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Front Pages

Athens Journal of Education

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The ***Athens Journal of Education (AJE)*** is an Open Access quarterly double-blind peer reviewed journal and considers papers from all areas of history. Many of the papers published in this journal have been presented at the various conferences sponsored by the Education Unit of the Athens Institute for Education and Research (ATINER). All papers are subject to ATINER's Publication Ethical Policy and Statement.

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The current issue is the third of the eleventh volume of the *Athens Journal of Education (AJE), published by the Education Unit of ATINER.*

Gregory T. Papanikos
President
ATINER

Athens Institute for Education and Research

A World Association of Academics and Researchers

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19-22 May 2025, Athens, Greece

The Education Unit of ATINER organizes its **27th Annual International Conference on Education, 19-22 May 2025, Athens, Greece** sponsored by the Athens Journal of Education. The aim of the conference is to bring together scholars and students of education and other related disciplines. You may participate as stream leader, presenter of one paper, chair a session or observer. Papers (in English) from all areas of education are welcome. Please submit a proposal using the form available (https://www.atiner.gr/2025/FORM-EDU.doc).

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- **Dr. John Spiridakis**, Co-Editor, Athens Journal of Education & Professor, St. John University, USA.

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- Abstract Submission: **15 October 2024**
- Acceptance of Abstract: 4 Weeks after Submission
- Submission of Paper: **21 April 2025**

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- **Dr. David Philip Wick**, Director, Arts, Humanities and Education Division, ATINER & Professor of History, Gordon College, USA.
- **Dr. John Spiridakis**, Co-Editor, Athens Journal of Education & Professor, St. John University, USA.
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Athens Journal of Education - Volume 11, Issue 3, August 2024 – Pages 177-194

COVID-19 Global Pandemic Upheaval: CTE Teachers Response in the United States

By John Cannon[±], Mary Self[*], Allen Kitchel[°], Sally Arnett-Hartwick[•], Carol Billing[♦], Kevin Elliott[♣], Michelle Bartlett[♠], Mari Borr[·] & Jeremy Jeffery[♥]

The United States along with the rest of the world has experienced an unprecedented disruption in daily life due to the COVID-19 pandemic. Almost everyone has experienced some sort of stay at home order resulting in an economic catastrophe greater than the Great Recession of 2008 and on par with the Great Depression almost a century ago. Educational institutions at both the K-12 and post-secondary levels have not been immune from the shutdown, with many schools closed from mid-March through the end of the 2020 school year. Many schools moved classes to remote, distance delivery platforms. Career and Technical Education (CTE) teachers were tasked with creative engaging learning activities online for curricula which is taught in a hands-on contextual learning environment. This paper will present preliminary results from research conducted by a collaborative group of nine researchers from across the United States with collectively over 200 years of career and technical education experience. The conceptual framework used for this study was Danielson's Framework for Teaching and Enhancing Professional Practice and Foundations of Career and Technical Education including Constructivism. 3,267 participants representing all 50 states responded to the 37-item survey. The research objectives included description of participants and identified challenges to planning and delivery of CTE content when schools were closed, and instruction was moved to remote/distance/online platforms. Participants ranked their challenges as instructors and their perceptions of challenges that were experienced by their students. CTE teachers ranked replicating classroom or lab environments online and lack of experience teaching online as their biggest challenges. The perceptions of the participants concerning challenges for their students included motivation to guide and manage their own learning and students' access to reliable internet connection. The emergence and prevalence of the COVID-19 pandemic added a layer of complexity to educational practice that was not foreseen and for which no intentional preparation had occurred. Understanding how CTE teachers and instructors responded to this call, and the challenges they and their students encountered, is important to efforts to improve practice in the

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future and to be in a better position should another crisis occur that forces learning to be delivered in alternative formats from that of the traditional face-to-face classroom.

Keywords: COVID-19, career and technical education, remote learning

Introduction

In December of 2019, infections of a new, novel Coronavirus were first diagnosed in Wuhan, China. In a short time, the virus spread to Europe, the United States, and throughout the world. The virus became what is commonly referred to as COVID-19 and the World Health Organization (WHO) declared the virus a global pandemic in March of 2020 (Centers for Disease Control and Prevention, 2020a; World Health Organization). 0As of early June 2021, just over 33 million had been diagnosed with COVID-19 in the United States, and just under 600,000 had died from the virus or because of virus related complications (Centers for Disease Control and Prevention, 2021).

With the WHO's declaration, leaders from the federal level down to local jurisdictions began issuing orders and mandates which brought civil society to its knees in an attempt to stop the spread of the outbreak or "bend the curve". Businesses were closed. Corporations and public agencies required employees to work from home. Because of the fear that schools could serve as "super-spreaders"; 48 states, four territories, and the District of Columbia issued school building closure recommendations in the spring. Schools shut down for the rest of the 2019-2020 school year, and students were required to complete learning activities and assignments remotely. Ninety-three percent of households in the United States with school age children and at least 50.8 million public school students were affected by the move from face-to-face learning environments to online platforms (Education Week, 2020; McElrath, 2020).

Career and Technical Education (CTE) students, teachers, and programs were also affected like other disciplines in the U.S. education system. Research has shown that 77% of the approximately 15 million secondary students participate in some form of CTE in the United States (Duffin, 2021). CTE is based on contextualized learning providing "hands-on" activities. School districts and teachers faced a challenge of providing a high-quality learning environment to students in order to learn and develop college and career ready skills. This research explored the CTE teacher perceptions of COVID-19 pandemic challenges to teaching and learning.

Conceptual Framework

In reviewing CTE literature, one can find many research studies using different learning theories as a lens for which to view findings. However, it is difficult to identify a specific and concise theoretical framework for CTE. As Camp and Johnson (2005) argued over a decade ago, "no coherent theoretical

framework" for CTE exists (p. 42). For this study, the researchers developed a conceptual framework based on the foundations of Career and Technical Education and the Danielson (2007) framework for teaching and enhancing professional practice.

Foundations of Career and Technical Education

Gordon and Schultz (2020) defined CTE as "organized educational programs offering a sequence of courses directly related to the preparation of individuals in paid or unpaid employment and in current or emerging occupations requiring other than a baccalaureate or advanced degree" (p. 433). Other scholars have described CTE as a conduit for students to develop "college and career ready" skills and provides these skills in an environment that provides real world applications (Stone & Lewis, 2012; Williams, 2019). Completing a rigorous CTE program provides students with skills sought after by employers and can lead students to a high-paying career path (Perna, 2018).

Even though CTE scholars have struggled to create a specific theoretical framework for the discipline, several theories can be identified as foundational underpinnings:

1. Social Efficiency
2. Behaviorism
3. Constructivism
4. Experiential Learning (Clark, Threeton, & Ewing, 2010; Doolittle & Camp, 1999).

From the earliest days of modern vocational education, specifically the enactment of the Smith-Hughes Act of 1917, to "contemporary" career and technical education of the first two decades of the 21st century; each of these theories should be considered as an important component of the CTE foundational footprint.

Social efficiency theory posits that "only an efficient society could create a positive environment in which the individual could prosper and find satisfaction" (Doolittle & Camp, 1999, p. 2). The "founding fathers" of modern vocational education, David Snedden and Charles Prosser, were proponents of *social efficiency theory*. They advocated that secondary vocational programs were a component of our social system. Because of this, the US public school system would benefit the public good by its contribution to society's efficiency (Doolittle & Camp, 1999). Pedagogy was considered a fundamental part of the *social efficiency theory*, and it involves the systematic study of teaching and learning (Doolittle & Camp, 1999). According to Doolittle and Camp (1999), Snedden and Prosser concluded that vocational education must have as its base a pedagogy that is hands-on, rigidly sequenced, and highly organized. Prosser went further into the creation of the foundations of CTE by creating the *Sixteen Theorems* of Vocational Education (Prosser & Allen, 1925). Prosser's theorems served as the guide in the development of vocational curriculum that provided students with realistic, hands-

on learning experiences in the vocational content areas (Prosser & Allen, 1925; Gordon & Schultz, 2020). This realistic, hands-on learning approach is the primary characteristic of contemporary CTE. School closings due to the pandemic led to the CTE curriculum being part of a remote or online environment. Because of COVID 19, most opportunities for hands-on learning were taken away from U.S. students.

Behaviorism provided the learning theoretical foundation to *social efficiency theory* and the work of Snedden and Prosser (Doolittle & Camp, 1999). Thorndike (1932) theorized that learning was the result of links forming between specific stimuli and responses due awards applied to the learner. In the late 20th century, *behaviorism* continued to be the predominant learning theory underlying CTE (Dobbins, 1999). To demonstrate this, Dobbins (1999) showed that the *competency-based* approach to teaching and learning, evident in CTE, was tied to *behaviorism* learning theory. A *behaviorist* approach to learning was quite clear when one looks through *Prosser's Sixteen Theorems of Vocational Education*. Theorem 6 says, "Vocational education should provide opportunities for students to repeat operations of thinking and manipulative skills until habits are formed characteristic of those required for gainful employment" (Gordon & Schultz, 2020, p. 37). There is a connection between behaviorism and hands-on learning as noted by Prosser in Theorem 1, "Vocational education should occur in the most realistic setting that replicates the work environment" (Gordon & Schultz, 2020, p. 37). Finally, Prosser argued that vocational education should meet individual needs. He wrote in Theorem 13, "Vocational education should meet the needs of individuals when it is needed and in such a way that they can benefit from it" (Gordon & Schultz, 2020, p. 37). In addition to this, he proclaimed in Theorem 14, "Vocational education is more effective when its methods of instruction are best suited to the particular characteristics of any particular group which it serves" (Gordon & Schultz, 2020, p. 37). With school closings as a response to the COVID-19 pandemic, opportunities to learn in a realistic environment were not available to CTE students.

At the end of the last century, scholars questioned the connection of CTE to *behaviorism*. Numerous researchers suggested that it was time to consider *constructivism* as part of a theoretical framework underlying CTE (Doolittle & Camp, 1999; Gregson, 1997). Whereas those who advocated for the social efficiency/behaviorist approach to vocational education to meet the country's labor needs (Rojewski, 2002), constructivist scholars have argued for consideration of the individual learner. Individual learning needs must be met for the learner to be prepared for life and career success. This line of scholarship was based on Dewey's philosophy of pragmatism (Rojewski, 2002). Hysop-Margison (2000) wrote:

> Dewey rejected the image of students as passive individuals controlled by market economy forces and existentially limited by inherently prescribed intellectual capacities. In his view, students were active pursuers and constructors of knowledge, living, and working in a world of dynamic social being (p. 25).

The student as the "constructor of knowledge" is the basis for *constructivism*. This is the concept that knowledge is constructed through a learner's experience

(Fosnot, 1996). Doolittle and Camp (1999) summarized the "essential factors" for a *constructivist* pedagogy:

1. Learning should take place in authentic and real-world environments;
2. Learning should involve social negotiation and mediation;
3. Content and skills should be relevant to the learner;
4. Content and skills should be understood within the framework of the learner's prior knowledge;
5. Students should be assessed formatively, serving to inform future learning experiences;
6. Students should be encouraged to become self-regulatory, self-mediated, and self-aware;
7. Teachers serve primarily as guides and facilitators of learning, not instructors; and
8. Teachers should provide for and encourage multiple perspectives and representations on content.

There is a "hands-on" nature to constructivism. Learning is best in the "authentic" and "real-world" environment. This sounds very similar to Prosser. If one adopts *constructivism* as a framework for CTE, one can see the challenges to students and teachers when schools were closed, and programs were forced to an online/remote learning environment.

The final theoretical component to the CTE foundations component of this study's conceptual framework is *experiential learning*. It can be argued that *experiential learning* is more identifiable with CTE than *social efficiency*, *behaviorism*, and *constructivism*. Clark, Threeton, and Ewing (2010) noted that *experiential learning* has been a significant part of CTE for a long time. *Experiential learning* has been described as having two contexts (Clark, Threeton, & Ewing, 2010). The first as described by Smith (2013) is that experiential learning takes place where learners are provided with the opportunity to gain knowledge and develop skills from immediate and relevant environments. Also important with this context is that learners are also able to apply the knowledge and skills in the relevant learning environment (Smith, 2001). The second context is the learner's reflection of participation and encounters in everyday life which make up the experience (Houle, 1980). Clark, Threeton, and Ewing (2010) described this context as being aligned with life-long learning. They also argued that CTE fits into parameters of the first context (Clark, Threeton, & Ewing, 2010). As with the other theoretical framings, relevant "hands-on", "contextual" environments are needed for the successful use of *experiential learning*. Again, closing schools and moving to the remote/distance classrooms removed learners from engaging experiential learning environments.

Danielson's Framework for Teaching and Enhancing Professional Practice

The second component to this study's conceptual framework is based on Danielson's (2007) framework for teaching and enhancing professional practice. The Danielson framework has been identified as being grounded in the *constructivist* approach to learning (Williams, 2019). Danielson described good teaching as requiring the design of learning activities and assignments which provide the learner an opportunity to problem solve which leads to the construction of knowledge (Williams, 2019). She developed an evaluation tool for which good teachers would consistently demonstrate proficient or distinguished levels of performance in four domains (Danielson, 2007; Williams, 2019). Those four domains consist of the following:

1. planning and preparation;
2. classroom environment;
3. instruction; and
4. Professional responsibilities (Williams, 2019).

"Planning and preparation" is how teachers prepare and organize content and activities for students to learn (Williams, 2019). This is the instructional design for which the learning environment will provide a platform for delivery. 0Because of the pandemic school closures, CTE teachers were faced with the challenge of providing engaging activities through the online environment. They were forced to move away from the traditional face-to-face environments which provided the platform for hands-on activities.

The second part of the Danielson (2007) framework is the classroom environment. With this component, the teacher creates the learning environment to implement planning and preparation for the learner to construct knowledge. In the CTE discipline, the construction of knowledge combines with the development of college and career ready skills. A good teacher has the skill to manage a classroom culture where students have the belief that they are safe and comfortable and can concentrate on learning (Williams, 2019). In the spring of 2020, schools throughout the United States as well as many across the world went to remote learning environments. Suddenly, CTE teachers were faced with trying to help students perceive that they were safe and comfortable in a much different classroom environment.

Planning and preparation along with the classroom environment lead to the third component of Danielson's (2007) framework, instruction. Student engagement is important to instruction. This provides the learner with the opportunity to construct new knowledge and develop new skills. Williams (2019) found that the interaction with students is key to high quality CTE teachers. Also, good CTE teachers have been found to be actively involved in student-centered activities outside of the classroom such as Career and Technical Student Organization (CTSO) events. These activities contribute to the overall effectiveness of a CTE teacher's professional practice (Cannon, Tenuto, & Kitchel, 2013). Besides the

school closures, CTSOs experienced numerous cancellations of events such as leadership conferences and career development events. This added to the challenges facing teachers to provide environments and activities consistent with the "hands-on" learning characteristic of good CTE programs.

The final cornerstone of the Danielson (2007) framework is professional responsibilities. This encompasses the teacher's commitment to high ethical and professional standards leading to improve practice (Williams, 2019). Two important parts to this component of the framework are "participating in the professional community" and "growing and developing professionally" (Danielson, 2007; Williams, 2019). The COVID-19 pandemic lead to the school closures, cancellation of CTSO events, and the absence of professional development activities and events. CTE teachers use all of these as components to professional development. Added to profound changes in classroom environment, instruction, planning and preparation, this is yet another area where CTE teachers were challenged to fulfill their responsibilities.

The foundations of CTE and the Danielson (2007) framework for teaching and enhancing professional practice comprised the conceptual framework for this study. The data was analyzed and interpreted through this conceptual lens. COVID-19 became a global pandemic which lead to the challenge for CTE teachers to provide engaging learning experiences congruent to the traditional CTE model.

Research Problem

This study sought to explore the impact of the COVID-19 pandemic school shut down on CTE teachers and programs.

Research Objectives

Specifically, the following research objectives were developed:

1. Identify the challenges to planning and delivery of CTE content when schools were closed, and instruction was moved to remote/distance/ online platforms; and
2. Identify the challenges for students as perceived by CTE teachers when learning environments were moved to remote/distance/online platforms.

Methods

CTE researchers from Idaho, Illinois, Kansas, North Carolina, North Dakota, Oklahoma, and Pennsylvania began meeting in late March 2020 to develop this study. The researchers collectively have over 200 years of experience in most of the CTE content areas, and experience at both secondary and post-secondar levels. Meetings took place through Zoom, and this panel of experts developed the initial survey items by the end of April 2020. Qualtrics served as the online software to

create, organize, and administer the survey. Upon completion of the initial draft, the researchers pilot tested the instrument with at least two CTE teachers in each of the seven researcher's states. The data from the pilot test was analyzed and used to make final revisions to the instrument. The final instrument contained 37 questions including demographic information. The use of the panel of experts and the pilot test are considered best practices to strengthen content validity (Dillman, Smyth, & Christian, 2014).

The population for the study were U.S. CTE teachers employed by secondary and post-secondary institutions during the spring of 2020. Researchers used convenience sampling in their states of residence to administer the instrument and collect data. Previous research has shown that "convenience" sampling can be an effective method to collect and analyze data (Swanson, 2005; Maddy & Cannon, 2014). The following describes how the convenience samples were determined in each state:

- Idaho: An email list of certified secondary and post-secondary CTE teachers was provided by the state CTE agency.
- Illinois: An email containing the survey link was emailed to the CTE State Consultants and the Illinois Association of Career and Technical Education Executive Director for distribution.
- Kansas: An email containing the survey link was shared with the Kansas State Department of Education CTE Consultants who are assigned to specific CTE areas in Kansas. The link was distributed to secondary CTE educators across the state.
- North Carolina: The link was sent to the state's CTE administrators. After conferring with the principal investigator for more information the link was sent to CTE teachers.
- North Dakota: The survey link was sent to the state CTE content supervisors who then sent it out to their respective secondary and post-secondary CTE teachers in the state.
- Oklahoma: Solicitation email was sent directly to email addresses from a publicly accessible directory of all CTE teachers in the state; to all instructional leaders in Oklahoma via OkACTE association
- Pennsylvania: Invitations to participate in the study with a link to the survey were sent to business teachers in Pennsylvania using a distribution list comprised of business teachers in the summer of 2020.

Additionally, an email with the survey link was sent to every state CTE director in the U.S. and all Career and Technical Student Organizations executive directors. The link was provided to CTE professional organizations such as Association for Career and Technical Education (ACTE) and the University Council for Workforce and Human Resource Education (UCWHRE) for dissemination to members and member institutions.

The instrument was implemented in mid-summer 2020 using research supported protocol for online surveys developed by Dillman, Smyth, and Christian (2014). Five email contacts containing the survey link took place over

approximately a month and half from the first contact. Data was collected through Qualtrics and analyzed using Excel and SPSS.

Findings

The effects of the pandemic on society began to emerge in North America in February of 2020. By March of 2020 schools were forced to respond to the emerging crisis and began to change their practices. These changes involved modification for face-to-face instruction, as well as a shift to distance education facilitated through online instruction. The pandemic worsened throughout 2020, during which time CTE teachers struggled to adapt to the changing educational environment. The data used for this study was collected during the critical three-month period from mid-June 2020 to mid-September 2020. The findings represent the perceptions and experiences of CTE teachers who responded to the request to complete the study's online survey consisting of 37 questions. The findings also include a description of the demographics of the research participants.

