.e., different organisational structures), it is difficult to definitively confirm the presence of organisational siloing. Conversely, even if silos contain a significant amount of valuable knowledge, without proper communication, this knowledge remains trapped within them, to the detriment of the entire organisation, while this exacerbates siloing tendencies. Communication deficiencies are particularly damaging in this scenario, but to stimulate and improve communication, the right knowledge is required, including appropriate strategies for action.

Causes and Determinants of Organisational Siloing

There are numerous causes of organisational siloing, ranging from poor leadership to enduring traditional functional structures. However, the aim of this article is to identify the specific causes of silo formation that are directly linked to the processes of knowledge accumulation, dissemination, and communication. Scientific sources indicate that the most fertile ground for silo formation is the lack, meaning at best the inability or insufficient capacity, and at worst, the lack of motivation, to share knowledge, especially beyond competency-based groups such as project teams (Aaker, 2008; Lessard & Zaheer, 1996). Problems related to knowledge dissemination and sharing increase in proportion to the growing specialisation in various industries and sectors (Hadi et al., 2022). This issue aligns closely with the definition of *siloing*, which revolves around obstacles to the flow of knowledge between different segments and levels within an organisation.

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A functionalist, bureaucratic perspective in the literature suggests that siloing results from inadequate or insufficient communication. According to this view, desirable organisational changes should focus on the members and levels of an organisation responsible for communication. However, this opinion has been losing support among scholars. Contemporary research indicates that achieving organisational success and increasing organisational value requires a holistic transformation—not just in communication but across the entire organisation, ensuring that communication occurs effectively across multiple levels (Dimitrov, 2014). Consequently, a successful enterprise is one that fosters smooth communication between its various structures and divisions.

Another significant factor contributing to silo formation is specialist knowledge, which is a unique and valuable organisational resource that enables a company to function and achieve its objectives efficiently. However, excessive expertise can become an obstacle to knowledge communication, leading to organisational outcomes that do not match the level of expertise possessed. The true value of knowledge only becomes apparent when it flows between the knowledge holder (the sender) and the person who requires it (the receiver) (Silberman et al., 2022). This does not mean undervaluing expert knowledge; rather, the goal should be to ensure that expertise remains connected to the organisation as a whole and its individual segments, particularly where it is needed and sought after.

Organisational silos can hinder knowledge sharing, and individual organisational units, even when aware of the problem, may require support to improve processes for transferring knowledge and practical experience among themselves (Rodriguez & Edwards, 2014). A lack of organisational response, even after diagnosing the issue, often intensifies siloing tendencies.

Siloing has a dangerous tendency to take control over communication processes and information flow, leading to limited or completely restricted access to information, a lack of information exchange, or unequal distribution of knowledge (O'Reilly & Paper, 2012). In the literature, in terms of both terminology and the general conditions of this problem, researchers even refer to the existence of a *silo mentality*, which is fragmented, self-serving organisational thinking that perceives the organisation as a whole but fails to connect it internally (Cilliers & Greyvenstein, 2012). This mindset can systemically reinforce the general tendency to create silos.

On the other hand, in knowledge-intensive organisations with strong reputations—such as IT firms and consulting companies—knowledge-sharing processes and collaboration through communication tools are key success factors that enable companies to compete in dynamic business environments (Mola et al., 2019). However, siloing can also affect technology within an organisation. Some researchers argue that creating independent internal company networks and relying exclusively on IT tools for knowledge and commu-

nication support—without complementary or even primary reliance on social tools—limits knowledge sharing (Swan et al., 1999).

Thus, the relationship between siloing, knowledge, and communication within an organisation is multidimensional. It involves interdependencies, cause-and-effect relationships, and a negative correlation between these concepts. However, these considerations merely provide context for the study and justify the need to pursue the primary objective of this article. This leads to the formulation of the second research question: What strategies can be used to counteract organisational siloing? As demonstrated above, siloing has been classified as a tendency that has an unequivocally negative impact on organisations. Therefore, posing this research question appears all the more justified.

Strategies for Counteracting Organisational Siloing

In pursuit of the fundamental objective of this article, the following section presents the results obtained through the adopted research procedure. However, before delving into the specifics, it is important to note that despite the widespread presence of organisational siloing, organisations are not passive in the face of this tendency. Although siloing presents numerous challenges and pitfalls, organisations employ various techniques—including extracting and integrating knowledge that remains 'trapped' within silos—to bring together previously fragmented knowledge into a cohesive whole (De Waal et al., 2019). Table 1, arranged chronologically based on the publication date (and alphabetically for materials published in the same year), provides a concise summary of strategies for counteracting silos and organisational siloing.

Before an organisation decides to merge existing silos, it should first focus on preventative measures to prevent them forming in the first place. Such an approach can be based on a retrospective strategy, which aims to minimise processes and events that contribute to the emergence of silos. This involves structuring the organisation in a way that keeps unwanted silos that do arise under control. Lencioni (2006) developed a comprehensive strategic framework for preventing the formation of organisational silos, outlining four interrelated strategies: establishing the organisation's primary thematic goal to unify all its activities; defining objectives that clarify and refine the overall thematic goal; setting a set of current operational goals that support and align with the main goal but do not belong to previous subcategories; implementing a proper organisational goal metric, which unifies goal structures transparently, making them easier for employees to identify with. For these objectives to effectively prevent silo formation, the organisation must possess or develop the necessary knowledge to establish relevant goals and the communication capabilities to ensure that every member is informed about them.