At the end of the data collection period, 4,460 survey responses had been submitted despite the survey being administered during part of the summer months into September. The responses were analyzed for completeness, errors, and consistency. The analysis consisted of a review of two distinct sections of the survey: demographic and background data, and transition challenges. Responses that provided nearly complete demographic and background data were first identified. This resulted in the identification of 3,492 records. Further analysis included a review of record and construct completeness. The key criteria for this study was the extent to which respondents completed all 13 of the survey questions concerning transition challenges for teachers. When a record had nearly complete demographic and background data, and all 13 transition challenges for CTE teachers had been responded to, then the record was kept for analysis. The result of the screening provided the researchers 3,418 records that addressed transition challenges for CTE teachers. Of these, 3,267 respondents also completed all 13 items that addressed their perceptions of the transition challenges faced by students.

Demographics and Background

Approximately two-thirds of survey respondents identified as female (n = 2,311), while one third identified as male (n = 1,060). A small number (n = 47) did not provide a response on the gender question. The ages of the respondents varied, with the majority (86%) being 35 years or older (n = 2,924). Of this 86%, the ages were distributed relatively evenly between the ages of 35-44, 45-54, and 55 years and older. All other participants indicated their age to be less than 35 years of old (n = 494).

The level at which respondents taught ranged from middle school to postsecondary college programs. Some participants reported they taught at mixed levels, even changing schools during a single workday. Overall, 16% indicated

they taught at both the middle school and high school levels, while another 11% indicated they taught at both the high school and postsecondary levels. The remaining 77% indicated they taught at only one level: either the middle school level, the high school level, or the postsecondary level.

The number of years that respondents had been teaching varied widely. Six percent indicated they had either one year of teaching experience or were still in their first year of teaching. Twenty-three percent had 2-5 years of experience. The remaining 65% were distributed somewhat evenly between 6-10 years, 11-20 years, and 21-30 years respectively.

Most sizes of communities were represented, with 41% of survey responders indicating they taught in a rural community with a population of less than 2,500. The other 59% indicated they taught in an urban community, with about half of these indicating a community size of 2,500-49,999, and the other half indicating community size of 50,000 or larger.

The participants of the study represented nearly all the states within the United States. Oklahoma (n = 930), Kansas (n = 426) and Idaho (n = 422) had the highest participation numbers. There were eight states that each had over 100 CTE teachers provide responses. States with less than 30 respondents collectively represented 7% of the total number of participants, some of these had as low as one respondent to the survey. There were 19 states where there were at least 30 participants, and these states combined represented 93% of those who completed the survey for this study (Table 1). Despite it being the summer months and off contract time for many CTE teachers, a solid number of participants responded to the survey.

Table 1. Location of Study Participants

Location	**Teacher Transition Challenges**	**Perceived Student Challenges**
Oklahoma	930	878
Kansas	426	409
Idaho	422	407
North Dakota	287	277
North Carolina	230	225
Missouri	159	157
Illinois	128	121
Pennsylvania	113	109
Michigan	75	72
Virginia	68	63
Kentucky	65	65
Indiana	41	40
Montana	34	33
Georgia	33	33
California	33	31
New York	33	33
New Mexico	33	27
Wyoming	32	29
Nevada	32	29
< 30 responses/location	244	229
Total	3418	3267

In addition to the wide representation from regional areas, CTE content areas were also well represented. Teachers indicated the content area for which they teach. For many, this involved a single content area, but some reported teaching across a mix of content areas (Table 2).

Table 2. CTE Content Areas Represented in Survey Responses

CTE Content Area	**Teacher Challenges Responses**	**Student Challenges Responses**
Agricultural & Natural Resources Education	324	318
Business Education	425	397
Business and Marketing Education	151	144
Engineering & Technology Education	251	237
Family & Consumer Sciences Education	995	957
Health Occupations Education	349	332
Marketing Education	39	39
Trade & Industry Education	402	376
Mix of CTE content areas	288	281
Unsure	179	173
Did not respond (blank)	15	13
Total	3418	3267

Research Objective #2: Challenges to Planning and Delivery of CTE Content

Thirteen plausible transition challenges for teachers, plus one "other" write-in option, were presented to the CTE teachers participating in the study. The participants were asked to rank these challenges based on their own professional experiences during the first half-year of the pandemic. Perhaps not surprising, particularly for the CTE context, replicating the classroom or lab environment was the item that was ranked first more than any other item. The next two teaching challenges that that followed were teachers' lack of experience teaching online, and then engagement with students as remote learners (Table 3).

Table 3. Rank Order List of Pandemic Transition Challenges for CTE Teachers

Item	**Rank**
Replicating classroom or lab environment online.	1
Lack of experience teaching online.	2
Engaging students as remote learners.	3
My access to reliable internet connection, software, and equipment.	4
Delivering class content in a meaningful and impactful way.	5
Students have not been adequately available/responsive.	6
Balancing teaching with additional family responsibilities (caring for children or older adults etc).	7
Course lessons or activities that haven't translated well to a remote environment.	8
Other (write in)	9
Using educational technologies (i.e., Zoom, RN, others)	10
Student discomfort or lack of familiarity with required technology.	11
Assessing student learning.	12
My own discomfort or lack of familiarity with required technology.	13
Using best practices in online instruction.	14

Research Objective #3: Challenges for Students as Perceived by CTE Teachers

In addition to ranking transition challenges for CTE teachers based on their own experiences, CTE teachers were also asked to rank order items identified as plausible perceived transition challenges for students. Thirteen plausible transition challenges for students, plus one "other" write-in option, were presented to the CTE teachers participating in the study. The teachers were asked to rank these challenges based on their experiences with and perceptions of their students' challenges. Of the student challenges presented, teachers indicated a student's motivation to guide and manage their own learning as the highest ranked student challenge. The next most top ranked student challenge was having appropriate internet access, followed by the student challenge of student's lack of experience being an online learner (Table 4).

Table 4. Rank Order List of Pandemic Transition Challenges for Students as Perceived by CTE Teachers

Item	**All-R**
Motivation to guide & manage their own learning	1
Students' access to reliable internet connection.	2
Lack of experience with remote learning	3
Students' access to technology equipment	4
Mental health and well-being/social isolation	5
Students' access to software.	6
Other (write in)	7
Family commitments	8
Work obligations	9
Financial barriers	10
Food or housing insecurity	11
Health/sickness COVID-19 related	12
Lack of access to assistive technologies	13
Health/sickness non-COVID-19 related	14

Discussion

Due to the contextual nature of CTE instructional delivery, school districts and teachers faced a challenge of providing a high-quality learning environment while teaching in a pandemic. To better understand the difficulties, this research explored the CTE teacher perceptions of COVID-19 pandemic challenges to teaching and learning. Specifically, the study sought to identify the pandemic transition challenges among CTE teachers and pandemic transition challenges for students perceived by CTE teachers. Over three thousand CTE teachers with nearly every state in the union represented, responded to the survey. All CTE teaching areas were represented with most respondents from Family and Consumer Sciences Education followed by Business and Marketing Education. The majority of the respondents were female. Age, size of community, years teaching, and school level had varied representation in each range. This profile

data provides a national snapshot of CTE teachers' challenges teaching in a pandemic.

The conceptual framework used in this study comprised of the foundation underpinnings of CTE and the Danielson (2007) framework for teaching and enhancing professional practice allows for interpretation of the findings through conceptual lens. Because of the nature of being a "hands-on" discipline or incorporating a constructivist approach, the challenges for CTE teachers themselves and their perceived student challenges represent significant altering of their skilled pedagogy due to transitioning from a traditional classroom setting to an online format. As a result, the findings of this study provided reasoning given the challenges among CTE teachers and their students.

CTE teachers in this study ranked *replicating classroom or lab environment online* as the top challenge when school closed and/or transitioned to an online platform. Doolittle and Camp (1999) believed learning should take place in authentic and real-world environments. These CTE teachers found it difficult to provide environments and activities consistent with the "hands-on" learning which is a characteristic of good CTE programs. Therefore, the struggle to teach technical skills while being online proved problematic for many CTE teachers. For example, it would be nearly impossible to teach welding proficiency online. Without a contextual classroom, a welding teacher would have difficulty demonstrating welding lines then having students practice while being closely supervised. CTE teachers had to improvise content instruction that did not have a hands-on component.

With the swift pivot from face-to-face to online instruction, the second ranked challenge among CTE teachers was their *lack of experience with teaching online*. By not having the familiarity or knowledge of technology platforms and software equipment, this challenge could be interwoven in all the other identified challenges. For example, experience with technology could *reduce the challenges of delivering content in a meaningful and impactful way* (ranked 4th), *course lessons or activities that haven't translated well to a remote environment* (ranked 8th), and *being able to assess student learning remotely* (ranked 12th). This challenge, *lack of experience with technology*, espouses the importance of Danielson's (2007) professional responsibilities component citing the need to improve practice (Williams, 2019).

According to Danielson's (2007) framework, student engagement is important to instruction. With the transition from in person to online, CTE teachers in this study ranked *engaging students as remote learners* as the third most ranked challenge. Smith (2001) noted that experiential learning engages learners to gain knowledge, develop skills, and apply the knowledge and skills in the relevant learning environment. Online instruction forced CTE teachers to abandon the engaging experiential learning component that is essential to a CTE classroom and settle for passive activities.

Education is a reciprocal process and challenges are posed for teachers when *students are unavailable or unresponsive* (ranked 6th) or *experience discomfort or are unfamiliar with the required technologies* (ranked 11th). Danielson's (2007) framework stresses the importance of student engagement to instruction. The lack

of student engagement whether non-participatory or the inability to use technology, disrupts the learning environment.

Several challenges that were ranked by CTE teachers in this study could be categorized as pedagogy for online teaching. These challenges include *engaging students as remote learners* (ranked 2nd), *delivering content in a meaningful and impactful way* (ranked 5th), *course lessons or activities that haven't translated well to a remote environment* (ranked 8th), *assessing student learning remotely* (ranked 12th) and *using best practices in online instruction* (ranked 14th). Danielson's (2007) framework emphasized professional development to improve practice. Going forward with the return of professional development activities, such as in-service meetings, conferences, and workshops, these are essential topics to focus on for CTE teachers.

While CTE teachers ranked their challenges teaching in a pandemic, they also ranked perceived challenges facing their students while learning in pandemic. The number one ranked perceived student challenge by CTE teachers was *motivation to guide and manage their own learning*. This challenge refers to the skill of self-regulated learning which is the process by which individual learners attempt to monitor and control their own learning (Zimmerman & Schunk, 2011). Transitioning from engaging experiential learning (hands-on) to a passive learning environment (i.e., watching videos) lessens the motivation to self-regulate one's learning. Williams (2019) found that an established classroom culture allows for students to concentrate on learning however with the school closures, students became independent learners away from their peers and teacher.

The next three perceived student challenges are related to technology. These include *students' access to reliable internet connection* (ranked 2nd), *lack of experience with remote learning* (ranked 3rd), and *students' access to technology equipment* (ranked 4th). With the quick transition from the classroom to online learning, there was little to no time to prepare families for technology needs at home. Financial constraints, geographical limits, and time are viable factors for these rankings by CTE teachers.

Ranked 5th among the perceived student challenges by CTE teachers was *mental health and well-being/social isolation*. Well documented, increased anxiety and depression among adolescents has exacerbated during the pandemic due to the forced isolation by the federal/state governments and the school closures (Hawes et al., 2021). Williams (2019) reported that a good teacher has the skill to manage a classroom culture where students perceive they are safe and comfortable so this upper-level ranking was a plus that CTE teachers in this study sensed mental health and well-being issues among their students from afar.

Conclusions and Recommendations

In a "normal" environment educational decision making for pedagogy, andragogy, curriculum design and administrative duties is complex. The first half of 2020 was anything but normal affecting not only education but all aspects of our lives. The emergence and prevalence of the COVID-19 pandemic added a

layer of complexity to educational practice that was not foreseen and for which no intentional preparation had occurred. Essentially, within a simple matter of days, face-to-face instruction and all its normal practices were disrupted, and the educational system and the people involved were asked to deliver instruction through online and various hybrid formats. Understanding how CTE teachers and instructors responded to this call, and the challenges they and their students encountered, is important to efforts to improve practice in the future and to be in a better position should another crisis occur that forces learning to be delivered in alternative formats from that of the traditional face-to-face classroom.

Findings from the current study indicate that CTE teachers may need additional supports in implementing remote teaching. Providing professional development to CTE teachers could help to mitigate the challenges these teachers report experiencing in delivering remote instruction to their students. Technology trainings would provide the opportunity for CTE teachers to feel more confident in their remote instruction, to provide higher quality and more effective remote instruction to their students, and to increase student learning and development. In turn, teachers could be able to support students and their families in learning about how to navigate technology and online learning platforms to be able to engage in remote learning.

The conceptual frameworks used in this study framed interpretation for the findings. The CTE teachers in this study struggled with implementing the constructivist approach which is grounded in experiential learning and in Danielson's (2007) framework for teaching and enhancing professional practice. The challenges for CTE teachers to provide engaging learning experiences were incompatible to the traditional CTE models. Therefore, professional development opportunities designed to transition a CTE classroom to an online CTE classroom is needed given that remote teaching is unknown for the upcoming school year.

While this research study ranked challenges for CTE teachers teaching in a pandemic and their perceived student challenges learning in a pandemic, the need to further understand the post effects of teaching and learning needs to be explored. The findings in this study predicate the need for future research that includes:

1. Explore a qualitative approach for in depth analysis of challenges in teaching in a pandemic among CTE teachers;
2. Determine professional development needs of CTE teachers post pandemic teaching;
3. Examine the social and emotional impact of teaching in a pandemic among CTE teachers;
4. Examine the burnout among CTE teachers teaching in a pandemic; and
5. Examine the commitment among CTE teachers post pandemic.

Since this manuscript was originally written and submitted, several researchers have focused on our research recommendations. One such researcher was DuPuis (2023). The researcher found that community college CTE instructors were able to use the virtual learning environment in a more successful and efficient manner

than high school CTE teachers. Academic achievement and motivation were higher for the CTE community college students. Bartlett et al. (2022) found that more professional development on engaging students online and ways to replicate the hands-on experience in online learning using augmented reality, virtual reality, and mixed reality design.

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Artificial Intelligence (AI) and its Potential Impact on the Future of Higher Education

By Lorraine Bennett[*] & Ali Abusalem[±]

Still rebounding from the impact of the global pandemic, the higher education sector is being challenged even further by the next wave of Artificial Intelligence (AI) technologies. These technologies have the power to generate in a matter of seconds, quality text, images, music and coding responses to questions or prompts entered into an online chat box. Currently, one of the most accessible and popular text generators is OpenAI's ChatGPT which was released in November 2022. Early evaluation indicates that the quality of the responses exceed standard pass rates for comparable university assessments. Even if academic protocols mandate that text cited from AI sources should be acknowledged and referenced as any other source material, the speed, accessibility and high quality of the AI material justifies a rethink of the purpose of higher education and a redesign of curriculum, pedagogy and assessment. An initial suggestion being promoted in the sector is that learning outcomes and assessments should move away from a focus on content memorisation and recall, to development of higher order thinking skills such as critical analysis, evaluation, resilience, creativity, problem solving, appraising and mastery of verbal communication and computer literacy. This preliminary paper examines some of the literature to date, which discusses potential risks and threats, as well as the opportunities to enhance learning, embedded in this new wave of emerging AI technologies in higher education.

Keywords: Artificial Intelligence technologies, generative text software, implications for curriculum, pedagogy and assessment design.

Introduction

The *advent of Artificial Intelligence (AI) technologies, such as ChatGPT, is poised to revolutionise the way we think about education. By allowing access to personalised, interactive learning experiences, AI-driven education promises to revolutionise the way students learn and educators teach. AI-driven technologies such as ChatGPT offer the potential to create personalised, interactive learning environments that are tailored to individual learning styles, interests, and needs. This shift away from traditional learning paradigms could fundamentally transform the way in which students learn and educators teach, providing unprecedented opportunities to engage with and learn from one another. The impact of AI-driven education technologies will be felt on a global scale, as it has the potential to revolutionise the way education is delivered and experienced around the world.*

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This introduction was created in under three seconds as a result of a simple request entered in OpenAI' s online Playground in early 2023. The question posted was 'Write an opening paragraph or two which positions the impact of AI technologies such as ChatGPT as a major shift in the future of education globally'.

Open AI's response is included in the opening of this paper to illustrate the capacity and power of AI text generative software. On the whole, it offers a reasonable introduction to the subject, although it is quite formulaic and repetitive. A more skilfully worded prompt or request would have harvested a higher quality response. This assumption can be tested by repeating the activity with an improved question.

This preliminary paper approaches the topic of 'Artificial Intelligence (AI) and its Potential Impact on the Future of Higher Education' from a broad perspective. It provides a brief overview of the history of AI in education and discusses some of the risks, threats and opportunities for learning reported in popular and academic literature. The focus of the investigation is on the impact of AI on the higher education sector in the short term and into the future. Future papers and presentations, which exam specific aspects such as the impact of AI on curriculum and pedagogies, and examples of digital assessments which incorporate or minimise the impact of AI, are currently being developed to stimulate further discussion and debate within the sector. It is anticipated that this body of work on AI generative technologies and their impact on education and learning, will form the basis for a professional development book or manual designed to build the capability of higher education institutions to optimise these tools in learning and research.

Context

There is no doubt that education is on the cusp of a new frontier and that to use the language of 'digital natives' - Generation Z, AI technologies will be 'major disrupters' and 'game changers'(Dodd, 2023a). It is not an exaggeration to suggest that advancements in AI will have greater and more sustained impact on our lives than the recent COVID-19 pandemic. Governments, businesses, communities, and education systems will be transformed and individual citizens will encounter quantum leaps in the way they experience and engage electronically, with these and other institutions related to daily activities. The pace of adopting AI technologies will be rapid. As a result of fundamental knowledge and content being more accessible, much is being written about the next wave of intellectual, technical and practical skills that citizens will need to develop. Chamorro-Premuzic (2023) describes this as a need to double-down on human traits of curiosity, adaptability and emotional intelligence and a need to sharpen our somewhat dulled virtues of empathy, humility and self-control.

Among the types of learning outcomes that are being advocated are agility, resilience, creativity, critical thinking, problem solving, appraising and effective communication, particularly verbal and computer literacy. Attributes or traits that are being advanced are those linked to ethics, citizenship, collaboration, teamwork, social conscious and global awareness. An insightful article on the skills that future

workers will need recommends grouping them into cognitive, interpersonal, self-leadership and digital literacy skills (Dondi et al., 2021).

The concept of developing a mind-set of 'life-long learning' is another strong theme in educational and business literature in recognition of the view that in the future, jobs will not remain static and employees with need to regularly transition and adapt their learning to new jobs and occupations, many of which may not exist at the present time. A 2021 paper argues that the notion of life-long learning needs to embrace AI and digital technologies and focus on human development and creating value through drawing upon AI technologies (Poquet & de Laat, 2021).

Purpose

The purpose of this paper is to spark discussion and debate amongst leaders, academics, practitioners and students on the potential impact of AI technologies on the higher education landscape.

The research question posed is:

> 'What will readily available student access to AI generative technologies mean for future teaching, learning and assessment practices and protocols in higher education institutions throughout the world?'

Scope and Limitations

The development of AI technologies is moving so fast and the ground swell of interest is expanding daily that a raft of new products is likely to be available, even before this paper is published. This paper provides a snapshot of the impact and appetite for AI technologies in higher education in the first three months of 2023.

The paper has been largely informed by developments in Australia supplemented by some reports from the USA and England. While some of the articles on AI technologies and education cover the broad education sector, preference has been given to material linked to AI in higher education.

As the wide-spread availability of generative AI technologies is very recent, there has been insufficient time for any long-term research into the impact of these technologies on student learning and assessment practices. It is anticipated that from 2024 onwards, academic literature will start to contain research papers on case studies and analysis of practice.

Definitions

The emerging topic of AI technologies is full of new terminology and acronyms. In order to assist the reader, the following definitions have been included in the paper.

Algorithms are sets of instructions or steps, usually applied in mathematics or computing to solve a particular problem.

Artificial Intelligence (AI) refers to the practice of getting machines to mimic human intelligence to perform tasks.

ChatBot is software which simulates human-like conversations with users via chat. Its key task is to answer users' questions with instant messages.

ChatGPT, the GPT stands for 'Generative Pretrained Transformer'. ChatGPT is an AI language model, that has been trained on a massive corpus of text data, including books, articles, websites, and other sources of information (currently sources up to 2021). The software has learned to recognise patterns and relationships within that data. The program uses algorithms and statistical models to generate responses based on the input (questions or prompts) it receives.

CodeX is an AI technology for producing coding.

DALL-E a tool for AI-generated art. It is similar to ChatGPT but instead of being based on language, it specialises in images and visual outputs.

Generation Z comprises people born between 1996 and 2010. They are often referred to as 'digital natives' - the first generation to grow up with the internet as a part of daily life and to have unlimited information available at the click of their latest digital device.

Generative artificial intelligence (AI) describes algorithms (such as ChatGPT) that can be used to create new content, including audio, code, images, text, simulations, and videos.

Machine Learning is sometimes abbreviated to ML. It is a branch of artificial intelligence (AI) and computer science which focuses on the use of data and algorithms to imitate the way that humans learn.

OpenAI was founded in 2015. It is an AI research and deployment company whose stated mission is to ensure that artificial general intelligence (AGI) benefits all of humanity. It is building a stable of software packages the most popular at this time being ChatGPT (text creation), DALL-E (image creation) and CodeX for coding.

Prompts refer to the key words or questions created to ask programs such as ChatGPT. The more specific and detailed the questions the better the output. A new concept of 'prompt engineering' is emerging in the business literature which refers to identifying the elements which make a quality prompt. These elements include stating the style, format and length of text required, points to be addressed, and the perspective to be taken.

Robotics rely on AI mostly associated with engineering. It involves design, construction, and use of machines (robots) to perform tasks done traditionally by human beings.

Paper Outline

The paper covers the following topics.

1. A preliminary review of literature which provides a brief discussion on the early developments of computers and machine-based learning.

2. Discussion and analysis of the espoused risks and opportunities to enhance learning, by implementing AI technologies in universities. This section is primarily informed by commentary and opinion articles, and reports on the recent application and impact of new wave 'generative' AI technologies in higher education.
3. Discussion on the need for major curriculum reform in higher education, especially in approaches to teaching, learning and assessment design.
4. In conclusion, some suggested areas that need to be addressed in order to minimise the risks and optimise the potential benefits of AI technologies in the higher education sector.

Review of Literature

Early Developments

Machine and computer programs designed to support education and learning originated in the mid-twentieth century. An early example is the American-designed computer software program widely known as PLATO - *Programmed Logic for Automated Teaching Operations.* This software was invented by a team led by Donald Bitzer, a university professor in electrical engineering who was concerned with reports that fifty percent of students graduating from inner city schools in the USA were functionally illiterate (Jones, 2023). The initial program deployed computer languages such as FORTRAN and TUTOR to prepare education materials. Users were confined to a single-purpose laboratory equipped with computers connected to a central mainframe. The early programs provided games, simulations and tutorials to support learners to build their capacity to read (Dear, 2018).

The next major advancements in computer-based learning occurred with the invention of the internet in the 1990s, followed by the widespread availability of personal computers and then the development of wifi, which afforded widespread accessibility and connectivity to the internet (Pastor-Satorras & Vespignani, 2010). The internet provided further opportunities for human interaction with computers for the purpose of learning. Amongst the next wave of popular computer-based education programs were quizzes to test knowledge, self-paced training modules in the areas of health and safety, Q and A databases for frequently asked questions, and programs which enabled automatic marking and feedback on computer-based tests. The availability of personal computers and expanding wifi connections meant that students could almost learn at any time and from anywhere.

Since the availability of AI technologies on the web, such as ChatGPT, educational institutions around the world have started to take great interest in the impact and potential of generative software programs to support learning and learners. To date, business and academic literature on this new wave of AI technologies mainly involves opinion and commentary articles which debate the pros and cons of AI in education and editorialise on key considerations for policy

makers, educational leaders and practitioners (Yousuf & Wahid, 2021; Chui et al., 2022, & Peterson, 2023).

The next groundswell of literature on AI in education will undoubtedly provide reports and findings from research and case studies into the new generation of AI software programs and their impact on teaching, learning and assessment in both controlled and in-situ settings.

So far, the literature review has provided a brief background on the evolution of AI technologies in education. It traced AI's early beginnings from the invention of computer mainframes, specific purpose computer laboratories, the internet, personal computers, wifi connectivity and most recently, responsive and generative text, image, music and coding software.

Discussion and Analysis of the Espoused Risks, Threats and Opportunities to Enhance Learning of Implementing AI Technologies in Universities

The next section of the paper identifies and discusses some of the risks and threats, as well as the opportunities to enhance learning, of the widespread implementation of AI generative software in higher education settings. As the application of AI technologies in higher education is a rapidly developing area, the risks, threats and opportunities discussed in this paper are those identified at this point in time. As universities integrate AI into their curriculum, pedagogy and assessment, and as new technologies become accessible, it is feasible that new risks and threats to academic integrity and new opportunities for learning enhancement will emerge and will need to be addressed. Society is facing a very fragile and shifting educational landscape.

Potential Risks to the Academic Integrity of Education by Drawing upon Artificial Intelligence

The previous section on the early developments in machine and computer learning indicated that computers have been used in education to support learning, especially for low performing students, for a number of years. However, the landscape changed significantly with the release of user-friendly, free or low cost AI generated text software in November 2022, through OpenAI and other companies. Initially, the response from academics and professionals in the advertising and marketing industries was one of fear or at least serious concern, as they saw their jobs being replaced by machines.

Since generative models of AI are new, research into the long-term effects of these tools in the business and education sectors is sparce. However, even at this early stage of implementation, a literature search and review of webinars and panel discussion on the risks and threats to academic integrity of such software, revealed a number of issues and challenges. Many of these articles and discussions are quite subjective but they raise significant questions such as: how AI might be used in different subjects? And, how might AI be able to support students with special needs? (Girdhar, 2022).

One major threat, not only to academic integrity but to the entire system of certification of university qualifications, is the potential for fraudulent submission of AI generated written text, artwork, musical compositions and coding algorithms as original work (Cohen, 2023). Without adequate regulations, policies and processes for monitoring and authenticating assessments, it might be possible for someone to pass an entire university course by submitting AI generated work. If this practice is allowed to progress unchecked, it has the potential to completely undermine the value of higher education qualifications and destroy the reputation of offending universities and even the entire higher education sector.

Commentators warn that to maintain academic integrity standards, AI generated text will need to be treated like any other source and acknowledged with appropriate attribution. However, a significant difference between AI generated text and traditional plagiarism is that the AI is constantly evolving and has the ability to respond quickly to detection software. Furthermore, the potential of AI software to deliver reasonable quality written work, calls into question the appropriateness of essays and simple written tasks for assessment purposes. A range of early research suggests that 50%-75% ChatGPT generated essays would receive at least a 50% pass mark compared to equivalent level university assessment. A study conducted at the University of Pennsylvania found that ChatGPT was capable of writing responses to an examination paper in a MBA course, to an overall B to B- standard (Terwiesch, 2023). Other researchers noted that the AI generated text was of a very high standard when it was required to perform basic analysis but made simple mathematical errors and struggled with more complex analysis questions (Rosenblatt, 2023).

A similar study found that the earlier foundational, less powerful ChatBot, GPT-3.5 had the potential to pass the multi-state multiple choice section of the Law Bar Examination, which generally requires seven years post-secondary school education and months of targeted preparation (Bommarito & Katz, 2022).

To avoid blatant cheating and academic misconduct, curriculum designers and assessors will need to become familiar with the potential of AI and either design assessment tasks which incorporate AI or minimise its input. It will no longer be sufficient to rely upon evidence of knowledge in a descriptive written essay format. Assessment design will require evidence of higher order thinking such as analysis and evaluation of the ChatGPT generated text against discipline-based theories, or reflection on the content of the computer text in reference to a specific context or case study.

A useful starting point for this approach might be to revisit Bloom's (1956) Taxonomy of Education Objectives and later adaptations of the taxonomy including ones for digital learning contexts (Anderson & Krathwohl, 2001 and Krathwohl, 2002). It is suggested that reference to Bloom's taxonomy requires a significant move up his knowledge hierarchy to more complex thinking, which is sometimes referred to as metacognition - thinking about thinking'(Chick, 2013). Reference to Bloom's affective domains which address feelings, emotions and attitudes as well as his psychomotor domains may also be helpful in optimising the application of AI educational technologies and reshaping curriculum, pedagogy and assessment (Armstrong, 2010 & Persaud, 2021).

While early research suggests that computer generated essays and responses are of a reasonable quality, others point to the potential for bias and inaccurate information (Scharth, 2023). AI generated text software relies on algorithms to search through the masses of data that the program has been trained to sort and retrieve. Its response is only as accurate as the information that it has been exposed to and, at the time of writing this paper, can only draw upon information that was available up to 2021. Any developments since that time will not be captured. However, as new information is fed into the system, one must assume that the quality of the responses will continue to improve.

If the question or prompt posted in the AI software is not carefully crafted, it can also inherently convey a bias which is reproduced in the software's response. For example, as an experimental exercise the following two requests were entered into ChatGPT. Prompt 1: 'Write two to three paragraphs on the significance of Australia Day Celebrations. Prompt 2: Write two to three paragraphs on why some people oppose Australia Day Celebrations?' On the surface these two prompts are very similar but the second one contains a definite negative view of Australia Day, which was captured in the AI generated responses.

While unwitting bias is identified as a risk of AI generated text, so too is the potential for inaccurate or unreliable information. The computer software behind programs such as ChatGPT are based on the material from a variety of sources, the status of which is unclear. This practice goes against conventional academic practice which teaches reliability and validity as cornerstones of research methodology. It might be possible to limit the field by requesting information from only scholarly or refereed sources but verification of the authenticity of the information provided may still be unclear.

Another risk of AI technologies that is raised in the literature and panel discussions is that of privacy. While, this is linked to academic integrity, the articulated concern is more to do with protection of student data, ownership of intellectual property and copyright. The issue of privacy flows into concerns about transparency and authenticity and illegal use of staff and student work.

The need to distinguish between computer-generated work and human output is partially being addressed by the need to acknowledge and cite sources, which is in line with the required protocol for any academic work. However, the risk can be mitigated or minimised significantly, by rethinking assessment design and monitoring and evaluating assessment artefacts through various stages of development. This might mean monitoring assessment at the planning phase, drafting phase, feedback phase and completion phase. Other strategies might be to preference recorded and personally narrated oral presentation assessments, and peer and self-reflections and assessments.

A significant risk to academic integrity, which flowed through much of the literature and discussion on the application of AI generated outputs, is the concern around ethics and ethical practices. The topic touches upon issues of equity for all students in relation to access to computers, reliable wifi and relevant software programs. It also covers ethics in relation to transparency, ownership and how the computer generated outputs are used (Buckingham Shum, 2023).

The potential to use computer programs to replace lecturers and human interaction was raised as a concern in some forums. This concern was often expressed in terms of the overall loss of human intellectual capacity and collegiality in our universities. Some academics noted the extra demands on tenured staff, and a trend toward casualisation of the workforce with inadequate compensation for demanding roles such as tutoring and marking assessments.

Potential Opportunities to Enhance Learning and the Academic Integrity of Education by Drawing upon Artificial Intelligence

While some early voices raised concerns about the potential of AI generated outputs to undermine the foundations of traditional education institutions, the more optimistic and pragmatic views are that AI generative software programs are readily available and that educators need to take advantage of their outputs to enhance and expand learning opportunities. An early article by Salomon, Perkins et al., (1991), identified benefits of human and computer technology partnerships as well as the residual, or spin-off cognitive effects for humans of working with machines.

An initial assumption is that machine learning is impersonal and generic. However, recent commentary on the value of utilising AI tools to enhance learning, suggests that software such as ChatGPT can be used to create more personalised learning experiences for individual students. The notion behind this view is that by accessing data on individual student's strengths, weaknesses and learning preferences, AI can generate an algorithm to provide learning activities tailored to each student's needs.

In a recent interview, controversial and prominent clinical psychologists and social commentator Jordan Peterson predicts that AI is going to highlight the importance of human intelligence with respect to our ability to bring meaning to content (Peterson, 2023). This view is already being somewhat challenged by a recent research project which investigated the ability of the latest AI, ChatGPT-4. This study reported a new general intelligence, coined 'artificial general intelligence' demonstrated in GPT-4's core mental capabilities of reasoning, creativity, and deduction tested in a range of disciplines including literature, medicine, and coding and tasks such as playing games and using tools. (Bubeck. 2023).

Already a number of University Learning and Teaching Centres are providing advice on how to use AI generated text to support student learning. In Australia at the University of Sydney researchers are exploring AI as a research partner, to improve student writing and language learning, and to foster interaction and creativity (Liu, 2023). At Stanford University in the USA, the guidance notes from the Center for Learning and Teaching strongly advise implementation of pedagogy and assessment which works with AI. The principles they follow include transparency, focusing on learning outcomes, designing assessments for an AI world (Stanford University 2023).

The topic of effective feedback is addressed substantially in educational literature. Concepts such as the impact on learning of Ebbinghaus's forgetting curve (Shrestha, 2017) and experiments around the number of new pieces of

information that can be processed at the same time are well documented in cognitive overload theory and research studies (Sweller, Ayres et al., 2011). The common concerns that emerge when evaluating effective feedback are, was the feedback provided in a timely manner, was the information provided accurate, and did the feedback provided lead to improvement. In terms of the above criteria for providing effective feedback, AI tools exceed all these expectations. They can be programmed to provide individual feedback in real-time, to identify areas for improvement and to suggest helpful resources and strategies.

Educators working with findings from contemporary neuroscience on how the brain learns point to a number of brain-friendly learning strategies or learning enablers which facilitate effective learning (Willis, 2007 & 2020; Hardiman, 2012). Effective feedback is named as one of the learning enablers, along with the provision of interactive and engaging activities, sequential learning tasks and fun and relevant activities. AI-powered educational tools can be designed to address all of these elements. Computer games which progress from simple to more complex levels of skill address elements of motivation, engagement, scaffolded learning and enjoyment; factors which neuroscience supports lead to enhanced learning (Willis, 2007).

While rural and remote students, and students from low socio-economic groups, may be disadvantaged by not having access to a personal computer and adequate wifi coverage to connect to AI tools, overall, the development of AI tools has the potential to expand and enhance educational opportunities to new student markets. For example, ChatGPT software offers language translation services for those whose first language may not be English.

Academic staff and students frequently complain about heavy work and study loads. They express frustration particularly about so-called ‘busy work’ which consumes significant time for little benefit. AI can relieve staff of many of the routine administrative tasks by providing time-saving tools. Examples include providing current lists of relevant research papers, opening chat rooms and discussion boards for integration and sharing of resources.

The Need for Major Curriculum Reform in Higher Education, Especially in Approaches to Teaching, Learning and Assessment Design as a Result of the Growth in AI Educational Technologies

Current literature on AI, notes the exponential growth in the application of AI across many aspects of society, especially the business, finance and education sectors. The speed of expansion was boosted by the global pandemic of 2020-2023 which saw many emerging technologies boom due to the necessity of doing business remotely and communicating and learning online.

In the education sector, schools and universities were closed and replaced by models of remote and online learning. As a result of this major transition to online and digital learning, educators sought out digital technologies and sources to support this mode of delivery.

Major concerns about the lack of regulations and policies to ensure ethical use of AI technologies continue to be expressed, in government, business and

education literature. According to a Stanford University Artificial Intelligence Index Report (2022), publications expressing concerns about the lack of fairness and transparency have increased fivefold over the past four years and that while AI models are excelling on technical benchmarks, there propensity for bias is increasing.

For Korteling et al., (2021) the issue is not whether human or artificial intelligence is better but rather '*For what tasks and under what conditions, decisions are safe to leave to AI and when is human judgment required?' (*Korteling et al., 2021. *p.1).* Korteling and colleagues argue for an approach to education based on a collaborative model which capitalises on the specific strengths of both human intelligence and artificial intelligence. This approach distinguishes between biological (human) and digital (machine) behaviours and concepts of intelligence. They identify that behaviours associated with humans reflect an anthropocentric perspective and include such capacities as awareness, attention, emotion, creativity, planning and reasoning. They propose a non-anthropocentric definition of artificial intelligence which draws upon the earlier work of Bieger et al., (2014) and Tegmark (2017) as 'non-biological capacities to autonomously and efficiently achieve complex goals in a wide range of environments'. The anthropocentric theme is reflected in a 2023 publication by Chamorro-Premuzic which calls for humans to reclaim was makes us unique from automation.

With respect to the future of education and curriculum development across all education sectors, one of the main messages from Korteling et al., (2021) is that educational leaders and curriculum developers will benefit from approaches to teaching, learning and assessment which utilise and integrate both human intelligence and artificial intelligence, recognising the strengths of each and determining for what and when to trust and rely on the information provided.

The potential or likelihood that AI generative programs such as ChatGPT will spark a major re-think of higher education curriculum, pedagogy and assessment is extremely high. A common view across the sector is that recent new breakthroughs in the field have the potential to drastically change the way we approach content creation (Chui et al., 2022 and Dodd, 2023b).

The potential of AI to change the focus of higher educational and teaching practice is not only being discussed in western countries. The review of literature found several examples from Asian countries which cited the power of AI to create positive learning environments and positive learning experiences spanning a range of disciplines. The ability of AI to translate across languages is also seen as a positive factor (Neha, 2020).

ChatGPT is a tool which enables non-technical users to access reasonable quality content on the web very quickly. In educational settings it is best treated as a resource to assist and optimise learning by shifting the focus from content acquisition and rote learning to higher order thinking skills such as analysis, critical thinking, evaluation, reflection and creative problem solving.