Table 1*Strategies for Counteracting Silos and Organisational Siloing Using Knowledge and Communication*

No	Author	Strategy	Application in the context of knowledge and/or communication
1.	Kets de Vries, 2005	Improving leadership and decision-makers	Creates efficient teams, bridges gaps between them, and enhances information flow
2.	Lencioni, 2006	Establishing a general organisational goal and sub-goals	Unifies and integrates the organisation through knowledge of its strategic direction
3.	Lemmergaard, 2009	Implementing benchlearning	Increases knowledge rotation and communication via an information platform
4.	Kabalski, 2012	Creating project teams	Facilitates the exchange of knowledge, information, and ideas
5.	Grycuk, 2016	Implementing lean management	Improves communication
6.	Świetlikowski, 2016	Leveraging internal employee mobility	Enables knowledge sharing and mentoring by more experienced employees
7.	Forsten-Astikainen et al., 2017	Creating CoPs – communities of practice	Breaks the isolation caused by silos
8.	Bilecka, 2018	Organisational network analysis (ONA)	Provides strategic, cross-sectional knowledge about organisational functioning
9.	Centola, 2018	Creating network clusters	Strengthens social actors and improves information flow
10.	Bjaalid et al., 2019	Developing meta-disciplinary structures	Increases the amount of knowledge within teams
11.	Świetlikowski, 2019	Implementing internal training policies	Integrates employees and the organisation as a whole through knowledge sharing
12.	Golczyńska-Grondas & Błaszczuk, 2020	Establishing systems for monitoring the institutionalisation process	Enables the collection, processing, and use of data and knowledge
13.	Staszewski, 2021	Strengthening knowledge exchange systems	Prevents organisational fragmentation and enables knowledge replication
14.	Hadi et al., 2022	Creating PMOs – project management offices	Synchronises and distributes knowledge released from silos throughout the organisation

Source: author's own work.

One effective solution, which, like the previously discussed anti-silo strategies, stimulates multi-directional knowledge exchange and communication processes, is benchlearning. This involves creating platforms for free knowledge exchange between different units. While organisational siloing is primarily a cultural rather than a technological issue (Cromity & Stricker, 2011), this does not mean that modern tools cannot be used to counteract it. Knowledge repositories, such as an internal knowledge-sharing portal, can help liberate valuable knowledge trapped in silos, aligning with ongoing digitalisation trends.

A study on knowledge dissemination in human resource management demonstrated that this approach resolved the issue of organisational siloing by ensuring that knowledge was shared not only within the organisation but also with external audiences, including the academic community (Lemmergaard, 2009). This study showed that siloing is not limited to individual organisations—it can affect entire sectors and networks. Thus, countermeasures must also be multi-level and directed towards a broad range of

stakeholders. Some scholars even argue for building bridges between silos, suggesting that the problem is not rooted in a lack of communication tools but rather, as already mentioned above, in cultural barriers (Cromity & Stricker, 2011). However, organisational silos can be harmful not only to organisations. They can undermine the effectiveness of technological tools meant to connect different departments (Mola et al., 2019).

One attempt to reduce silos and siloing in the areas of knowledge and communication is the creation of project management offices (PMOs)—specialised units responsible for managing projects within organisations. PMOs play a key role in bridging the strategic and operational levels of a company by facilitating team-based project work. However, PMOs are not always entirely effective in counteracting siloing. Some researchers argue that organisations often struggle with communication difficulties in transferring knowledge between operational and strategic management levels, causing valuable knowledge to remain trapped at the operational level (Ershadi et

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al., 2021). PMOs have also been criticised for lacking conceptual frameworks for knowledge mediation across different organisational segments. Despite these challenges, PMOs can still play a crucial role in releasing knowledge trapped in silos. By balancing bottom-up experiential learning with top-down strategic learning, while ensuring horizontal knowledge synchronisation, PMOs facilitate multi-directional knowledge transactions (Hadi et al., 2022).

Another anti-silo strategy is the creation of network clusters. Research on network analysis has provided theoretical foundations for understanding how these structures function as spaces of social reinforcement, essential for the spread of complex information and the mitigation of siloing tendencies. However, for this to work, a balanced network structure is required—one that connects local clusters for close interactions and establishes broad bridges for information flow. Networks in this sense function as social system structures, comprising dynamic, ever-changing member flows, information flows, and social support availability (Centola, 2018). A powerful example of network-based organisational improvement can be found in public administration, where increased structural fragmentation has coincided with growing demands for public services from local stakeholders. This juxtaposition of siloing and networks as a potential solution raises the bar for public organisations, which must operate with increasing efficiency to achieve their objectives. A study conducted in a large European city demonstrated that integrating municipal public organisations into smart networks reduces communication barriers and knowledge flow restrictions, thereby neutralising the organisational siloing that is common in public functional organisations (Todorović et al., 2015).

According to some self-improvement trends in management, every employee, to some degree, bears responsibility for the organisation. Some researchers have concluded that the most crucial department in an organisation is the one that manages its most valuable asset—its people. Studies show that this department plays a significant role in preventing the emergence of organisational silos. A tool used by social capital specialists is the establishment of *communities of practice* (CoPs). Due to their inherent interdisciplinarity, CoPs transcend the boundaries and limitations imposed by silos. CoPs emerge organically, allowing employees to break free from isolation and move beyond rigid, closed work patterns. These groups are not project teams, but rather informal practitioner groups within an organisation that focus on a particular topic or issue and facilitate knowledge exchange. However, for CoPs to develop effectively, HR departments require additional competencies that enable them to foster the growth of these communities beyond the existing silo structures (Forsten-Astikainen et al., 2017).