Earlier in the paper, reference was made to Bloom's taxonomy and updated digitalised versions, to inform integration of AI into curriculum reform. The Structure of the Observed Learning Outcomes (Solo) Taxonomy, devised by Biggs and Collis (1982), is another way of thinking about students' level of learning and may assist in devising ways to integrate AI technologies into learning activities

and assessment design. It may even be worth running fresh eyes over Maslow's hierarchy of needs with a focus on the concepts of wisdom and intelligence embedded in his concept of self-actualisation (Rudin, 2017).

Curriculum design generally starts with the identification of course and unit learning outcomes which become the anchor or reference point for the curriculum content, pedagogy, learning activities and assessment tasks. The regulator and curriculum experts have encouraged practitioners to think of learning outcomes in terms on acquisition of knowledge, skills, application of knowledge and skills along with attributes such as ethics, life-long learning and teamwork (Higher Education Standards Framework (Threshold Standards) HESF 2021 and TEQSA 2023).

With the increasing accessibility of AI technologies capable of furnishing quality content within seconds, the focus on curriculum design will need to move away from content generation, memorisation and recall to a curriculum which evaluates and applies the content through processes such as critical analysis, problem solving, comparing and contrasting, and contextualising the content to specific case studies and personal scenarios. Learning outcomes and assessments will need to aim for authenticity, innovation, involve experiential and personal activities and be forward looking. A recent Digital Assessment Framework (DASH C21) development by Bennett and Abusalem (2023), is a useful resource for thinking about and developing digital assessments that utilise technology tools, which support academic integrity policies and practices. The DASH C21 Framework is underpinned by a set of ten principles and values which are the inputs. It draws upon four dimensions including practices and pedagogies, strategies, emerging technologies and stretching horizons and provides outputs in the form of digital assessments which are authentic, forward looking, experiential and innovative embedded in academic integrity.

Discussion

The preliminary investigation undertaken in this initial paper on the potential impact of AI education technologies on the future of higher education, corroborates the notion that the sector is at a tipping point of relevancy and survival. This situation has been building for some time. In an evidenced-based book entitled *The University Challenge Changing universities in a changing world*, co-authored in 2020 by Byrne and Clarke, the former an eminent international academic and leader of higher education institutions in Australia and England and the latter, a former Minister for Higher Education in the British Parliament, argue that the current university model is no longer fit-for-purpose. They claim that universities are losing their status and relevancy in society and need to become more responsive and flexible to new modes of learning and life-long education. Despite this rather grim view of the current system of higher education they strongly advocate that 'high quality universities are the best way to help our world deal with the enormous challenges of accelerating change' (p.245). They propose a higher education model which, understands and interprets change

in the world, offers approaches to harness the process of change for general benefit, educates and trains the specialists whose skills are necessary to address change and creates an intellectually engaging climate and culture across societies. Thinking of change that is currently upon higher education as a result of AI technologies, the four tenets suggested by Byrne and Clarke are well worth keeping to the forefront of curriculum reform in higher education.

An area of learning theory which is worth considering when assessing the risks and benefits of content derived from artificial intelligence is the body of work on human and multiple intelligences. An early component of multiple intelligences was Gardner (1986), who suggested eight types of human intelligences. These are linguistic, logical/mathematical, spatial, bodily-kinesthetics, musical, interpersonal, intrapersonal, and naturalist. Since this early research into multiple intelligences, other forms of intelligence have become popular in education and psychology disciplines to help explain human behaviours and reactions. The most common of these new wave intelligences are spiritual, emotional, social, moral and existential intelligences (Mayer & Salovey, 1999). Although there is some debate as to whether these are intelligences or simple attributes or personality traits, it is this latter group of 'human intelligences' which may need to be prioritised in an education environment where machine-derived content is a given.

Another perspective on the concept of human versus machine intelligence is that instead of discussing the differences between the way humans and machines process content as 'intelligences' we consider the differences in terms of lenses or filters. Using this premise, it is possible to argue that unlike machines, humans have the capacity to be aware of their environment and apply filters to the content/ knowledge in their possession. These filters could heighten our consciousness of the lack of social, political, cultural, environmental, diversity, equity and emotional dimensions of AI content. Application of the filters to content involves higher order thinking skills such as critical analysis, evaluation, problem solving, appraising, innovation and creativity. The same learning outcomes that are being recommended as the cornerstones of curriculum, pedagogy and assessment reform.

The risk of non-alignment or misalignment of the goals of AI and human intelligence has been identified by key players in the AI space. Tegmark (2017), an American cosmologist and a cofounder of the Future of Life Institute, warns of the implications for society when AI and human goals are at odds with each other. Christian (2020) who raises questions about ethics, transparency and inbuilt bias in AI source material, refers to this tension between machine learning and human values as the 'alignment problem'.

A recent book entitled *'I Human'* (Chamorro-Premuzic 2023) recommends that we focus on the qualities that make us human, that is distinguishes us from machines, and that we position ourselves as the main beneficiaries of AI and technologies and not allow them to stop us from learning and become mentally lazy.

A warning against the notion of AI replacing human learning is also touched on in a very recent article by an Australian deputy vice-chancellor (Crossley, 2023) who is responsible for academic quality. His reaction is typical of the concerns raised by academics and researchers who caution against dilution of scholarship.

He concedes that while AI is a useful learning tool, students still need to learn and be able to quickly draw upon the foundation knowledge of their discipline in order to discuss and interact with their colleagues on a deeper level, independent of AI response to a prompt. He sees the challenge for education is to keep ensuring that students do the 'intellectual heavy lifting'.

The research question posed at the beginning of this paper was:

> 'What will readily available student access to AI generative technologies mean for future teaching, learning and assessment practices and protocols in higher education institutions throughout the world?'

From this preliminary review of literature, webinars and panel discussions, there is little doubt that the rapid growth and availability of AI technologies will change how learners access content. While there are risks and threats that will need to be addressed, it is apparent that the benefits and opportunities to foster and enhance learning will far out-weigh the downside of using AI technologies for learning.

An issue of significance will be how AI technologies can be integrated into higher education in transparent and ethical ways in order to enhance learning but also to validate its authenticity. This is likely to require a mix of communication, education, regulation and detection strategies as well as a major rethink of how to reconceptualise curriculum pedagogies and assessment design. The aim will be to engages students in stimulating and challenging activities and projects that will not only equip graduates for future jobs but will create generations of citizens who manage the application of artificial intelligence for the greater good of society.

Conclusion

This paper is the first in a planned series on the impact of emerging AI technologies on the form and function of higher education in the future. Other topics that are under development or are being considered for subsequent dissemination include: time to rethink the purpose of Higher Education; the form and function of the reconceptualised university of tomorrow; is the essay dead as an assessment tool?; optimising the potential of AI technologies to enhance learning; focusing on new learning outcomes which develop and assess higher-order thinking and skills; designing digital assessments which are authentic, forward looking, experiential and innovative, utilising the features of Learning Management Systems to harness and ethically apply AI content; and, managing the gap between artificial intelligence and emotional, social, political, cultural, environmental and ethical intelligences in higher education settings.

This is an ambitious list of topics, it is not an exhaustive list, as almost on a daily basis new challenges and opportunities arise as a result of 'playing' with AI technologies and learning more about their limitations and capabilities. Much of this learning is coming from grandchildren in primary and secondary schools who are already using the language of trained researchers such as 'unit of inquiry', investigating possible causes, ranking preferences, and developing hypotheses.

They are regularly capturing their learning using multi-media programs such as *ClipChamp* which allows them to record and edit personal videos, insert photographs and graphics, add text and narration using their personal computer or mobile phone. Their mobile phones are constant 'accessories' and used, almost as a reflex action, to find the meaning of a new word, to translate a question or answer into a foreign language or to find the nearest restaurant serving dumplings.

These simple anecdotes should act as red flags for those working in the higher education sector. While I am not suggesting that this type of creativity in not taking place in higher education, it does not appear to be the norm. Yet it will be the expectation of future cohorts of current school children as they decide whether to advance to higher education. There is mounting evidence that Generation Z may well by-pass higher education in preference to self-paced learning through the internet and using their creativity and skills in Artificial Intelligence technologies to start up their own business enterprises.

The evidence presented in this paper suggests that society is at a tipping point: a major shift in human existence, and that for higher education institutions to remain relevant they will need to undergo major reform. It may be too late. Whatever course of action is taken, it will require significant collaboration and goodwill across all levels of society including governments, business and industry groups, employers, unions, educational regulators and authorities, higher education leaders, academics and students, and most significantly local communities. It will be important that the reform is framed by ethical responses and considers multiple 'bottom-lines', not just financial outcomes, with the priority outcome being for the greater good of society. In recent times, the current university business model has not served us well and must be realigned if we are to continue to attract the brightest minds and talent to study and work in the sector and nourish future generations of young learners.

Even from this preliminary investigation, the potential impact of powerful emerging AI educational technologies on approaches to teaching, learning and assessment in the Higher Education sector will be life changing. It will require significant investment in time, resources and our smartest minds to lead and nurture the necessary changes in order to reposition higher education as the 'go-to' place for leading research and innovation as well as a significant player in the process of life-long learning.

Postscript

This paper was initially accepted for Review by ATINER in June 2023. Many of the ideas raised in this paper have been further developed and expanded upon in a book now available, entitled *Optimising AI Technologies: A practical guide to transform higher education* by Lorraine Bennett and Ali Abusalem. For enquires about the book go to www.benetali.com or email AIbook.bennett@gmail.com

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Supporting Distributed Learning through Immersive Learning Environments

By Carsten Lecon[*]

In this paper, we describe a teaching scenario using a virtual environment (known also in the context of the 'metaverse'). This is motivated by the challenges that arise during the pandemic. More and more teaching scenarios are transferred to online learning settings, which allow learning at any time and at any time. One of the possibilities are virtual 3D environment. These allow more intensive immersion than for example video conferences. Furthermore, they offer new didactic concepts, for example, for group activities. The benefit of using virtual 3D environments we demonstrate by a concrete learning scenario: the simulation of robot programming. A further advantage when using virtual 3D environments are personal assistants (conversational/ pedagogical agents), for example, to the ease the work load borne by teachers; meanwhile, this works well also with natural language due to advantage stage of artificial intelligence implementations.

Keywords: e-learning, e-teaching, immersion, virtual 3D rooms, gamification, cyber-physical systems

Introduction

Since the pandemic epidemic, it was common for teaching to switch from the classroom to online places like, for example, video conference systems. But even now we still have challenges, in addition to the aftermath of the corona: For example, the current crisis is leading to much higher energy costs, which concerns the arrival to the training location and in particular external training (ride costs). Working and learning from home has also become more and more established. To create a learning environment that is as authentic as possible, virtual 3D environments are an option. We will go into the special properties of virtual 3D rooms and show their suitability for training, especially in university teaching and adult education.

Since there was not enough time for the creation of e-learning self-learning materials (self-directed, asynchronous learning) and synchronous accompaniment of the learning process (at schools, universities, and also in companies) was still expected, appropriate on-line tools were used, especially video conferencing systems. However, to achieve a better sense of presence, virtual 3D rooms are available in which participants can act as avatars ("alter ego") in an environment conducive to learning. In the following, we will explain the properties of such virtual worlds and use specific scenarios to illustrate their effectiveness.

First, we will discuss the general properties of 3D virtual spaces (Section 2). We use this environment to implement a learning scenario for computer science

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students in higher semesters (Section 3). The virtual environment designed for distributed learning should be integrated into the existing e-learning infrastructure (Section 3.1).

The task to be completed is carried out in group work (collaboration). What needs to be considered is explained in Section 3.2. Especially in the virtual 3D environment, in which the learners are connected in a distributed manner, pedagogical agents or conversational agents (Section 3.3) can be used as additional participants to provide support, including as companions when entering the virtual environment for the first time, for example, or to assist in the fulfilment of learning objectives, whereby the agents can be targeted to test and support different levels of competence (section 3.4).

The first results are depicted in Section 5. The paper ends with a summary and an outlook on the next steps.

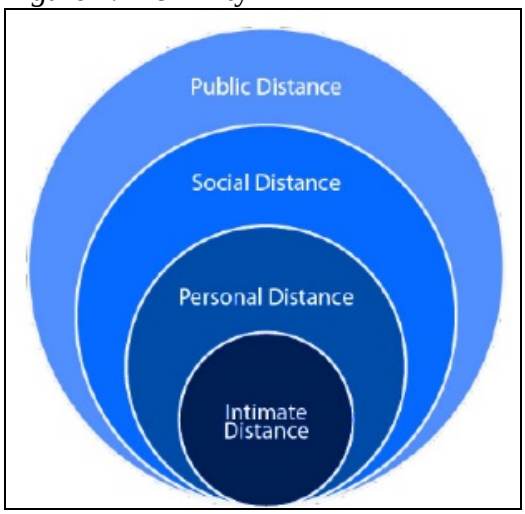
In this paper we only describe scenarios, which are currently being implemented. The evaluation of the scenario is currently in progress.

Virtual 3D Rooms

Immersion plays an important role in a virtual learning environment, that is, ‘immersing’ or ‘sinking’ in an artificially generated environment. Studies have shown that immersion in virtual environments has a major impact on learning efficiency. This is achieved, e.g., by allowing multiple perspectives, situated learning, and transfer (Dede 2009). Meanwhile, proven immersion environments are virtual 3D environments. [Churchill, EF, Snowdown, D] argue that there is a ‘paradigm shift’, because such virtual environments “provide a space that contains or encompasses data representations and users. Virtual 3D room support supports that the key aspect of many pedagogical methods and theories involves how students learn through observation, imitation, and interactions with other students and the instructor (Beck, 2019).

Regarding the virtual user experience, there are two aspects (Girvan, 2018): Sense of presence (“being in a virtual room”) and ‘Shaped by its inhabitants’ (the user - ‘inhabitant’ can become a content consumer and a content producer.). The user experience is also influenced by technical features (Girvan (2018): Avatars, multiple concurrent users, content creation tools, persistence, and space representation. The interaction of an avatar is significantly influenced by the so-called "embodiment", e.g., by appearance, gesture options, facial expression, etc. (Churchill & Snowdown, 1998). However, social proximity [39], that is, proximity to someone opposite, can also play a role in a virtual environment. "Walking through" a person is not usually possible, but if one avatar encounters another on their way (for example, if the user in question is inexperienced in controlling his/her avatar) and then automatically stands in front of you, this can lead to a feeling of distress. Since the virtual 3D world is basically just a piece of software, countermeasures can be taken if necessary, for example, by placing a "ban mile" around the avatar in order to maintain the social distance (Borkovic, Skovira, & Kohun, 2021, p. 39; Figure 1); this is 4 to 7 feet.

Figure 1. Proximity



Virtual 3D environments are advantageous in many ways in contrast to – for example – often used 2D video conferences. Simple conversational situations are perceived as more natural than in 2D environments (Garau et al., 2023). The virtual environment can be comfortable and friendly, so that this environment can trigger relaxation, silence, and pleasure in the user. Induced positive emotions can be a decisive factor for collaborative work and self-regulated learning, which is also reinforced by the intensive flow and presence experience (Boekaerts, 1996). In general, for collaborative learning and working, spatial and social immersion are central characteristics of these environments, as well as appropriate usability. Spatial immersion means feeling as being in another place as in reality (Boekaerts, 1996; Zinn, Guo, & Saga, 2016). In Lai (2011) it is postulated that the effect of collaborative learning depends on the quality of the interaction. With distributed learning, virtual 3D environments offer better possibilities than, for example, video conferences or asynchronous media such as Wikis or chat groups.

In principle, virtual worlds promote the activity of participants, since the avatar reduces risk perception, especially for shy and insecure students (Lueckemeyer, 2015).

It makes sense to offer the possibility to place (interactive) 3D objects in such a 3D environment, which can also be interacted with in a protected, safe environment (Mantovani, & Castelnuovo 2003). In this way, digital twins can also be integrated into the 3D environment (Qi et al., 2021; Dembski, Wassner, & Letzgus, 2019). The size of objects can also be experienced particularly intensively in a virtual 3D environment.

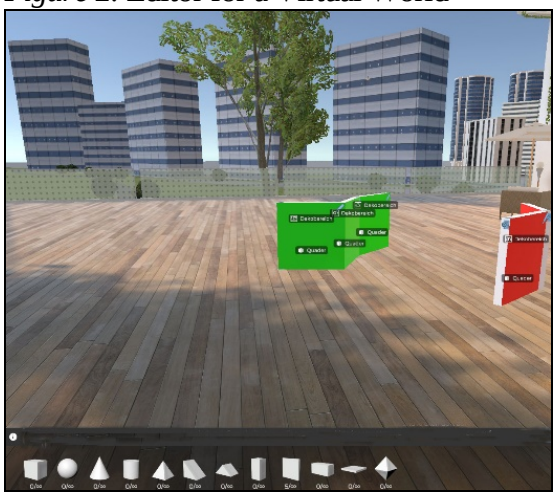
"Second Life" can be seen as a quasi-pioneer of virtual 3D worlds; this environment is still used in some cases, for example (Dede, 2009) in the context of ‘self-efficacy’. In the meantime, there are now many commercial and open source providers of virtual 3D environments.

Conceptual Framework

We will implement a kind of cyber-physical application in the context of a computer science course: A (virtual) robot has to navigate through a maze. To do this, a software template must be completed with the appropriate source code. Beforehand, learners have to build a parkour using an editor. This learning scenario can be expanded to include a gamification concept, in which learners have to go through the course as quickly as possible. In this case, participants (represented as avatars) not only 'see' the moving robot in the virtual environment, but also each other. Since the processing of this task takes place as a group work, we address several areas of competence. The use of conversational agents is also being considered; for example, we try to find out what kind of programming error it is and then offer appropriate help.

We use the virtual 3D learning environment for programming training in universities, among other things. While in a subproject this environment is used to learn a programming language (in the first semesters) (preliminary work see Lueckemeyer (2015)), in the project presented here (inspired by Lecon, and Herkersdorf (2014)) the students are supposed to steer a virtual robot through a maze and collect items, i.e. the corresponding algorithms should be developed and programmed. Beforehand, the students have to create a robot with a 3D modelling tool and provide appropriate animations. The robot movement is programmed in group work. The parkour is setup using an editor (see Figure 2). In addition to finding the way, the challenges here include dealing with collisions and, among other things, considering the physical properties (for example, how many items can be picked up at the same time?). The running time is measured and can be compared between the student groups; this is a kind of gamification.

Figure 2. Editor for a Virtual World



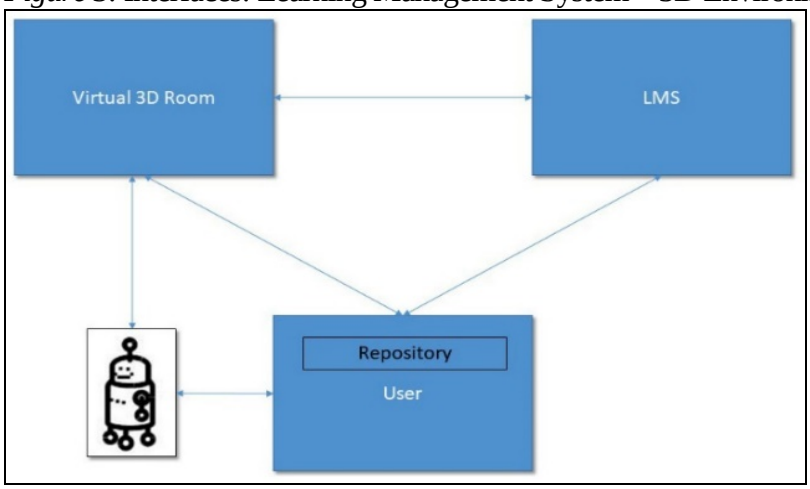
We use virtual 3D rooms as part of blended learning, which offers 'apparent effectiveness in offering flexible, timely and continuous learning" (Bizami, Tasir, & Na, 2022). Particularly immersive media, such as virtual 3D learning environments, are ideal for their implementation, among other reasons, because

they are applicable and relevant to contemporary life and transferable to ‘real world’ situations (Bdidara, & Rusman, 2016).

Integration into an e-Learning Infrastructure

We determine appropriate interfaces for the seamless integration of virtual 3D rooms into existing teaching/learning infrastructures (Figure 3).

Figure 3. Interfaces: Learning Management System – 3D Environment - Repository



The user enters the virtual world through a Learning Management System (LMS), which most educational institutions have. The current programme code can be accessed via a repository. The code can be analysed and used as a basis for support by conversational agents (Section 3.3). In addition, the virtual robot's log data, which provide information about the success or failure of the task, can be sent to the LMS.

In the next expansion stage, it is planned that a real robot will transfer its data to its digital twin in virtual space. The virtual environment is generated beforehand using the sensor data from the real robot by driving through a specific area in the real world.

Collaboration

For our scenario, distributed learning takes place as collaboration. In Lai (2011) one definition of collaboration is ‘a situation in which two or more people learn or attempt to learn something together and, more especially as joint problem solving’. In contrast to "cooperation", where each member makes an independent contribution, whereas in a "collaboration" everyone works at the same time to solve a problem or task. The advantages are specified in the meta-study (Lai, 2011), among other things, as follows: “[…] knowledge is constructed through interactions among collaborators. This approach emphasises that the whole group behaviour is more than the sum of the individual parts. ‘An interesting question about how the group is made up, including what the different skills and previous

knowledge are. The following statement can be found in Lai (2011): '[...] collaboration tends to benefit students with lower ability, while there appears to be no carryover effect for students with higher ability.' In general, heterogeneous groups seem to be the most ideal, especially for large groups, as stated and proved in Oliver, and Marwell (1988): "When groups are heterogonous, a larger interest group can have a smaller critical mass" (Macy, 1999). In this way, one ideally avoids the "social trap" (Oliver, & Marwell (1988):

- *Free-rider-problem*: A group member can benefit from the result of the group work without contributing anything themselves.
- *Problem of efficacy*: A group member does not benefit despite constructive contributions.

We were able to observe the effectiveness and creativity of the group work with a heterogeneous composition. In a course on virtual reality and animation techniques, interdisciplinary groups consisting of computer science students and user experience students formed. The respective core competencies (advanced programming knowledge on the one hand and design and 3D modelling expertise on the other) led to very mature VR projects in terms of functionality and human-computer interaction.

The efficiency of group work is also influenced by the so-called *social facilitation* (Harkins, 1987). This means that people who have prior experience working on the task act better when they are observed by other participants. This is easier to implement in a virtual 3D environment than, for example, in video conferences. On the other hand, people who are inexperienced and therefore insecure tend to be less productive when they feel like they are being watched. But because these people are partially anonymised by the visual representation as an avatar, they don't feel pressured. If they look out of the window in the real world or do research (in books or on the Internet), for example, the other participants in the virtual world do not notice. The "penetrating" look that is not visible in the virtual environment when the other person is waiting for an answer quickly reduces stress.

Conversational Agents

In general, the support of teachers or tutors is helpful or even necessary in learning settings. In a normal classroom, this is usually the case when the teaching staff is physically present. In the virtual 3D space, this can be done by the teaching staff represented as avatars. However, this only applies in synchronous learning settings. If learners want to use the virtual learning environment independently of the curriculum, their own virtual 'intelligent' virtual avatars to communicate with: conversation agents (Allouch, Azaria, & Azoulay, 2021) that act as 'pedagogical agents' (Terzidou, & Tsiatsos, 2014). Since the individual agents each act independently, any number of such "helpers" is possible, in principle.

In general, there are a few things to keep in mind when using conversational agents:

- Dialogue form: Should communication take place via text, speech bubbles, or natural language? In the latter case, artificial intelligence methods can be integrated.
- Type of appearance: Should the agent always be there (at what distance? Typically, in social distance; see above). Or should the agent appear on "call"? Or should you explicitly go to a certain point (e.g., a "counter")? Should the agent be visible and audible to everyone or only to a specific person? If this is the case, the other participants should at least be informed of its existence; otherwise, it can happen that it is "walked through", and communication with an "invisible spirit" would also seem strange.
- Appearance: Do you want the agent to dress formally or informally? It will probably be something in between: more casual clothing. Gender also plays a role. A neutral, gender-neutral visualisation could take place through a comic-like representation, but the agent should also radiate seriousness (trust). The agent should also be clearly recognisable as an agent. If you can customise your avatar, in extreme cases, the agent could look the same.

In order for an educational agent to be able to provide support, two implementation options are conceivable in our scenario: either the user addresses the agent directly with a question, or a need for intervention is automatically recognised; this can be the case if the user gets stuck or the solution (the software programme) is wrong or not optimal.

In the first case, natural language communication is required, as known from chatbots (see Adamopoulou, and Moussiades (2020) for an overview). In the other case, there must be a way to observe the actions of users. This in turn can be synchronous or asynchronous. In the case of synchronous observation, a "guardian" must be integrated into the software development system; in the asynchronous case, for example, the current status of the software stored in a version control system (VCS: Version Control System (Spinellis, 2004)) - Such a system should be used anyway and is accessed via the repository mentioned above.

Furthermore, we will use conversational agents to help learners navigate a virtual environment quickly by providing guidance and support; especially if they are entering the virtual environment for the first time (and perhaps an introductory tutorial either doesn't exist or hasn't been completed). In this way, the teachers are not bound by the time-consuming assistance, but can take care of the actual content.

In our context, we use graphically embodied agents (Allouch, Azaria, & Azoulay, 2021) which are visualised by a virtual body (avatar); they have, as well as voice-understanding and speech generation abilities, the interaction intensity can be increased by gestures and – to some extent – facial expressions. Another step towards the most effective human-computer interface is when the agent can both recognise human speech and is able to form and speak complete sentences (as, e.g., in Zargham et al., (2021)). The so-called "Virtual Agents" offer increased

immersion and interactivity, a personalised experience, and the ability to convey complex concepts and processes in an engaging and interactive way.

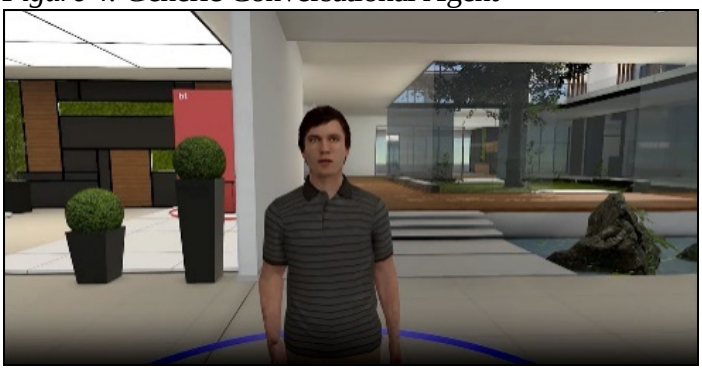
The actions of an agent can either be rule-based or be controlled by artificial intelligence. A rule-based behaviour is, for example, the implementation of an introductory tutorial at the beginning of a session in virtual space or the detection of problems in software programming. In this case, the agent can react to the following situations, among others.

- The user has not made an entry for a long time – this can indicate that he/she does not know what to do. Based on the analysis of the source code created so far, the agent can suggest based on a comparison with the model solution.
- It will use wrong or useless software libraries. The agent can point out this and, if necessary, provide information on where to look for suitable libraries.
- The task will not be solved after a certain time. Here, the agent can refer to relevant learning materials or tutorials; in extreme cases, he can also disclose parts of the sample solution.

When simulating a real conversation situation, the counterpart (the agent) can be equipped with artificial intelligence for speech recognition and the formulation of answers. It is usually advisable to use existing systems, such as current *ChatGPT* (see, for example, Thorp (2023)). However, in such cases, licence fees apply, which must be considered when planning conversational agent-supported virtual learning environments.

A generic virtual assistant (Figure 4) was implemented as a kind of "proof of concept", which responds to natural language and responds using a speech processor, the interaction logic was implemented with ChatGPT.

Figure 4. Generic Conversational Agent[1]



To describe learning goals (among others of virtual agents) and to verify compliance, we use common taxonomies.

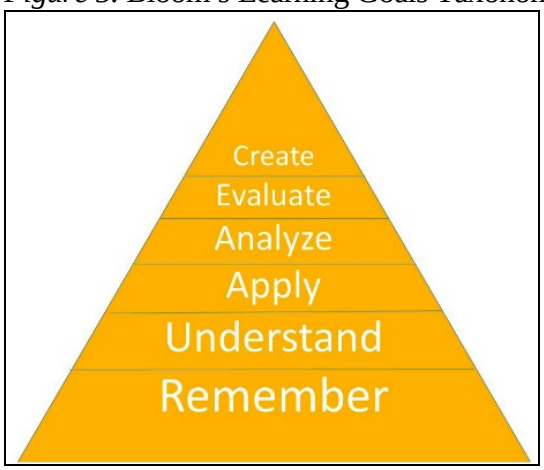
[1]https://tricat.net/neuigkeiten/generative-ai-meets-corporate-metaverse/.

Learning Goals: Taxonomy

Learning goals are specified by the competencies to be achieved.
One of the first acquisitions of skills is defined according to Bloom's taxonomy (Bloom et al., 1956). It is a taxonomy of learning goals in the cognitive domain consisting of knowledge, comprehension, application, analysis, synthesis, and evaluation. This taxonomy was designed for K-12 teachers and college instructors.

This was adapted by Anderson and Krathwohl with the aim of better applicability for curriculum design (Anderson, & Krathwohl, 2001): The Anderson-Krathwohl Taxonomy (AKT). These propose a two-dimensional matrix with four types of knowledge (factual, conceptual, procedural, metacognitive) and six dimensions of cognitive processes (remember, understand, apply, analyse, evaluate, create). The taxonomy hierarchy is shown as a pyramid in Figure 5.

Figure 5. Bloom s Learning Goals Taxonomy



The achievement of these competencies can best be formulated using appropriate verb forms for the levels.

Dreyfus describes a simplified approach using a five-stage model for adult skill acquisition (Dreyfus, 2004): Novice, advanced beginner, competence, proficiency, and expertise.

Furthermore, to keep the description of learning objectives simpler, these levels of competence are sometimes broken down into "professional competence", "interdisciplinary competence" and "particular methodological competence".

These terms are usually not precisely defined and must be adapted for the respective domain, which can also lead to misunderstandings. For example, in the context of programming education, the term "apply" can be interpreted for the execution or implementation of a procedure in a given situation, but also for the application of programming language constructs; the latter would be a misinterpretation (Kiesler, 2002).

Pedagogical principles, especially with regard to immersive blended learning, are proposed in Bizami, Tasir, and Na (2022): human agency, capability, self-reflection, double loop learning, nonlinear learning.

In our context (teaching and applying programming), we use an adoption of the AKT, described by considering the competences in Kiesler (2002): Factual Knowledge, Conceptual Knowledge, Procedural Knowledge, Meta-cognitive Knowledge and the above-mentioned process dimensions. These are combined in the domain of 'programming competencies'.

In the scenario described, the students should reach the highest level: climbing to the top of the pyramid (Figure 4). For each process dimension, we will give an example (according to the sentences in Kiesler, (2002)):

- Remember: Knowledge of computer science-related topics should have been imparted and checked in the first semesters of the course.
- Understand: Understanding the syntax and semantics is a prerequisite for the development of software, and is taught in the lectures, which participants are required to attend. This also includes dealing with software development environments.
- Apply: The complete software consists of individual – partially standardised - procedures; certain software quality requirements have to be met; in the context of cooperative software development, uniform programming conventions should be adhered to.
- Analyse: Information relevant to the implementation must be extracted from the task description. In addition, it is important to find the most suitable ones from the abundance of existing software frameworks and libraries, as well as to look for known algorithms (for example, the A* algorithm for efficient way-finding (Hart, Nilsson, & Raphael, 1968).
- Evaluate: There are different algorithms to find the way and collecting the items. Some of these were covered in the lectures. It is now a matter of finding the right one and adapting it if necessary, also with regard to the time complexity.
- Create: An executable application (robot in action) should result based on the preliminary considerations of the previous competence levels.

In order for a conversational agent to be able to provide support, two implementation options are conceivable in our scenario: either the user addresses the agent directly with a question, or a need for intervention is automatically recognised; this can be the case if the user gets stuck or the solution (the software programme) is wrong or not optimal.

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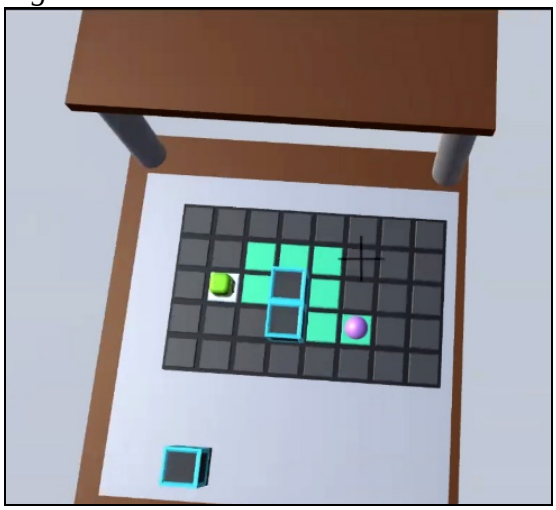
Results

Regarding the concepts mentioned above, we have implemented a robot simulation using the ROS interface (Koubâa, 2017). The course can be set manually; there is a corresponding editor for this. The programming itself should be done by the students. This is the next step, together with an evaluation. Before, to illustrate the optimal solution, we use the A* algorithm for path finding (later, the students have to find out this approach). The robot s commands are transferred via the client/server architecture.

The described scenario is a proof-of-concept (working application, see Figure 6).

Figure 6. Robot Simulation Environment



You can see on the picture a small maze, the robot from above (green), the target point (violet), and the proposed path (turquoise), calculated by the A* algorithm.

There is an effective integration of ROS with the game engine *Unity* in a virtual 3D environment, which creates an intensive learning experience for robot programming. The results of the programming task are visible to the students: the robot essentially drives through the participant's feet in the virtual environment. Real-time communication between the ROS and virtual environment is possible (Lecon, Soeser, & Stegmaier, 2024).

The immersive setting leads to an improvement in student engagement and understanding of complex programming concepts. The scalability of this project enables one to address a heterogeneous group of students by using different use cases with, regarding different (competence) levels of the students.

Parallel (in another subproject) conversational agents are implemented, which can also be used in our scenario for individual support of the teacher.

The next steps are as follows:

- Fully integration in the virtual 3D environment: up to now, we simulate the virtual environment; but the appropriate interfaces (publish-subscribe model) are existing.
- Evaluation by students of a face-to-face university (synchronous group work) and a distance learning university (asynchronous group work).

Conclusion

We have presented a robot programming learning scenario using a virtual 3D environment. Such an environment is meaningful useful, for example, if a teaching/ learning is not possible, for example during pandemic-related restrictions –, or when most teaching takes place online anyway: for distant learning courses.

The use of virtual worlds can overcome the methodological-didactic challenges faced by some courses that require face-to-face interaction and the development of practical skills, such as programming and laboratory seminars. The advantage of such environments is, for example, the more intensive social and spatial presence (immersion), so a more natural communication is possible in the three-dimensional environment than in a two-dimensional one.

We have presented a programming scenario as an example of an application. An algorithm is to be developed and implemented in order to steer a robot through a course previously created by the trainer or the learners themselves. The result can be 'seen' in the form of a 3D model within the 3D environment: the robot practically drives in front of your eyes.

The participants are embodied by avatars, which means social immersion in virtual space. Facial expressions can be simulated to some extent, but such an abstract representation can also contribute to more objective communication. In addition to the participants themselves, computer-generated agents can be integrated, for example, to relieve teachers by acting as a 'contact person' who can always be reached.

In our case, such conversational agents act for support in using the virtual environment itself and to advise on technical matters. The design of such agents is diverse; we have highlighted individual aspects.

Actually, we have a prototype as a proof-of-concept. Next, we will evaluate this setting as well in a presence university as an addition to traditional classroom teaching, as well as part of the online learning material at a distant learning university.

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Fostering Students' Active Participation in Higher Education: The Role of Teacher-student Rapport

By Ana Bardorfer[*]

The concept of teacher-student rapport is a relatively new concept that pertains to one of the factors in the classroom setting that promotes learning. It enhances the classroom atmosphere and promotes the well-being of students. The objective of our study was to examine the predictive value of teacher-student rapport in higher education on students' active participation in class. The study included a total of 1,682 students who were enrolled in classes taught by 50 instructors across three Slovene public universities. Self-reported measurements to assess teacher-student rapport (Instructor-Student Rapport Scale; Bardorfer & Kavčič, 2020), teachers' effectiveness (Student Evaluation of Educational Quality Scale; Marsh, 1982), autonomously regulated behaviour of students (The Self-Regulation Questionnaire-Academic; Ryan & Connell, 1989) measured by the index of relative autonomy (RAI), and participation levels (Participation Scale; Fassinger, 1995b) were used in the study. The findings from the hierarchical linear modelling analysis revealed that teacher-student rapport significantly predicted students' active participation in class. Establishing rapport between teachers and students therefore presents an effective way of promoting active student participation. The paper concludes by discussing the implications of the study on strategies that teachers might employ to foster rapport with students.

Keywords: teacher-student rapport; interpersonal relationships; higher education; active participation; constructivism

Introduction

A diverse array of favourable student-related results such as motivation, success, engagement, learning, and hope are significantly enhanced by positive teacher-student relationships (Wendt & Courduff, 2018; Xie & Derakhshan, 2021; Frymier & Houser, 2000; Havik & Westergård, 2020). Teacher-student rapport, as defined by several scholars (Catt, Miller, & Schallenkamp, 2007; Faranda & Clarke, 2004; Frisby & Martin, 2010; Wilson, Ryan, & Pugh 2010), refers to the positive ties and connections that teachers aim to establish with their students. Extensive global research conducted in the realm of higher education has revealed rapport results in numerous positive outcomes for students. In addition to its favourable effect on students' self-perceived learning (Frisby & Martin, 2010), final grade achieved (Wilson, Ryan, & Pugh 2010), motivation for studying (Bouras & Keskes, 2014; Clarke, 2004; Frisby & Myers, 2008; Granitz, Koernig, & Harich, 2009; Zheng, Yu, & Wu, 2021), and academic success (Estepp & Roberts, 2013; Jimerson & Haddock, 2015; Lammers, Gillaspy, & Hancock, 2017) scholars have also observed a notable and positive correlation between

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rapport and active participation (Frisby & Martin, 2010). In the context of these studies, the conceptualization and operationalization of rapport and active participation exhibit a notable lack of consistency.