Some researchers emphasise that an organisation's susceptibility to silo formation is directly linked to leadership quality, meaning that decision-making effectiveness is a crucial factor. This view is difficult to

dispute, given the widely accepted belief that leadership shapes an organisation and dictates its management practices. Although an organisation consists of various processes, information flows, and people, leadership remains the factor determining how much knowledge is accumulated, how it is conveyed, and how effectively communication flows. It is therefore not surprising that enhancing the competencies of decision-makers—for example, through leadership coaching and group coaching—has been identified as an effective remedy for organisational siloing. Such development efforts create high-performance teams, which, in turn, dissolve unnecessary organisational boundaries and facilitate knowledge exchange (Kets de Vries, 2005).

Organisational silos can, of course, be minimised or eliminated through direct structural reforms, implemented via organisational redesign. This approach relies on insight into the most effective organisational structures, but is also a broad, overarching strategy. One study presented the results of an implementation experiment at a Norwegian university hospital, where the organisation was restructured to create a multi-disciplinary working environment. The new structure was no longer based on individual medical disciplines, but instead on meta-disciplinary teams. This decision provoked resistance from some employees. The experiment demonstrated that it is possible to reduce the tribal culture among silos and establish a working environment based on effective, multi-directional knowledge transfer through structural change (Bjaalid et al., 2019).

Polish language sources also present a wide range of contextual solutions. Researchers recommend basic yet effective strategies, such as implementing project teams (Kabalski, 2012), and introducing lean management principles (Grycuk, 2016) aimed at limiting or counteracting siloing. A particularly popular and widely applied strategy for addressing siloing is the implementation of internal training programmes. These programmes enhance integration among employees and unify the organisation by facilitating knowledge transfer from experienced employees to new hires. A systematic approach in this context is the internal trainer function, where a designated individual oversees and facilitates this knowledge exchange (Świetlikowski, 2019).

Organisations can counteract siloing by analysing both internal structures and the external environment. One strategy that supports this effort is Organisational Network Analysis (ONA), which leverages dedicated platforms to map organisational relationships and interactions (Bilecka, 2018). An ONA provides cross-sectional and diverse knowledge about both external and internal organisational dynamics, particularly concerning employees, resources, and developmental barriers related to relationships. Tools that visualise knowledge flow and relationships can be used for talent management, among other applications. By identifying knowledge movement within the organisation, silos can be effectively neutralised by directing

knowledge application to where it is needed most. Importantly, an ONA can support the development of CoPs or project teams. For example, in social policy and foster care system organisations, Golczyńska-Grondas and Błaszczuk (2020) propose continuous monitoring of the institutionalisation of service recipients as a means of systemic deinstitutionalisation, ultimately reducing siloing tendencies.

Another more ambiguous strategy for organisations is creating conditions for employee mobility. Employees who change roles within an organisation develop a broader perspective and higher engagement levels. They also accumulate specific knowledge that grows over time. For organisations, this is highly beneficial in terms of knowledge sharing and breaking down silos. However, if an employee leaves the organisation, the acquired knowledge benefits another company and the entire sector instead (Świetlikowski, 2016). Overall, strengthening knowledge exchange systems makes it more difficult for silos to form, creates a foundation for knowledge replication and release, and helps to identify both effective and ineffective organisational solutions. This aspect is particularly significant in the implementation of innovations within the public sector (Staszewski, 2021).

Summary

The primary context of this study is the desire to improve the quality of organisational functioning, with siloing identified as a key barrier in this process. Considering the arguments presented, due to the detrimental nature of siloing, the topic addressed by the author is of great significance, and the search for counteractive strategies is fully justified. On the other hand, the roots of siloing can also be traced to knowledge deficiencies or constraints on information flow. By exploring these aspects, the author fills an existing research gap by presenting the inherent relationship between siloing, knowledge, and communication—demonstrating that these concepts and their cause-and-effect dynamics are inextricably linked.

The strategies described in this article are diverse, multi-layered, and interdisciplinary. They include solutions focused on internal organisational structures (e.g., project structures or CoPs), external organisational environments (e.g., network clusters), digitalisation and new technologies (e.g., benchlearning), and the quality of public management itself (e.g., effective leadership). These strategies have been empirically validated and have been shown to support organisations in mitigating or preventing siloing by enhancing knowledge dissemination and information flow. This underscores the broad scope of the issue and provides an opportunity for further academic exploration. However, given the complexity and structural diversity of modern organisations, as well as the numerous challenges they face, it seems advisable that managers implement more than just a single, isolated strategy. Instead, a comprehensive approach should be pursued, integrating multiple

complementary strategies. Similarly, scholars should further investigate the effectiveness of such an approach to tackling siloing.

The structure of this article serves a dual purpose: first, it provides a concise compendium on siloing and its relationships with knowledge and communication, and second, it lays the foundation for further academic inquiry. A deeper understanding of these strategies could serve as a valuable extension of this study, contributing to the theoretical development of the field. For practitioners, this article may function as a practical tool, offering guidance on strategies to mitigate organisational challenges arising from silos.

Nevertheless, due to the limitations of this article, the strategies discussed and the relationships between the described concepts have been highlighted only briefly, leaving room for further scientific exploration, particularly in areas such as the relationship between knowledge management, communication, and siloing, in-depth analysis of individual strategies, and the potential for their integration. An interesting direction for future research could be the evaluation of these solutions in terms of their effectiveness.