Following the constructivist paradigm of teaching and learning, active participation of students is desirable, as interaction with the social environment enables the individual to form his or her knowledge. Such knowledge tends to be of higher quality, characterised by comprehension, applicability, and permanence (Marentič Požarnik & Plut Pregelj, 2009; Marentič Požarnik & Puklek Levpušček, 2005). Some research (Beadoin, 2002; Martin & Mottet, 2000) also shows that students' active participation in lessons leads to better academic performance (Beadoin, 2002) and plays an important role in the success of education and students' personal development (Tatar, 2005). Students who are actively involved also report higher satisfaction with classes and higher persistence rates (Astin, 1999).

While studies on the relationship between teacher behaviour and active participation are quite extensive, Fassinger (1995a) observed that research on participation is "dominated by studies of children, while less is known about the dynamics of classrooms containing adults or young adults" (p.25). As the desirable consequences of teacher-student rapport, such as academic achievements, learning and motivation for studying have been widely researched, other student-related variables, such as academic engagement and active participation received less attention (e.g., Estepp & Roberts, 2015; Geng, Zheng, Zhong, & Li, 2020). Moreover, in these studies, relevant factors related either to teachers or students were not controlled. To fill this gap, this paper focuses on rapport in the context of higher education and its role in students' active participation. Since those students who exert more effort in performing classroom activities are more likely to acquire the course content (Zhou, 2021), exploring factors which may positively contribute to students' active participation surely seems worthy of research. The present study aims to investigate the role of teacher-student rapport in students' active participation in the context of higher education while controlling for several relevant student and teacher-related factors.

Teacher-Student Rapport in the Context of Higher Education

An examination of the scholarly literature pertaining to rapport in higher education reveals the prevalence of multiple vague and ambiguous definitions of the concept. As such, they do not offer opportunities for the precise operationalization and construction of a psychometrically sound measuring instrument. Consequently, an accurate conceptual framework of this phenomenon (for details *see* Bardorfer, 2013) and a rigorously validated instrument for assessing rapport within the context of higher education (Bardorfer & Kavčič, 2020) were developed.

When considering the establishment of teacher-student rapport within the higher education setting, emphasis is placed on the experience dimension. The phenomenology of the subjective experience of rapport in higher education can be

broken down into three distinct yet interconnected structural components: mutual attention, positivity, and coordination. Rapport can be conceptualized as the degree of proximity or distance existing between the teacher and students at the relational and cognitive levels (Bardorfer, 2013).

The positivity component encompasses various aspects that contribute to a favourable dynamic between students and the teacher. These include the teacher's amiable demeanour and ability to engage with students in a pleasant manner, the creation of a relaxed classroom environment that minimizes student frustration, students' perception of the teacher's concern for their well-being and their comprehension of the subject matter, as well as their perception of the teacher as understanding and respectful. Additionally, students' sense of a balanced, appropriately personal yet professional relationship with the teacher is also a crucial element of the positivity component. The concept of mutual attention pertains to the active involvement and investment of both the teacher and students in the educational exchange. This is demonstrated by the teacher's inclination to share their professional experiences and demonstrate an interest in and receptiveness to students' perspectives, opinions, and inquiries. Additionally, it encompasses the students' willingness to continue collaborating with the teacher, as well as the teacher's endeavours to ensure that students acquire a comprehensive comprehension of the subject matter. Moreover, it encompasses the teacher's accessibility and the absence of negative emotions experienced by students when seeking assistance. The coordination component pertains to the management of interaction and is manifested by the teacher's display of patience when engaging with students while allowing them ample time to provide responses or do pertinent course tasks. Simultaneously, the coordination component encompasses the coordination within the realm of learning and teaching, as evidenced by students' cognizance and endorsement of course objectives, as well as the teacher's inclination to modify explanations in accordance with students' pre-existing knowledge (Bardorfer, 2013).

While the descriptions of students’ perceptions included in the components of positivity and mutual attention are also mentioned in the definitions developed by most researchers dealing with rapport in higher education (e.g., Faranda & Clarke, 2004; Frisby & Martin, 2010; Frisby & Buckner, 2017; Fitzgerald & Hooker, 2022; Wilson, Ryan, and Pugh 2010), the coordination component represents a novelty in the proposed model.

Active Participation in the Context of Higher Education

Research in higher education in the context of pedagogical communication studies, which examines students' active participation in lessons defines it differently, while all the authors point out difficulties in definitions. The most often cited definition is that of Fassinger (1995a), according to which active participation includes any comments or questions by students. Christensen, Curley, Marquez and Menzel (1995) understand active participation as any verbal communication between the teacher and the students and among two or more

students about the learning material, which includes presenting information, stating opinions, asking, and answering questions. Similarly, Auster and MacRone (1994) state that active participation is understood by most teachers as predominantly asking and answering questions and students' engagement in discussions. However, they emphasize that the quality of active participation is much more difficult to define. This is probably the reason why the researchers of this aspect of teaching and learning in higher education focus on the quantitative rather than the qualitative aspect of active participation, but they nevertheless suggest that the more frequent the active participation of students, the more likely it is that the participation is also of higher quality (Auster & MacRone, 1994)

North American researchers report that on average, students ask about three questions per hour, most of which refer to clarification of the material and the procedures and content related to schoolwork or assignments (West & Pearson, 1994). Fritschner (2000) provides a significant piece of information in his study, namely that an average of 28% of the students in a whole group are actively engaged. In line with the constructivist paradigm of teaching and learning, it is not surprising that both teachers and researchers in this field of research question what is it that influences students' participation and how to encourage student activity in the classroom (Auster & MacRone, 1994; Fassinger, 1995a; Marentič Požarnik & Puklek Levpušček, 2002).

At higher education level, a number of factors influence students' active participation in lessons (Christensen, Curley, Marquez, & Menzel, 1995; Fassinger, 1995a; Fassinger, 1995b; Fassinger, 2000; Auster & MacRone, 1994), e.g., the size of the year group and spatial distribution, students' age, their self-image, readiness for learning, self-confidence and communication skills, the climate of the year group and the general university culture, as well as other factors, including those related to the teacher, such as their authority and the way they communicate (Auster & MacRone, 1994; Fassinger, 2000), as well as teacher-student rapport conceptualised as quality relationships (Frisby & Myers, 2008; Frisby & Martin, 2010). We propose rapport represents a suitable setting for fostering students' active participation. As the leader of the educational process, the teacher can encourage students' active participation through the establishment and maintenance of rapport, as this aspect of teaching can be actively influenced by the teacher.

The study aimed to examine whether teacher-student rapport can provide an appropriate social context for fostering students' active participation inside and outside of the classroom. Specifically, we tested the following hypothesis: teacher-student rapport, as perceived by students, significantly predicts students' active participation, while controlling several student-related characteristics (age, gender, previous academic performance, level of autonomously regulated motivation for studying the subject matter) and several teacher-related teaching practices, which are generally included in teachers' evaluation (enthusiasm, breadth of coverage and organization).

Methodology

The research data was quantitative using a non-experimental causal method.

Participants

The study utilized a convenience sample consisting of 50 higher education teachers, specifically teaching assistants, professors, and lectors (62% women). These individuals were affiliated with natural or social science study programs at three prominent public universities in Slovenia (University of Ljubljana, University of Primorska, University of Maribor). The age range of the participants ranged between 25 and 65 years, while their teaching experience in higher education ranged from less than 5 years to 25 years or more. The structure of the sample of teachers is shown in Table 1.

Table 1. Sample of Teachers

	Natural sciences		**Social sciences**		**Total**	
	N	**%**	***N***	**%**	***N***	**%**
University						
University of Ljubljana	8	53.3	7	46.7	15	30.0
University of Maribor	9	50.0	9	50.0	18	36.0
University of Primorska	8	47.1	9	52.9	17	34.0
Gender						
Male	11	57.9	8	42.1	19	38.0
Female	14	45.2	17	54.8	31	62.0
Age						
25–35 years	5	41.7	7	58.3	12	24.0
36–45 years	9	47.4	10	52.6	19	38.0
46–55 years	5	50.0	5	50.0	10	20.0
56–65 years	6	66.7	3	33.3	9	18.0
Experience in teaching						
under 5 years	6	50.0	6	50.0	12	24.0
5–10 years	7	50.0	7	50.0	14	28.0
11–15 years	5	41.7	7	58.3	12	24.0
16–20 years	2	50.0	2	50.0	4	8.0
21–25 years	1	33.3	2	66.7	3	6.0
over 25 years	4	80.0	1	20.0	5	10.0
Total	25	50.0	25	50.0	50	100.0

A convenience sample of approximately 30 students per individual teacher was also used. The study included a cohort of 1682 students (71.5% women). These students were enrolled in a specific course taught by the target teacher and had attended at least 50% of the sessions. The age range of the participants was 18 to 30 years and older. The structure of the sample of students is presented in Table 2.

Table 2. Sample of Students

	Natural sciences		**Social sciences**		**Total**	
	N	**%**	***N***	**%**	***N***	**%**
University						
University of Ljubljana	270	51.8	251	48.2	521	31.0
University of Maribor	285	47.2	319	52.8	604	35.9
University of Primorska	271	48.7	286	51.3	557	33.1
Gender						
Male	330	68.8	150	31.3	480	28.5
Female	496	41.3	706	58.7	1202	71.5
Age						
18–20 years	512	52.6	462	47.4	974	57.9
21–23 years	275	44.3	346	55.7	621	36.9
24–26 years	31	44.9	38	55.1	69	4.1
27–29 years	4	57.1	3	42.9	7	0.4
30 years and older	4	36.4	7	63.6	11	0.7
Total	826	49.1	856	50.9	1682	100.0

According to statistical data 57.000 students were involved in public universities in Slovenia in the year when our data was gathered. The statistical power analyses revealed the ideal sample size for our population is N = 382 so our sample greatly exceeds ideal sample size.

Instruments

1. Instructor-Student Rapport Scale (ISRS; Bardorfer & Kavčič, 2020) describes students' perception of teacher-student rapport. The participants were requested to evaluate 35 items using a 5-point Likert scale, ranging from 1 (strongly disagree) to 5 (strongly agree). The authors report high reliability and appropriate constructive and criterion validity of this scale on the sample of Slovene students.
2. Student Evaluation of Educational Quality Scale (SEEQ; Marsh, 1982) measures nine factors of effective teaching: perceived learning, teacher enthusiasm, organization, peer relationships, rapport, breadth of coverage, examinations, assignments/readings, and difficulty. The statements are accompanied by a 5-point scale, ranging from 1 (strongly disagree) to 5 (strongly agree). The nine-factor SEEQ structure was validated on a sample of North American students from several different disciplines, with α coefficients of reliability for individual subscales ranging from 0.88 to 0.97 (Marsh, 1982). In the present investigation, we employed three distinct subscales: Breadth of Coverage, which contains 4 statements related to teacher competence in the subject matter, presentation of the conceptual background and alternative approaches and theories; Organisation, which

contains 4 statements related to the teacher's organization, structure and clarity of explanations, teaching materials and goals; Enthusiasm containing 4 statements relating to the teacher's enthusiasm, energy, wittiness, and ability to sustain students' interest. The scales underwent a double-independent translation process. The reliability coefficients (α) for the four subscales ranged from 0.82 to 0.87 (Bardorfer, 2016).

3. The Self-Regulation Questionnaire-Academic (SRQ-A; Ryan & Connell, 1989) assesses the underlying motivations that drive students to fulfil class assignments, actively engage in classroom activities, provide answers to teacher inquiries, and overall, endeavour to achieve success in the specific course instructed by the target teacher. It consists of 32 statements, with 9 statements pertaining to External Motivation, 9 statements pertaining to Internal Motivation, 7 statements pertaining to Identified Motivation, and 7 statements pertaining to Intrinsic Motivation. Participants were requested to evaluate the degree to which each statement was applicable to their personal circumstances, using a rating scale ranging from 1 (indicating no applicability) to 5 (indicating total applicability). The findings can be succinctly captured by a singular metric referred to as the relative autonomy index (RAI), which quantifies the degree of self-regulated behaviour, i.e., learning the subject matter taught by the target teacher (Grolnick & Ryan, 1987, 1989). A higher Relative Autonomy Index (RAI) is indicative of a greater level of autonomy, while a lower RAI suggests a lower degree of autonomy. The questionnaire underwent a process of double-independent translation. Reliability coefficients α for the four subscales ranged from 0.78 to 0.87 (Bardorfer, 2016).
4. Participation Scale (Fassinger, 1995b) measures students' self-perceived active participation in lessons. It consists of 5 statements that delineate various manifestations of active engagement in classroom settings (e.g., I actively participate in these lessons). Participants are requested to assess the frequency of their engagement behaviours using a five-point Likert scale (1 - never, 5 - often). For the present study, the scale was translated (double independent translation). The reliability coefficient was $\alpha = 0.88$ (Bardorfer, 2016).
5. Students' previous academic performance expressed in the number of points attained at the national end-of-secondary school examination.

Procedure

An invitation was extended to higher education teachers from three public universities in Slovenia, who have publicly accessible e-mail addresses, to partake in the research. Participants who expressed their agreement were then visited at one of their classes, where they and their students were provided with a comprehensive explanation of the purpose and objectives of the study. The students who submitted their consent to partake in the study were provided with explicit instructions for filling out the questionnaire using a paper and pencil format.

Data Analysis

To assess the statistical significance of the contribution of several variables on students' active participation statistical technique hierarchical linear modelling (HLM) was used. The hierarchical structure of the data was taken into consideration with the use of HLM, where data from different participants (students) within individual groups (for each target teacher) are correlated (Raudenbush & Bryk, 2002). We used three-and two-level linear models of the HLM 7 software (Raudenbush et al., 2011), whereby Level 1 was represented by students, Level 2 by groups taught by individual target teachers (target teacher's group level), and Level 3 by universities. Given the absence of significant differences between the universities (Level 3) in criterion variable active participation, we only used a two-level linear model.

Results

We anticipated rapport, as perceived by students, would significantly contribute to predicting students' active participation. HLM analyses on a sample of 1453 students were performed as 229 of the total of 1682 students did not provide data on their previous academic performance, which was a predictor at the student level (Level 1).

To determine the proportion of variance in the dependent variable active participation that could be attributed to differences between groups of target teachers and to differences between students within the same groups first a null model with no predictors included was constructed. In the next step, we compared the model which included predictors at the student level (Level 1) with the null model. As we were interested in the proportion of variance in active participation of students that could be explained by rapport, after controlling for students' demographic variables, their prior academic achievement, motivation for learning the target teacher's subject, and the variables of the teacher's teaching effectiveness, the following predictors (independent variables) were entered in the model: students' gender and age, prior academic performance, relative autonomy index (degree of autonomy in learning for the target teacher's subject), teacher's enthusiasm, organization, and the breadth of coverage, as well as rapport with the teacher. Since we had no reason to expect that the effects of individual predictors differ between groups, we only analysed the main effects of the predictors, which we considered to be fixed.

Following the recommendations by Enders and Tofighi (2007), all predictors were group centered, except for the variable of gender, which was uncentered. We also assumed between group variances of dependent variable active participation didn't differ significantly. As we aimed to compare different models, maximum likelihood estimation was used for the assessment of parameters (Raudenbush & Bryk, 2002).

Table 3. Unexplained Variance of Active Participation of Students at the Student Level and Target Teacher's Group Level in Different Models ($N_{students}$ = 1453, $N_{teachers}$ = 50)

	Unexplained variance	*df*	χ^2	*p*
Null model				
Target teacher's group-level	0.16	49	415.38	<0.001
Student level	0.76			
Model with student-level predictors (Level 1)				
Target teacher's group level	0.18	49	510.70	<0.001
Student level	0.57			

Table 3 shows the unexplained variance at the target teacher's group level and the student level in different models. In the null model, the target teacher's group level variance accounted for 17% of the total variance in active participation (or 0.16 / [0.16 + 0.76]), while the variance at the student level accounted for 83% of the total variance (or 0.76 / [0.16 + 0.76]). The differences between self-perceived active participation in different target teachers' groups were therefore small and represent a lower proportion of the differences in active participation of students. A larger share of differences between students in students' active participation can thus be attributed to differences between students within an individual group.

After entering the student-level predictors (level 1), the total unexplained variance was decreased by 19% (1 - [0.18 + 0.57] / [0.16 + 0.76]). Individual predictors therefore explained a total of 19% of the total variance in active participation of students. In the model with student-level predictors, the unexplained variance at the student level was 25% lower than the variance in the null model ([0.76 - 0.57] / 0.76). The model comparison test showed the model with predictors at the student level significantly improved the null model ($\chi^2(8)$ = 1004.76, $p < 0.001$).

Table 4 shows the standard parameter estimates reflecting the main effects of predictors. We used standard parameter estimates, which are more appropriate when the number of units is less than 100 (for an overview, *see* Robust Standard Errors, 2013).

The analysis of the effects of student-level predictors (Level 1) showed that teacher-student rapport was statistically significantly and positively correlated with the active participation of students after controlling for the effects of the remaining predictors in the model. In addition to rapport, some other predictors that were used as control variables, namely gender, prior academic performance, and RAI, were statistically significantly correlated with active participation. After controlling for the effects of the remaining predictors female students rated their active participation lower than male students. Students with better prior academic performance (higher scores at the national end-of-secondary school examination) rated their participation as more active after controlling for the effects of the remaining predictors. The degree of autonomy was also important for active participation, as students with a higher degree of relative autonomy for learning target teacher subject matter rated their participation as more active after

controlling for the effects of the remaining predictors. Students' age and factors related to the teacher's teaching effectiveness, i.e., teacher enthusiasm, organisation, and breadth of coverage, did not statistically significantly correlate with the dependent variable active participation.

Table 4. Estimates of The Effects of Predictors of Active Participation of Students ($N_{students}$ = 1453, $N_{teachers}$ = 50)

	Fixed effect estimation of the predictor				
Parameters in models	Coefficient	SE	t	df	p
Intersection	3.07	0.08	40.39	49	<0.001
Student level predictors					
Gender	–0.27	0.06	–4.68	1395	<0.001
Age	0.02	0.05	0.40	1395	0.691
Previous academic performance	0.01	0.01	2.27	1395	0.023
RAI	0.12	0.01	11.10	1395	<0.001
Teacher’s enthusiasm	0.03	0.05	0.69	1395	0.492
Teacher’s organisation	–0.03	0.04	–0.92	1395	0.361
Teacher’s breadth of coverage	0.03	0.05	0.65	1395	0.516
Rapport	0.42	0.07	6.21	1395	<0.001

Discussion

Based on the results in Table 4, we can support our hypothesis, which predicted that the quality of rapport between the higher education teacher and students, as perceived by the latter, would significantly contribute to the prediction of self-perceived active participation of students. Students who experienced the interaction with the teacher as pleasant, without feelings of frustration, and perceived the teacher as friendly, witty, respectful, understanding, patient, relatively open, relaxed and approachable both in and out of the classroom, who allows sufficient time for activities and answering questions, tailors his/her explanations to the students' prior knowledge, and of whom they also assumed cared about the students and their learning progress and was interested in their opinions, comments and questions, with whom they wanted to continue working with in the future, did not feel uncomfortable asking for help, were aware of and accepted the learning objectives and perceived the relationship as appropriately personal but still professional, and rated their participation as more active. Students who thus rated their rapport with the teacher as of higher quality, compared to the students who rated their rapport with the teacher as of lower quality, also participated in the lessons to a greater extent without hesitation, volunteered their answers, commented, and asked questions when they did or did not know the answers, and expressed their personal opinions.