Another notable limitation is the relatively small number of sources and studies directly addressing the impact of knowledge and communication on siloing. Some of the cited research was conducted some time ago, which suggests that there is a need for renewed academic attention to this topic. This, in turn, highlights the paradox that despite the significance of the problems caused by siloing, the issue remains relatively niche in the context of knowledge and communication studies. As such, this study represents an important step toward a better understanding of the issue and serves as an invitation for further research in this field.

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Piotr Popęda is a PhD student at the University of Economics in Katowice (Poland), a scholarship recipient of The Fund for American Studies, and a delegate to the 23rd session of the United Nations Committee of Experts on Public Administration. He has many years of professional experience in local government administration. His core mission is the broad improvement of organisational functioning, particularly in public institutions, from both a scientific and practical perspective.

WE RECOMMEND



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The second edition gathered 35 participants from 12 universities. With guidance from mentors representing 11 academic centers, they developed 35 Individual Research Plans. This was possible through 175 online mentoring sessions and five training workshops focused on online databases, research planning, academic writing, and scientific publishing.

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Synergy Effect of Selected Management Tools – Case Study

Abstract

The aim of this article is to describe the practical application of selected management tools. When these tools are used together, they enable a synergy effect to be attained, which is a more extensive and more accurate analysis of the problem and better prevention than in the case of the application of a single tool. All of the tools used, which are the Ishikawa Diagram, Pareto Diagram, and 5 Why technique, are tools used to diagnose the causes of problems. They can be used separately to examine the problem analysed in this article and jointly to show the synergy effect. This article briefly describes the tools used in the application and indicates the main competencies, i.e. analytical thinking, problem-solving and deep listening, as those that are practiced during classes with students. The paper presents a description of the problem that has arisen, and includes a ready-made case study which can be used during academic classes. It also contains a ready-made sample solution using three classic quality management tools. Moreover, this article concludes with a discussion that summarises the entire article with suggestions and recommendations with regard to didactic, substantive and ethical issues. The suggestions may be helpful when working with students.

The presented case study can be an inspiration for changes to enhance quality, especially for people dealing with comprehensive quality management in various departments of the organisation. Therefore, the study is dedicated not only to academic teachers, students and university management staff, but also to practitioners who use, for example, complaint documentation such as the 8D report or people dealing with communication or quality improvement working with both external and internal clients.

Keywords: management tools, Ishikawa diagram, Pareto principle, 5Why technique, case study, competences, higher education

Introduction

The efficiency achieved by an organisation largely depends on the effectiveness of its manager's operations (Kuc & Zemigala, 2010, p. 4). A good manager, like a good teacher, develops potential, teaches, and guides employees in their development. Just as it is an indispensable part of university education to combine the experience of business practitioners with academic knowledge, business management methods and tools can be combined and applied to a variety of problems not only in business practice. Problems are an inherent part of people's lives, and the methods and tools for resolving them are universal, enabling them to be employed in various aspects of human functioning. The tools that were used in the study are applicable with regard to management and quality management. Meanwhile, these tools have been found to be applicable beyond business problems. Kuczaba-Flisak (2022) and Maciejowska (2020) emphasise that the ability to diagnose problems is one of the key skills that should be acquired in professions involving work with people—it is also a component of the professionalisation pathway for the teaching profession (Maciejowska, 2020, p. 55).

According to *The Future of Jobs Report 2023* (WEF, 2023), analytical thinking is a crucial skill that is highly valued by most employers. This skill encompasses both the capacity for deeper data analysis and the ability to comprehend problems, enabling the separation of facts from thoughts. In the ranking of the ten most important skills for 2025, analytical thinking and innovation were listed at the top (Kozłowska, 2022). In a report on empirical research into future competencies and professions, which identifies future skills based on monitoring national sources, complex problem-solving ranks

first among cognitive competencies, while analytical thinking is ranked fourth (Socha & Wojdyła, 2021). In turn, the respondents to a survey conducted by Łapińska et al. declared that by 2030, analytical skills supported by technology will be crucial. A significant 58% of management representatives acknowledged that this will be an extremely important competence, without which a company would struggle to perform operational tasks and achieve long-term development goals (Łapińska et al., 2022, p. 30).

Fostering or practising any skill—whether strategic or creative thinking—necessitates a commitment from both managers and academic educators, along with ingenuity, expertise, knowledge, and their own creative competencies. The highest level of these competencies—linked to the professional creativity of the teacher—is innovative activity associated with implementing new solutions into academic teaching. These innovations are the result of many years of creative pedagogical efforts by academic teachers (Okraj, 2023, p. 38). Academic freedom in teaching lies in the fact that a teacher can independently develop a personalised approach for students in terms of the course design, content selection, methodology, form, tools, etc. Finally, it also involves forming relationships with students. It is crucial that these choices are made freely, yet with an awareness of alternatives (Sajdak, 2013, p. 19).

This article features a completed case study, representing unique application of three selected tools specifically designed for diagnosing and resolving the causes of problems. The tools were intentionally chosen to illustrate how causes are diagnosed using each of the proposed tools when applied to the same problem. This aimed to demonstrate how the tools can complement one another in the process of in-depth problem analysis. Three tools were selected.

The Ishikawa diagram, also known as a *cause-and-effect* diagram or a *fishbone* diagram, is one of the most widely used and effective traditional quality management tools. It was developed in the twentieth century by Kaoru Ishikawa and first applied in Japan by Sumitomo Electric. The diagram visually represents the relationship between effects and their potential causes across various categories. Over the years, the diagram has evolved. The diagram has been used to diagnose a variety of business problems, and refined with standard groups of causes common in manufacturing organisations. The most recognised classification of these groups, known as 5M+E, includes Machines, Methods, Materials, Management, Manpower and Environment. Occasionally, a separate category, *measurement*, was added alongside *Methods* (Hagemeyer et al., 2006; Kowalik, 2018; Szczesna & Klimecka-Tatar, 2017; Szczesniak et al., 2012).

The proposed Ishikawa diagram presented in this paper includes new problem categories specifically tailored to the given situation. These are instructor, students, university, course specificity, and teaching methods. Taking into account the traditional categorisations, the teacher and student groups can cor-

respond to *manpower*, the course specificity group to *materials*, the teaching methods group to *methods* or *measurements*, and the university group to *management* or *environment*. A similar approach, involving the proposal of new categories, is adopted by Kuczaba-Flisak, who uses the diagram in her work with Polish studies students (Kuczaba-Flisak, 2022, p. 12).

The second tool is the Pareto diagram, which is primarily used in quality management. However, it is now employed in many scientific fields, as quality improvement pertains to virtually every aspect of daily life, not just professional domains. Its creator, Italian economist and sociologist Vilfredo Pareto, designed the diagram as a bar chart illustrating the distribution of causes and effects in a process. It highlights the uneven distribution between causes and effects, showing that a relatively small number of causes account for a significant portion of the effects. Typically, 20-30% of factors determine approximately 70-80% of the effects. Accurate diagnosis of the causes determines the effectiveness of preventative measures. An alternative name for this is the *20–80 rule*, or the *ABC method*. This diagram introduces a hierarchy of factors that directly impact the phenomenon under investigation (Chądzyńska & Klimecka-Tatar, 2017, p. 32; Dahlgaard et al., 2001; Jazdon, 2001, Strycharzka et al., 2018 p. 263).

The third technique applied is 5W, also known as the *5 Whys*. Its primary goal is to ask the question 'why' five times to determine the cause of the problem. The 5W technique is part of the Japanese kaizen philosophy, which is based on the observation that no enterprise is perfect, and each one encounters specific problems (Czaczkowski, 2014, p. 146). The 5W technique is used to analyse cause-and-effect relationships. The number '5' in the name originates from the empirical observation of the number of iterations typically required to solve a problem; however, the exact number of iterations (asking 'why') is not crucial here. What is more important is to continue asking questions until the root cause of the problem is identified and eliminated. Like the Ishikawa and Pareto diagrams, the 5W technique is not only applied in quality management but also in areas such as coaching, to better understand the reasons behind actions taken or goals set (Czardybon, 2017, p. 115). A very important practical aspect when applying this tool is its ability to identify processes or aspects that can be modified or controlled to effect real change (Helman & Rosienkiewicz, 2016, p. 67–68; Serrat, 2017, p. 310).

Also, when diagnosing causes, both quantitatively and qualitatively, listening skills in open communication between students, the course instructor, and the year supervisor proved extremely helpful. Deep listening was found to be a competency that aids leaders and entrepreneurs in problem-solving, creating innovative solutions, and decision-making amidst the continuous volatility, uncertainty, complexity, and ambiguity characterising the modern world (the *VUCA* world) (Rędzińska, 2018, p. 100). Indeed, chal-

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lenging situations present an excellent opportunity for practising this competency, particularly at the academic level.

The presented case study not only integrates selected quality improvement methods. It also leverages the resulting synergy to uncover the root causes of the problem and focus on them, saving time and increasing the chances of a better implementation outcome. As a result, the problem is thoroughly analysed, and identifying the root causes, rather than all possible causes, is a more effective means of preventing the problem from recurring.

Furthermore, combining methods necessitates communication, mutual openness, and honesty, fostering the development of future skills.

Description of the Problem and Selection of Tools to Solve it

In the academic year 2021/2022 at university 'X' in course 'A'¹, 50% of students² failed an examination in both term zero and terms 1 and 2. The issue became a topic of discussion not only among the students of the same cohort but also among older students, the year supervisor, and the course instructor. To address the problem, the year supervisor conducted interviews with students from the current cohort—those who passed, those who failed, and students from the previous cohort who had already passed the course, as well as the course instructor³. From the interviews with students who failed the course, the year supervisor learned that in their opinion, the course instructor was too demanding, did not share notes, expected attendance, and required students to take their own notes. They also mentioned that the subject matter was challenging and required knowledge also from other courses to better understand the content. Additionally, during practical classes, not everything in the lab worked as expected. The test is multiple-choice, which requires additional focus not only on whether something is correct, but also on its logical consistency. In such conditions, according to the students, *getting a C is nothing short of a miracle*.

In turn, the year supervisor learned from the course instructor that students often used their phones during class instead of paying attention and were habitually late, and that those with an individual study plan frequently skipped classes (the university regulations allow exemption from attendance for part of the coursework). Also, full-time students were unwilling to share their notes with them. In addition, the instructor noted that while students preferred hybrid classes, during tasks or discussions, there was *radio silence*, as students were either commuting from work or at home distracted by pets or children. Moreover, gaps in knowledge from other courses exacerbated the difficulties in passing the course. *They need to catch up*, the instructor commented.