These results are consistent with the findings of previous research on the relationship between teacher-student rapport and active participation in the USA (e.g., Frisby and Myers, 2008; Frisby and Martin, 2010), even though these

authors define teacher-student rapport as a general quality of relationships. In comparison with the new definition of teacher-student rapport in higher education (Bardorfer, 2013), their definitions only include the components of positivity and mutual attention, i.e., relational proximity, but not the component of coordination. Additionally in studies where the relationship between active participation and phenomena similar to teacher-student rapport, the authors report of similar results. For example, Christensen, Curley, Marquez, and Menzel (1995) and Menzel and Carrell (1999) found that students' willingness to communicate and their level of active class participation are statistically significantly and positively connected to the teacher's psychological availability, which overlaps substantively with the rapport components of positivity and mutual attention (Bardorfer, 2013). Similarly, the teacher's concern for students, which overlaps with the positivity component, was also positively associated with active participation (Myers, 2004).

The results of previous studies that examined the relationship between certain teacher characteristics and active student participation also support the results of the present study. For example, Fassinger (1995b, 2000) found that teacher support, encouragement, responsiveness, and accessibility are positively and statistically significantly associated with active student participation in lessons, while Pearson and West (1991) also mention active listening, which can be achieved by the teacher listening to the student's comments and questions without judgement. All these subjective perceptions of teacher behaviour and characteristics are captured in the new definition of teacher-student rapport for higher education (Bardorfer, 2013). At the same time, the results of the present study are consistent with the results of research on the negative association between active participation and teacher behaviours, which reflect low-quality teacher-student rapport, such as condescension, disrespect, sarcasm, and unkindness (Kearney, Plax, Hays, & Ivey, 1991).

The feeling of relational and cognitive proximity, which is a key feature of the newly defined rapport, has also been detected as an important factor for the active participation of students in several studies. In an experimental study on a sample of postgraduate students, Stephen (1981), for example, found that students were more willing to participate actively when the teacher took on the role of a fellow student rather than the teacher – when the teacher diminished the psychological distance between him/herself and the students and moved away from the role of omnipotent and omniscient teacher. A positive correlation between active participation and teacher self-disclosure, which the authors hypothesise reduces differences in power and psychological distance between the teacher and students, has been reported in several studies (e.g., Fritschner, 2000; Goldstein & Benassi, 1994). In a study of undergraduate students in the USA, Auster and MacRone (1994), found that students participated significantly more actively with teachers who more often called them by name, nodded and smiled, communicated to students their interest in the students' answers and comments, who encouraged students to elaborate on their answer, and who gave them enough time to do so. The importance of sufficient time for reflection and elaboration of students' answers or comments is also stressed by Bean and Peterson (1998). The finding by Fritschner (2000) that students do not believe their participation is even desirable

when the teacher lectures quickly and does not give them enough time to think and formulate a response is also of considerable importance. The positive relationship between active participation and the teacher's characteristics such as friendliness, approachability, openness to different opinions, the use of humour, and the teacher's trait of not punishing mistakes, but emphasizing that any input from students, even if incorrect, is welcomed as mistakes are seen as part of the learning process, also captured in the new conceptualization of rapport is also reported in a study conducted within the Asian context, specifically in Malaysia (Siti Maziha, Nik Suryani, & Melor, 2010). This suggests that the aforementioned behaviours captured in the teacher-student rapport are important factors for students' active participation in different cultures, which should be verified in future research.

Based on the consistency of the results of previous research with the results of the present study, we can conclude that through the demonstration of specific behaviours, the teacher is likely to succeed in diminishing the psychological distance and establishing a quality teacher-student rapport between him/herself and his/her audience. In such a psychologically safe environment, in which the teacher is also open to different opinions, points of view, comments and questions from the students, in which mistakes and errors are not punished but treated as part of the learning process, and in which the teacher is interested in the students' understanding of the subject matter and tries to help them understand it as well as possible, the teacher is accessible and students do not feel uncomfortable seeking help from the teacher, the students are more willing to check their ideas, to participate actively and to publicly discuss their misunderstandings and their misconceptions and to take intellectual risks in general to form their knowledge in interaction with the social environment. In the case of poor teacher-student rapport, even frequent and enthusiastic use of active working methods most likely does not encourage students to participate actively. Quality teacher-student rapport can thus be seen as a ground where constructivist-based teaching can happen. Thus, the new definition of teacher-student rapport for higher education (Bardorfer, 2013) represents a step towards student-centred teaching, or a constructivist paradigm of teaching, respectively.

However, as HLM analyses only provide information on the relationships between predictors and the criterion variable, the result of the present study does not suggest a cause-effect relationship between predictors and the criterion variable. Thus, it is possible that more active students are more likely to interact with the teacher, resulting in higher quality teacher-student rapport, and it is also likely that teachers respond more positively to and support the active students to a greater extent than the less active students.

In addition to teacher-student rapport, gender was also statistically significantly correlated with active participation, with female students rating their participation on average 0.27 points lower than male students when controlling for the remaining predictors (see Table 4). Therefore, male students rated their participation in lessons as more active, i.e., in comparison to female students, they were more likely to actively participate in lessons without hesitation, voluntarily answer, comment, and ask questions, even when they don’t know the answers, and to express their opinions in the target teacher's lessons. The role of gender in active

participation has been investigated in numerous studies using either self-reported or observational measures of students' active participation, or both, but the findings of these studies are rather inconsistent. Similarly, as in the present research, authors of studies with self-reported measures, report that male students rate their participation as more active compared to female students (e.g., Auster & MacRone, 1994; Crombie et al., 2003; Fassinger, 1995b). As a possible explanation for such gender differences, Rocca (2010) cites the fact that men have higher self-confidence compared to women (Fassinger, 1995b; Kling, Hyde, Showers, & Buswell, 1999). This is consistent with the finding of Larkin and Pines (2003) that female compared to male students more often avoid eye contact with the teacher and pretend to read when the teacher calls on them, and with the finding that female students compared to male students are characterized by a higher degree of anxiety when communicating in the lecture hall (Jaasma, 1997).

On the other hand, studies based on observational measures do not always support the findings of studies with self-reported measures of active participation. For example, Howard, Zoeller and Pratt (2006, cited in Rocca, 2010) found a significantly higher proportion of female students in active participation, while Brady and Eisler (1999), Pearson and West (1991), as well as Tatum, Schwartz, Schimmoeller, and Perry (2013) report no gender differences in active participation. A possible explanation for the results of the present study is that Slovenian female students also have lower self-confidence compared to male students, resulting in lower levels of active participation, regardless of the quality of the rapport they have with the teacher. It is also possible that female students rate their active participation lower due to experiencing more anxiety in interacting in the classroom, regardless of the rapport they have with the teacher, as this anxiety may be related to fellow students. In active participation, the student not only exposes his or her lack of knowledge or lack of understanding but also e.g. their social skills and rhetorical abilities. For a clearer picture, the connection between self-confidence, gender and active participation should be tested on a representative sample of students, which would include a more objective measure of participation, such as the observational measure. In addition, it would be useful to include the quality of relations among fellow students, a variable which was not controlled in the present study and influences students' classroom behaviour (Fassinger, 1995b).

The results (see Table 4) also showed that when controlling for the remaining predictors, students with better prior academic performance also rated their participation as more active. It is possible that students with better prior academic performance due to past success and confirmation of their competence in the educational system, also have a higher academic self-concept and self-confidence. Both academic self-concept and self-confidence are positively associated with active participation (Auster & MacRone, 1994; Christensen, Curley, Marquez, & Menzel, 1995; Fassinger, 1995a, 1995b, 2000; Weaver & Qi, 2005). Several authors (e.g., Fritschner, 2000; Howard & Henney, 1998; Weaver & Qi, 2005) suggest that students do not choose to participate due to feelings of fear or inadequacy in front of both the teacher and other students. In fact, according to students, self-confidence is the key motivating factor for their active participation (Weaver & Qi, 2005). We conclude that a student who is confident in his/her

abilities due to positive past experiences and successes, is less reserved in commenting, questioning, and answering, even if he/she is not sure of the correctness of his/her answers. Interestingly, Bowers (1986) found that among those students who experience fear in the classroom, about 60% choose not to participate, while about 33% of students choose to participate despite their fear. Rocca (2010) explains this with Wade's finding (1994, cited in Rocca, 2010) that students are more likely to actively participate when they consider their ideas to be relevant and worthwhile, or if they are interested in or know something about the topic. It is worth noting here that teacher-student rapport may be crucial for active participation, especially for students with lower self-confidence. By demonstrating behaviours through which the teacher communicates to students that their contributions are desirable, valuable, and important, i.e., through quality teacher-student rapport (Bardorfer, 2013), the teacher can probably have a significant impact on their active participation. This assumption should also be tested in further research, optimally using an objective measure of participation activity, e.g., the observational measure and a measure of self-confidence.

The results of the present study (see Table 4) also showed that the degree of relative autonomy in studying the subject matter of the target teacher is important for active participation. While controlling the remaining predictors, students with a higher degree of autonomous motivation for studying the target teacher's subject matter, i.e., who were up-to-date with their studies, made an effort to be successful in the target teacher's subject during the semester and who studied the subject matter because they found it interesting, fun, in line with their interests, or because they perceived knowledge of the material as important for achieving their own goals, also rated their participation as more active, compared to the students with a lower level of autonomy in studying the target teacher subject matter. This is not surprising, as similar results have been found in studies at lower levels of education, as well as higher education (Juriševič, 2012; Connell & Wellborn, 1990, cited in Ryan & Deci, 2000). Increasing internalisation and thus a related sense of personal commitment is associated with greater persistence, more positive self-perceptions, and higher quality of participation (Ryan & Deci, 2000). Similarly, several researchers (Auster & MacRone, 1994; Fassinger, 1995a, 1995b, 2000; Goodboy & Myers, 2008; Weaver & Qi, 2005) have found that students who are more interested in the material, a characteristic of intrinsic motivation, also participate more actively in lessons.

Conclusions

Given the importance of teacher-student rapport in creating a favourable learning environment for fostering students' learning (Wendt & Courduff, 2018; Xie & Derakhshan, 2021; Frymier & Houser, 2000; Havik & Westergård, 2020) and at the same time the importance of students' active participation in and out of classes for the thoroughness of learning and consequently the quality of the achieved results (Marentič Požarnik, 2010), we aimed at investigating the predictive value of teacher-student rapport on students' active participation. The

study findings suggest that teacher-student rapport significantly predicts students' active participation in lessons. Along with rapport, students' gender, previous academic performance, and autonomously regulated learning behaviours significantly predicted their active participation. As such, the study provides useful information on the effect of rapport on students' active participation in lessons. The results are consistent with the findings of previous research on the positive correlation between active participation and teacher-student rapport in the USA (Frisby & Myers, 2008; Frisby & Martin, 2010) and previous research on the positive correlation between active participation and similar phenomenon to teacher-student rapport, such as psychological availability (Christensen, Curley, Marquez, & Menzel, 1995; Menzel & Carrell, 1999) and teacher's concern for students (Myers, 2004). The results are also in accordance with the results of previous research on the relationship between active participation, psychological distance, and differences in power (Stephen, 1981). Most likely, through high-quality rapport, the teacher manages to reduce the psychological distance between himself and the students and thus create a psychologically safe environment in which the mistakes and misunderstandings of the students are not punished, but treated as part of the learning process, and in which the students are therefore more willing to check their understanding, ideas and, in general, to take intellectual risks. Although the study employed convenience sampling the sample is large enough and heterogenous by type of studies and universities, we conclude presented results can be generalized to the population of students involved in public universities in Slovenia.

Practical Implications

The findings of the current study have significant practical consequences, as they offer valuable insights into strategies for improving students' active engagement both within and outside the classroom in higher education. Aligned with the constructivist paradigm of pedagogy within the realm of higher education, as well as recognizing the numerous benefits of students' active participation in enhancing the quality and sustainability of knowledge, teachers in higher education should strive to establish a sound rapport with the students to foster students' active participation through their behaviour and attitudes. This may encompass demonstrating respect towards students, embracing their contributions to the instructional process, refraining from penalizing errors and refraining from passing judgment on misunderstandings and lack of knowledge, displaying a willingness to adapt to some extent in terms of content and structure, striving for consistency in their conduct, being approachable, sharing their experiences with students, fostering opportunities for interpersonal connections, and employing nonverbal cues that foster a sense of safety and reflect a democratic disposition (for further information, *see* Bardorfer, 2017).

Limitations and Future Research Directions

Some methodologic limitations of the study should be noted. The first constraint pertains to the employed measures. Self-reported measures were employed in this study, indicating that participants were limited to reporting on factors within their awareness and their replies may have been subject to the effect of socially acceptable tendencies (Ashton, 2013; Carducci, 2009). Given that hierarchical linear modelling (HLM) analyses solely yield insights into the association between predictors and criterion variables, the findings of the current study do not imply a causal relationship between the predictors and the criterion variable. Hence, it is plausible that the differential ability of certain students to develop a stronger connection with their instructor stems from their heightened level of active participation during classroom sessions. It is plausible that educators exhibit a more favourable response towards these students and provide them with increased support, and as a result, students perceive rapport as stronger. This assumption could be verified in further longitudinal studies, which would measure the differences in students' active participation at the beginning and end of the semester and thus directly determine the effect of rapport on students' active participation. Future research designs should also measure and control the relationships between students, *e.g*., classroom climate, as past research has shown that these also influence the desired academic behaviours of students (Frisby & Martin, 2010) and other possible relevant factors (*e.g.* class size, type of studies). Employing objective measures, such as systematic observation of teachers' and students' behaviour, would be valuable considerations for the design of future studies.

Ethics Statement

The study was conducted by the ethical standards of the institutional research committee and with the Declaration of Helsinki and its later amendments. Before participating in the study, the participants were informed of the purpose of the study, its expected benefits, as well as ethical aspects. Written informed consent was obtained from all participants in the study. Confidentiality and anonymity were assured, therefore, there was no possibility to identify the participants from their responses.

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Metacognitive Strategies and Tendency to be Open to Learning: A Predictive Study[1]

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The aim of the study was determining the openness to learning tendencies and metacognitive learning strategies and analysing the predictive relationships between the related variables. The predictive research model was used in the study. Within the research, 499 education faculty students participated. For data collection, "Metacognitive Learning Strategies Scale" and "Tendency to be Open to Learning Scale" were used. The collected data were analyzed using simple linear regression analysis and multiple linear regression analysis. Consequently, it was determined that students frequently use metacognitive learning strategies; their tendencies to be open to learning are at a high level. It was concluded that the tendency to be open to learning significantly predicted the total scores obtained from the metacognitive learning strategies scale. It was concluded that the most predicted variable by the predictive variables together was planning strategies, and the least predicted variable was evaluation strategies. These results show that openness to learning is a vital variable in activating metacognitive learning strategies.

Keywords: metacognitive learning strategies, learning tendency, tendency to be open to learning, teacher competencies, teacher education

Introduction

The scientific, social, and technological developments experienced today lead to the change of knowledge and skills needed in different fields. With the pandemic process, which is one of these developments and affecting the world, some skills that impact the learning of individuals have come to the fore even more. These skills include the required qualities for individuals to cope with increasing knowledge in either face to face or online learning environments, evaluate the knowledge offered to them, and take responsibility for their own learning processes by exploring individual learning ways. A significant part of these skills needed in the learning process are gained through life-long learning experiences.

Lifelong learning process consists of learning activities that aim to improve individuals' personal, social, or professional knowledge, skills, and competencies throughout their lives (European Commission, 2002). Within the focus of life-long learning, there is the concept of learning more than teaching. In this context, learning is defined as a job that is triggered by good teaching and that the individual will do in accordance with the educational, social, and economic needs (Scales, Briddon, & Senior, 2013/2015). The learner characteristics that affect lifelong learning

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consist of individuals' attitudes, tendencies, and motivations towards learning and high-level thinking skills necessary for lifelong learning (Adams, 2007; Crow, 2006; Diker-Coşkun & Demirel 2012; OECD [Organisation for Economic Co-operation and Development], 2000; European Commission, 2002; Tan & Morris, 2005). The learning to learn skills among these characteristics require individuals to determine their own learning objectives, plan, monitor, and evaluate their learning process through these objectives (Adams, 2007; Knapper & Cropley, 2000). The learning to learn skills are seen as one of the most effective ways of supporting the lifelong learning of individuals in online and face-to-face education environments (Cornford, 2012).

Literature Review

(1) Metacognitive Learning Process

(2)

(3) It is seen that the concepts of metacognition, metacognitive skills, or metacognitive awareness are used to explain learning to learn skills. Flavell (1979) who used the metacognition concept, emphasizes an individual's knowledge about their own cognition and the use of this knowledge to follow and organize cognitive processes in explaining this process. In this sense, metacognitive knowledge includes individual's knowledge about self, knowledge regarding learning task, and knowledge about the necessary strategies for accomplishing this task successfully. The individuals using their metacognitive knowledge are expected to focus their attention, plan the task in detail, evaluate each step of the learning process, and doing the necessary reorganizations (Marzano et al., 1988). These kinds of activity require the application of metacognitive knowledge strategically to reach the learning objectives (Meijer, Veenman, & van Hout-Wolters, 2006; Schraw & Moshman, 1995) are conceptualized as metacognitive strategies. Within this context, individuals who realize the learning to learn process uses metacognitive strategies while organizing their own cognitive process.

(4) When the concept of metacognitive learning strategies entered the literature of learning strategies, it was discussed together with cognitive strategies, but as a result of the conducted studies, the two strategy types were separated from each other (Namlu, 2004). Since, though cognitive and metacognitive strategies are closely related to each other, they have conceptually distinctive aspects (Cornford, 2012). Both cognitive and metacognitive strategies used in the learning process are goal-oriented, deliberately applied, effortful strategies (Schraw 1998). However, cognitive strategies are used to process the necessary knowledge to reach learning objectives. On the other hand, metacognitive strategies include activities involving questioning how and why this knowledge will be processed, understanding if the objectives are reached or not, and evaluation (Marzano et al., 1988).