The year supervisor conducted sessions with students from an older cohort who had successfully completed course 'A' in the previous academic year. Upon asking their opinion, the supervisor learned that although the instructor was indeed demanding, all of the full-time students had managed to pass; they attended classes, refrained from sharing their notes with peers, and discussed issues directly with the instructor if there were any disagreements.

Given the situation, an anonymous survey⁴ was conducted using Google Forms, also including feedback from students who passed the course and students from the previous cohort. Table 1 presents the number of responses and the reasons cited.

After analysing table 1, it was clear that the most common causes of the problems included:

- the issue of note-taking, the fact that the teacher does not share them, requiring students to create their own,
- the course is challenging, demanding additional knowledge,
- the vast majority of students prefer hybrid classes, which, as noted by the instructor, lead to further issues (lack of concentration); students believe the problem is complex.

After discussions with students who did not pass the course, certain conclusions came to light that might help to resolve the issue of the failed examination. No one reported any problems with how the

¹ The course 'A' is included in the curriculum of full-time studies with 30 hours of practical classes and 30 hours of lectures. Passing it is mandatory, and the lectures conclude with an examination.

² Out of a total of 200 students.

³ The year supervisor held discussions with students once the semester had ended, following the board examinations for course 'A', which all students ultimately passed. The objective of the discussions, as well as the entire study, was to address the problem in order to prevent such situations from arising in the future. The supervisor spoke with students either before or after various practical classes, contingent upon his own availability according to the schedule. The discussions took place from February to mid-April 2022, and students also had the option to write or call the supervisor to express their opinions—however, no one exercised this option. However, students were eager to express their views in smaller groups, which is why the year supervisor spoke with each practical group from two cohorts. The conversation with the course instructor was conducted over the phone after the students failed the second attempt at the examination during the resit session.

⁴ Out of 377 students across both cohorts, a total of 300 students participated in the survey. The survey was anonymous and featured a single multiple-choice question with options drawn from the reasons identified by the students and the academic instructor during the discussions, along with an open-ended *other reasons* option (no one provided additional reasons).

Table 1*Reasons for Failing the Course According to the Students*

Reason	Number of indications
Full-time students do not share their notes with students who have an individual study plan	30
The subject matter is challenging, requiring knowledge not only from this course but also from others	180
The instructor requires attendance	15
Students must take notes themselves	270
The instructor does not distribute notes	300
Not everything is functioning in the lab	5
Multiple-choice test	20
Students lack knowledge from other courses	30
Being late for classes	15
The instructor is very demanding	20
During classes, the student commutes home (causing concentration issues)	15
Students prefer hybrid classes	223
I find it difficult to concentrate at home (with children and pets)	40
Unauthorised use of mobile phones during classes	80

Source: author's own work.

instructor graded the tests, so it is evident that the students failed because they did not provide correct answers. After their second attempt at the examination, the students claimed they were studying – using their notes and the materials they had—but they were studying. This raises suspicions about the quality of the notes they were using. The notes also pose a problem for students with an individual study plan (evidently, this is a bone of contention between full-time students and those with an individual study plan). Following the supervisor's suggestion, the instructor selectively reviewed these notes and found that the students with an individual study plan did not have complete materials, whereas errors were discovered in the notes of full-time students: items were misinterpreted, omitted, etc. Moreover, the full-time students did not share their notes with the students with an individual study plan, nor did the instructor distribute the notes to them.

The matter was not left unresolved. Both students and the instructor were asked why notes were not being shared. The instructor responded that these arrangements were made at the beginning of the course, no objections were raised, and taking notes is also a form of learning. Full-time students, on the other hand, found it to be unfair that those granted an individual study plan did not attend classes yet had the same conditions for passing as those who did attend.

The issue was resolved by implementing corrective actions targeting the key causes of the students' failure to pass the examination. As a preventative measure, the option for students to consult the instructor on their notes during office hours was introduced. The instructor also began sharing links and source materi-

als, recommending books used during the classes, and made changes to the course completion requirements for students granted an individual study plan to make them feel fairer from the students' perspective.

Example of the Application of Selected Management Tools

To address the issue as effectively as possible, several management tools were employed. Initially, the Ishikawa diagram was used to display and categorise the groups of causes more effectively. This provided a global view of the problem and definitely made it easier to visualise it as a whole. Figure 1 presents an Ishikawa diagram for the problem of students failing an examination.

The Ishikawa diagram presented in figure 1 is proposed based on the description of the problem, drawing on data obtained from interviews and conversations with both the students and the course instructor, as well as the data in table 1.

Using the Ishikawa diagram enabled the visualisation of cause groups and helped to categorise them and to organise them systematically. However, in order to best resolve the situation, the focus was directed towards the key causes of the problem. To this end, a Pareto diagram was created from the survey data, and the resulting information is presented in table 2.

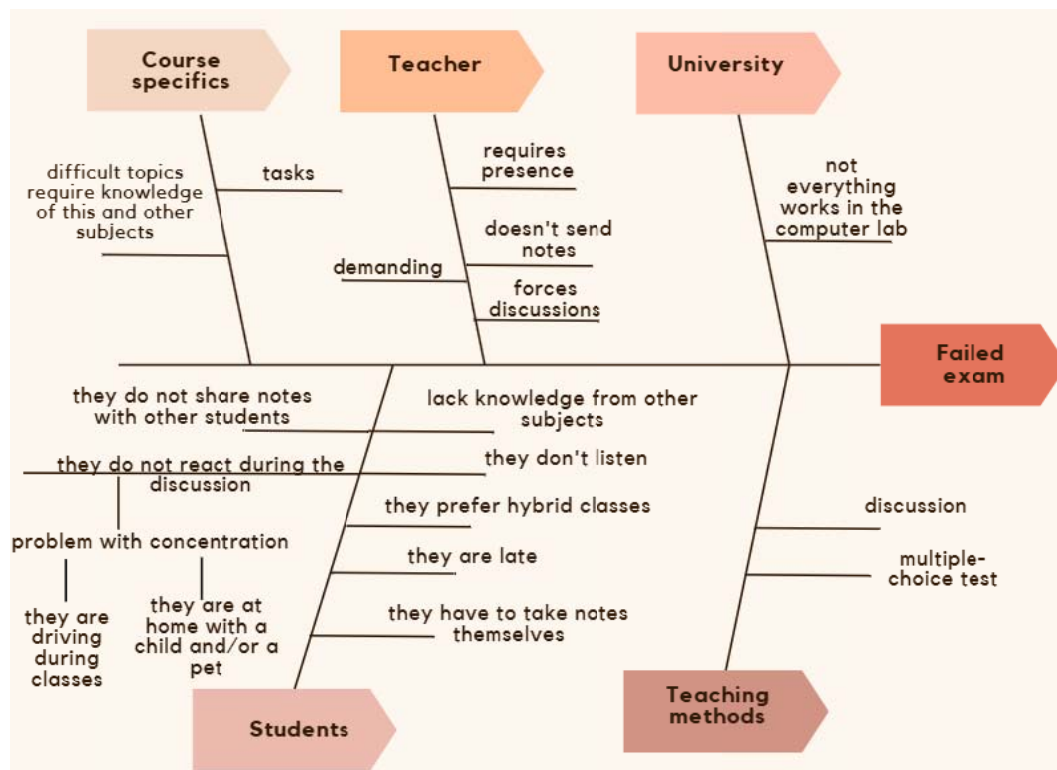
The data from table 2 is illustrated in figure 2.

The data from table 2 and figure 2, which present the results of the anonymous student survey, show clearly that 78.28% of all responses account for 28.57% of all reported reasons for failing the examination. These include the instructor not sharing notes, which automatically means that students have to take their

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Figure 1

The Ishikawa Diagram for Students Failing an Examination



Source: author's own work using the Canva.

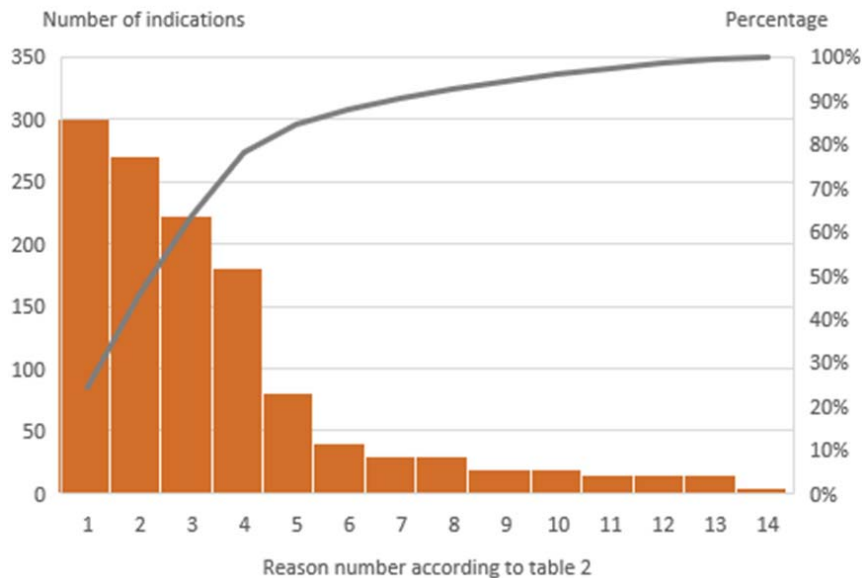
Table 2

Diagnosis of the Key Reasons for Failing an Examination using the Pareto Principle

No	Reason	Number of indications	Percentage	Cumulative Percentage
1.	The instructor does not distribute notes	300	24.14	24.14
2.	Students must take notes themselves	270	21.72	45.86
3.	Students prefer hybrid classes	223	17.94	63.80
4.	The subject matter is challenging, requiring knowledge not only from this course but also from others	180	14.48	78.28
5.	Unauthorised use of mobile phones during classes	80	6.44	84.71
6.	I find it difficult to concentrate at home (with children and pets)	40	3.22	87.93
7.	Full-time students do not share their notes with students who have an individual study plan	30	2.41	90.35
8.	I do not have information from other courses	30	2.41	92.76
9.	Multiple-choice test	20	1.61	94.37
10.	The instructor is very demanding	20	1.61	95.98
11.	The instructor requires attendance	15	1.21	97.18
12.	Being late to classes	15	1.21	98.39
13.	During classes, the student commutes home (causing concentration issues)	15	1.21	99.60
14.	Not everything is functioning in the lab	5	0.39	100.00

Source: author's own work.

Figure 2
Reasons for Failing an Examination According to the Number of Indications



Source: author’s own work.

own; students preferring hybrid classes, which, despite being held outside the university, involve students participating from various locations and under different conditions; the fact that the subject matter is challenging and requires knowledge not only from this course but also from others. Consequently, focus was directed towards the core reasons by engaging in further discussions with both the students and the course instructor to examine these issues further (detailed findings from these investigations are included in the situation description). For this purpose, the 5 Why technique was employed. For the fourth and fifth whys,

logical connections between certain facts emerged from the discussions, resulting in expanded responses being added to these points as 4a and 4b, and 5a and 5b. The 5W technique is visualised in table 3.

Table 3 illustrates that in fact, the primary causes of the problem stemmed from the arrangements between the instructor and the group, as well as from the dynamics within the student group. As a preventative measure, the option for students to consult the instructor on their notes during office hours was introduced. The instructor also began sharing links and source materials, recommending books used, and

Table 3
Use of the 5W Technique to Examine the Issue of a Failed Examination

Problem	A student failed an examination	
1. Why	did the student fail the examination?	
Answer 1	The student did not provide correct answers on the test.	
2. Why	didn't the student provide correct answers on the test?	
Answer 2	The student had no materials to study from.	
3. Why	didn't the student have any materials to study from?	
Answer 3	It turned out that the student did not have complete notes.	
4. Why	didn't the student have complete notes?	
Answer 4a	Answer 4b	
The instructor did not distribute notes.	The students were unwilling to share their own notes.	
5a. Why	5b. Why	
didn't the instructor distribute notes?	were the students unwilling to share their own notes?	
Answer 5a	Answer 5b	
These were the arrangements made at the beginning of the course (taking notes is also a form of learning).	They consider it unfair.	

Source: author’s own work.

Synergy Effect of Selected Management Tools – Case Study

made changes to the course completion requirements for students granted an individual study plan to make them feel fairer from the students' perspective. Thanks to these preventative measures, the pass rate for the course significantly improved in subsequent years. In the 2022/2023 academic year, all students passed either during the zero examination session or on the first attempt.

Summary and Discussion

The problem described in this study has practical applications and can serve as a ready-made case study for management-related courses. The analysed issue directly pertains to student affairs, enabling them to better understand the given situation, identify the underlying causes, and analyse and diagnose the interrelations more thoroughly. Furthermore, it allows them to see the benefits of combining several management methods. This synergy enables a more thorough problem analysis and a focus on the root causes, making prevention significantly more effective. The effect of synergy was also made possible through collaboration based on open communication, honesty, and above all, deep listening. Moreover, using three tools in the proper logical sequence enabled the true causes of the problem to be identified, while they were not immediately apparent. By selecting an appropriate order of tools, it was possible to focus on the root causes of the problem. As a result, the implemented preventative measures completely resolved the issue.

The presented case study has been used twice by the author in management-related classes. Several suggestions arose from observing how students worked with the material, which have been organised into three categories: didactic, substantive, and ethical.

The didactic category includes suggestions aimed at enhancing the understanding of the methods themselves, offering insights into the distinctions between them. It is recommended to start the class by presenting examples of each tool separately, without combining them. After discussing all the methods with various examples, the case study presented in the article should be divided into three parts, on separate sheets of paper (Ishikawa diagram, Pareto diagram, 5W technique). Students are informed that there will now be a case study demonstrating that it is possible to combine the methods. The class should start with a presentation of the problem (up to the paragraph beginning with *Given the situation...*), followed by the content from *Given the situation...* along with table 1. Finally, the content beneath table 1, starting with the sentence *After analysing table 1, it was clear that...* is discussed. For each section, a discussion should be conducted: What is this method? Why this method? Which information in the text helps apply this method? Brainstorming sessions or group discussions can be conducted, allowing students to share their opinions on a given problem after, for example, 15 minutes. Once the tool is correctly diagnosed, solutions can be visualised on the board or worked on in groups.

Suggestions in the substantive category focus on classifying causes into specific groups. During the diagnosis of individual groups of causes, particularly their names, various proposals may emerge that should be considered from the perspective of their substantive correctness. For example, with an Ishikawa diagram, causes can be diagnosed using the traditional 5Ms + E or 6Ms + E division, a new division (as shown in figure 1) can also be introduced, or two divisions may be overlaid, and, for instance, instructors and students may correspond to *manpower*, the course specificity to *materials*, teaching methods to *methods* or *measurement*, and the university to *management* or *environment*. Students can also be encouraged to propose their own logical groupings of causes and explain their reasoning. While the article demonstrates the use of selected tools, students can be asked what other tools could be applied to resolve the issue (the students failing an examination). They could also consider what additional information would be needed or whether the 5W2H technique could be used. This approach fosters discussion, analytical thinking, and creativity.

In the ethical category, it is suggested to focus not merely on the methods themselves, but on the comments, reactions, and statements from students that may emerge during the application or classification of the various causes, revealing the attitudes and values demonstrated by individual students. Since the case study directly concerns student issues, and one of the causes of the problem is a sense of unfair treatment, various comments, jokes, and questions often arise. This situation can be used as a platform for dialogue about different perspectives, viewpoints, and motives of the interested parties. The main benefit of such discussions is the reflection they provoke. When well-facilitated, this reduces tension within the group, fosters dialogue with instructors, and ultimately serves as a preventative measure against issues such as failing examinations.

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Patrycja Pudło holds a PhD in Economics from Jan Grodek State University in Sanok. Her work focuses on the economics and quality management of various business areas. Her research interests also include creative solutions in marketing and management. Her work includes designing simulation games and HR development workshops, used at the university as well as in training and career consultancy.

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