(5) It is observed that there are various classifications for metacognitive learning strategies in the literature. For example, Brezin (1980) classified metacognitive learning strategies into five basic categories which are planning,

focusing and maintaining attention, analysis, revising, and evaluation. Jacobs and Paris, (1987) and Kluwe (1987) consider these strategies, which they conceptualize as metacognitive activities, in three groups. These strategies are planning, monitoring, and evaluating (cited in Schraw & Moshman, 1995). In the classification of Blakey and Spence (1990), there are three categories similarly defined as planning, monitoring, and evaluation. The metacognitive strategies in the measurement tool used in this study were grouped as planning, organizing, monitoring, and evaluation strategies (Namlu, 2004). When the metacognitive learning strategies used in the learning to learn process are evaluated, it is seen that planning, monitoring, and evaluation strategies are significantly emphasized strategies within the literature. Among the strategies, planning requires the determination of learning objectives that will guide monitoring the process and making a plan for these objectives (Marzano et al., 1988). Within the scope of this plan, there are activities such as determining the strategies suitable for the learning objective and predicting the planned time for the learning process (Meijer, Veenman, & van Hout-Wolters, 2006). On the other hand, monitoring strategies help individuals deliberately and consciously monitor and organize their own knowledge, processes, and emotional conditions regarding learning (Hacker, 1998). Learner through these strategies needs to make decisions about whether s/he has the necessary knowledge for learning, the difficulty of the task, and whether the understanding is achieved (Pintrich, Wolters, & Baxter, 2000). Evaluation strategies, it is aimed that individuals make judgments about activities conducted and products created in his/her learning process (Schraw & Moshman, 1995). The typical examples of an evaluation process include the learner's re-evaluating the objectives determined at the beginning of the process and reinforcing the cognitive attainments (Schraw, Crippen, & Hartley, 2006). In some occasions, reflection activities are used immediately after the evaluation process aiming to put forward the possible results of the learning experience for future cases (Meijer, Veenman, & van Hout-Wolters, 2006).

(6) The planning, monitoring and evaluation strategies used in the learning-to-learn process are not independent from each other but enable the learning process to be organized interactively. For instance, individuals using metacognitive learning strategies should plan the required basic concepts for learning tasks beforehand. As for the learning process, it is necessary that individuals question whether they discriminate these concepts determined beforehand that should monitor the process. Individuals take the results reached based on these concepts under consideration for the next task showing that they use evaluation strategies (Namlu, 2004). Flavell (1979) distinguishes these strategies hierarchically and states that planning strategies are used before starting the task, monitoring strategies are used during the execution of the task, and evaluation strategies are used after the completion of the task.

Metacognitive Learning Strategies and Learning Tendencies

In the use of metacognitive strategies in the learning process; several affective characteristics such as individuals' motivations, attitudes, beliefs and tendencies toward learning and thinking play an important role (Ang, Van-Dyne, & Koh, 2006; Buckingham-Shum & Deakin-Crick, 2012; Carr & Claxton, 2002). Learning tendency which composes the focus of this research consisted of three interacting elements. These elements are heading for the learning task or being motivated, being sensitive to the learning task and completing the learning task (Perkins, Jay, & Tishman, 1993). Generally, supportive learning tendencies in the acquisition of metacognitive strategies include individuals' being open to learning, ready, and willing to take advantage of learning opportunities (Carr & Claxton, 2002). In this line tendencies fed by the desires and motivations of individuals to take action, it is revealed in the actions they take in certain situations. For example, an individual with a curious tendency reflects this tendency by continuously asking questions and researching (Buckingham-Shum & Deakin-Crick, 2012). Among the learning and thinking tendencies; it has been determined that features such as mental flexibility, perseverance, openness to change, strategic awareness, willingness to take risks, open-mindedness, intellectual curiosity, and openness to learning come to the fore (Buckingham-Shum & Deakin-Crick, 2012; Carr & Claxton, 2002; Claxton, 2008; Perkins, Jay, & Tishman, 1993).

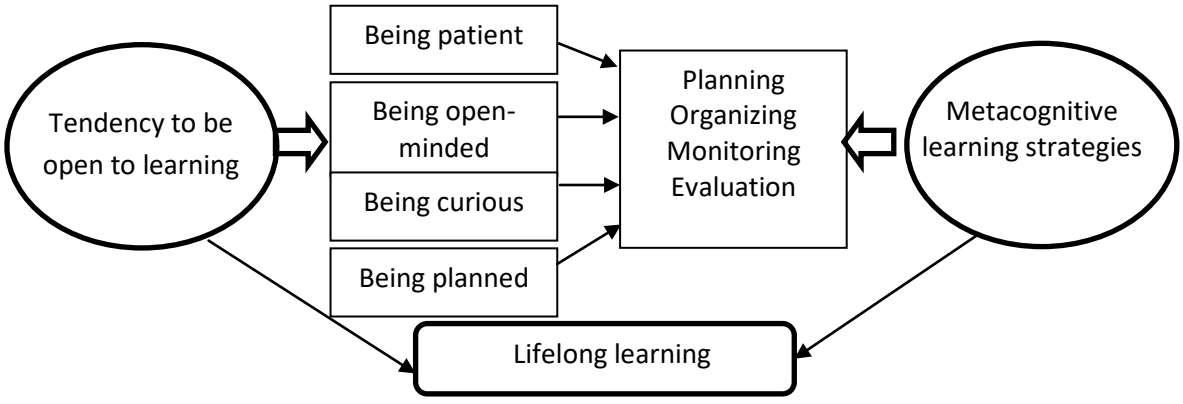
Being open to learning, which is among these tendencies and constitutes the independent variable of the research, is defined as learning the quality of thinking and knowledge while making judgments about events, reasons for events, and what needs to be done (Robinson, 2018). Openness to learning reflects actions embodying individuals' taking action about learning. Individuals establishing a continuous and developmental relationship with knowledge have motivation for learning (Türker, 2021). The tendency to be open to learning, on the other hand, requires the individual to be willing to be open to learning, to tend towards learning and to perform actions that reflect openness to learning, while making judgments about the quality of the learning process. It is indicated that individuals whose tendency to be open to learning is strong, are creative, prone to acculturation and mental development, curious, unique and open-minded, and artistically sensitive (Barrick & Mount, 1991). In the study by Tunca-Güçlü, Yeşilpınar-Uyar and Alkın-Şahin (2022), it was determined that there are four dimensions composing the tendency to be open to learning. These dimensions are; being patient, open-minded, curious, and planned.

Being patient generally necessitates students to struggle against the negative situations they faced and be insistent (Dweck, 1986; cited in Sideris, 2007). Individuals with the tendency for patience are expected to make an effort in their new learning experiences and situations require struggle (Tunca-Güçlü et al. 2022). The tendency to be open-minded is an important affective feature that requires an understanding approach to different ideas and perspectives and directs social relations and individual experiences (Meadows, 2006). In this sense, open-minded individuals should be politically, socially, and culturally unprejudiced, consider different perspectives in necessary situations (Tunca-Güçlü et al. 2022).

Curiosity is defined as the desire of individual for continuing to learn about fields of interest in a way developing his/her potential and contributing to society (Meadows, 2006). Individuals with a tendency to be curious are expected to search for interesting topics and problems to support formal and informal learning processes. The tendency for planning which is the last dimension of being open to learning involves preparing for the learning task by organizing conditions such as time management, setting, and materials required for the learning task (Tunca-Güçlü et al. 2022).

These dimensions are the characteristics associated with metacognitive learning strategies and lifelong learning tendencies. Since, in the lifelong learning process, individuals should be open to learning to be able to follow the developments in academic and occupational fields, keep up with these developments, and be success-oriented (Doğar, 2013; Kozikoğlu & Altunova, 2018). It is seen that individuals open to learning are more willing to participate in the learning experience, get more benefits from the learning experience (Barrick & Mount, 1991), and much easier adapt the developments related to social, economic, and political situations (Watters & Watters, 2007 cited in Türker, 2021). It is stated that the cognitive awareness of individuals who are prone to learning new things and willing to seek innovation and try, is also high (Ang, Van-Dyne, & Koh, 2006) and they are more successful in activating their metacognitive processes (Maurer & Shipp, 2021; Öztürk, 2021). Therefore, lifelong learning individuals should use metacognitive strategies effectively and be open to learning. It is considered that the tendency for being open to learning could be a significant variable supporting these strategies. Within this context, the metacognitive strategies required for the lifelong learning process and the tendency for being open to learning are the theoretical basis of the research. The relationships between these concepts are in Figure 1.

Figure 1. Tendency to be Open to Learning and Metacognitive Strategies in the Lifelong Learning Process



The Need for Research/Rationale

Contemporary approaches adopted in the learning-teaching process required restructuring the meaning attributed to learning concept, learning and teacher roles, and the characteristics of the learning environment in line with the needs of the age. In this process, it is aimed to raise individuals who are open to learning and innovations, who make sense of the presented information by establishing a relationship with their prior learning, and who use the information they make sense of in a creative way in new situations (Wiske, Sick, & Wirsig, 2001). Individuals who show cognitively active participation in learning activities should acquire the necessary metacognitive skills to take responsibility for their own learning and thinking processes (OECD, 2019).

These features among the 21st-century learning skills directly affect the competencies teachers should possess. Teachers responsible for guiding the learning process, are expected to consider students' individual differences, plan, apply, and evaluate activities for gaining metacognitive skills (Marzano et al. 1988). Teachers' organizing this kind of activities requires their being open to learning and professional development, and undertaking their own learning responsibilities (Ang, Van-Dyne, & Koh, 2006; Askell-Williams, Lawson, & Skrzypiec, 2012). Professional development opportunities provided for teachers are seen as very important for the acquisition of these features regarding the organization of metacognitive processes (Bredeson, 2002).

Pre-service teacher education plays a fundamental role in providing reflective learning experiences necessary for professional development. In this context, it should be aimed to train teachers who are open to learning and development and have metacognitive skills through qualified pre-service teacher education programs structured in line with the needs of the age. It is necessary to examine the skills and tendencies of pre-service teachers in a relational and multidimensional structure in order to determine the extent to which the programs serve this purpose and to organize them considering the current needs.

In related literature, it is observed that the metacognitive awareness of pre-service teachers and the metacognitive strategies they use have been analyzed in terms of different variables (Alkan & Erdem, 2012; Ay & Baloğlu-Uğurlu, 2016; Baykara-Özaydınlık, 2018; Deniz, 2015; Güven & Çevik-Kılıç, 2021; Tümen-Akyıldız & Donmuş-Kaya; 2021; Zhang & Seepho, 2013). Within the other research related to the topic, it is determined that the lifelong learning tendencies of pre-service teachers have been examined (Bilici & Bağcı, 2020; Bulaç & Kurt, 2019; Demir & Doğanay, 2019; Yenice & Alpak-Tunç, 2019; Pilli, Sönmezler & Göktan, 2017; Recepoğlu, 2021). These studies present significant data for the description of these variables. However, limited number of studies, in which the tendency to be open to learning was examined as a sub-dimension of attitude towards learning, were reached (Yavuz-Konokman & Yanpar-Yelken, 2014). Besides, no study was found that analyzed the tendency to be open to learning and metacognitive learning strategies.

In this study conducted based on this requirement, it was aimed to determine the tendency to be open to learning and metacognitive learning strategies of the

students in the faculty of education, to analyze the predictive relationships between related variables. With respect to this aim, the answers for the research questions below were sought.

- What is the level of students' metacognitive learning strategies?
- What is the level of students' tendency to be open to learning?
- Does the tendency of students to be open to learning significantly predict the total scale scores of metacognitive learning strategies?
- Which of the sub-dimensions of the tendency to be open to learning significantly more predict the total scale and subscale scores of metacognitive learning strategies?

Methodology

Research Design

Predictive research design was used within the study. The predictive (independent) variables of the research were tendency to be open to learning and the being patient, open-minded, curious and planned tendencies forming it. The predicted (dependent) variables of the study were metacognitive learning strategies and the planning, organizing, monitoring, and evaluating strategies composing them.

Study Group

The population of the study consisted of students in the faculty of education at a university in the western part of Turkey. The sample of the study consisted of 499 students determined by disproportionate cluster sampling among this population. The 79.40% of the students in the sample were women and 20.60% were men. 51.10% of the students were freshmen, 48.90% were seniors. The 24.80% of students were early childhood education, 21% were primary education, 15.80% Turkish education, 15.60% social sciences education, 10.40% science education, 12.20% primary mathematics education program students.

Data Collection

In data collection, Metacognitive Learning Strategies Scale developed by Namlu (2004) and Tendency to be Open to Learning Scale developed by Tunca-Güçlü et al. (2022). Metacognitive learning strategies scale is a 4-Likert type tool consisting of planning, organizing, monitoring, and evaluating sub-dimensions and 21 items. The total variance in the scale explained is 44.70%. Cronbach Alpha internal consistency coefficients regarding sub-dimensions of the scale are varying between .51-.83. Cronbach Alpha internal consistency coefficient for the whole scale is .89. Within this study, Cronbach Alpha internal consistency coefficients

were determined as .86 for the total scale, .68 for planning subscale, .83 for organizing subscale, .79 for monitoring subscale and .51 for evaluating subscale.

Tendency to be Open to Learning Scale is a 5-Likert type tool with 22 items consisting of being patient, open-minded, curious, and planned subscales. The total variance explained by the scale is 49.31%. The Cronbach Alpha internal consistency coefficients for the sub-dimensions of the scale ranged from .64 to .84. The Cronbach Alpha internal consistency coefficient for the entire scale is .85. The Cronbach Alpha internal consistency coefficients in this study were determined as; .87 for the whole scale, .83 for being patient subscale; .82 for being open-minded and .74 for being curious, .81 for being planned subscale.

Data Analysis

Simple linear regression analysis and multiple linear regression analysis were used in the analysis of the data. Within the preparation of the data for simple linear regression analysis, the normal distribution characteristics regarding the scores of dependent and independent variables were checked by determining the kurtosis and skewness coefficients. In this study, it has been determined that the kurtosis and skewness coefficients of the variables varied between -1 and +1, and the values obtained by dividing the skewness and kurtosis coefficients by their own standard errors were between -1.96 and +1.96. Thus, it was found that the scores of predictive and predicted variables showed normal distribution. In addition, correlation analysis was utilized for testing the linear relation between dependent and independent variables, it was determined that there was a moderately significant relationship (r=.60) between these variables.

In the process of preparing the data for multiple linear regression analysis, the multivariate normal distribution characteristics of the scores of the dependent and independent variables were checked with a scatter plot. The elliptical shape of the resulting graphs showed that the multivariability normality assumption was met. The linear relationship between predictive variables and each dependent variable included in the analysis was tested by correlation analysis and it was determined that there were moderately and low significant relationships between predictive variables in line with indicated values in Table 1. When examining whether there is a multicollinearity between the independent (predictive) variables; VIF values were determined as <10; TO (tolerance) values were determined as>.10 and CI (Condition Index) values were determined as <30 and it was determined that there was no multicollinearity problem. Durbin Watson coefficients calculated to detect autocorrelation were found as; 2.09; 1.89; 2.11, 1.90, and 1.91. That the values were between 1.50 and 2.50 indicated that there was no autocorrelation in the data set.

While the scores of the metacognitive learning strategies scale and the tendency to be open to learning scale were interpreted, the weighted average values were calculated. Mean values regarding the scores obtained from metacognitive learning strategies scale and subscales were interpreted as “between 1.00-1.75 never”; “between 1.76-2.50 sometimes”; “between 2.51-3.25 often” and “between 3.26-4.00 always”. On the other hand, mean values for the scores got from tendency to

be open to learning scale and subscales were interpreted as “between 1.00-1.80 very low”; “between 1.81-2.60 low”; “between 2.61-3.40 moderate”; “between 3.41-4.20 high”; “between 4.21-5.00 very high”. The significance level of .05 was taken as a criterion in interpreting whether the results were significant or not.

Results

Descriptive Statistics and Correlation Values Regarding Predictive and Predicted Variables

The descriptive values and correlation values obtained in line with the first and second questions of the research are presented in Table 1.

Table 1. Metacognitive Learning Strategies Total and Subscale Scores and Mean, Standard Deviation and Correlation Values for Predictive Variables

Predicted Variables	**N**	**X**	**Sd**	**1**	**2**	**3**	**4**	**5**
MLST	499	2.67	.43	.600*	.508*	.225*	.371*	.581*
Planning strategies	499	.67	.15	.478*	.427*	.110*	.229*	.555*
Organizing strategies	499	.79	.18	.514*	.388*	.192*	.335*	.539*
Monitoring strategies	499	.71	.13	.452*	.419*	.266*	.302*	.284*
Evaluation strategies	499	.47	.10	.327*	.279*	.098*	.243*	.311*
Predictive Values								
1.TOLT	499	3.79	.48	-	.823*	.677*	.667*	.656*
2. Being patient	499	1.17	.20		-	.399*	.439*	.418*
3. Being open-minded	499	1.07	.18			-	.362*	.130*
4. Being curious	499	.71	.12				-	.270*
5. Being planned	499	.83	.18					-

* p<.01
MLST (Metacognitive learning strategies total)
TOLT (Tendency to be open to learning total)

The mean of the predicted variables in Table 1 for the MLST score was 2.67; the standard deviation value was determined to be .43. It was seen that means for subscales ranged between .47-.79, while standard deviation values varied between .10 and .18. The mean for MLST score shows that students frequently use metacognitive learning strategies. It was determined that mean for TOLT score from predictive variables was 3.79; the standard deviation was .48. It was seen that the means of the subscales were between .71 and 1.17; the standard deviations varied between .12 and .20. The mean value for TOLT shows that the tendencies of the students to be open to learning are at high level. It was determined that the

variables of being patient, being curious, being open-minded, and being planned, which constitute the dimensions of the tendency to be open to learning, were in a moderate and low-level significant relationship with the predicted variables. Again, it is seen that there is a moderate and low-level significant relationship between the predictive variables.

Inferential Statistics Regarding Predictive and Predicted Variables

In this section, inferential statistical results related to the scores obtained from the metacognitive learning strategies scale and its sub-dimensions are presented and explained under sub-headings.

The Prediction Level of the Metacognitive Learning Strategies Total Score of the Tendency to be Open to Learning

Simple linear regression analysis results obtained through the third research question are presented in Table 2.

Table 2. Simple Linear Regression Analysis Results on Metacognitive Learning Strategies and the Variables of Tendency to be Open to Learning

Variable	**B**	**Standard Error B**	**β**	**t**	**p**
Constant (MLS)	13.151	2.591	-	5.076	.00
TOL	.515	.031	.600	16.704	.00
R= .600 R2=.36	Adjusted R2= .36		F(1-497)= 279.022		

MLS (Metacognitive learning strategies)
TOL (Tendency to be open to learning)

It was determined that students' TOL total scores significantly predicted MLS scores as a result of simple linear regression analysis in Table 2 (R=.60. R2=.36. F=279.02. p<.01). It is seen that students' tendencies to be open to learning significantly explain 36% of the change in metacognitive learning strategies.

Prediction Level of Metacognitive Learning Strategies Total and Subscale Scores of Sub-Dimensions of Openness to Learning

The results regarding the level that predictive variables constituting tendency to be open to learning predicts MLS total score were presented in Table 3.

Table 3. Multiple Regression Analysis Results Regarding Metacognitive Learning Strategies Scale Total Score and Predictive Variables

Variable	**B**	**Standard Error B**	**β**	**t**	**p**	**Zero-order r**	**Partial r**
Constant (MLS)	15.351	2.467	-	6.224	.00	-	-
2.Being patient	.550	.088	.262	6.258	.00	.508	.271
3.Being open-minded	.035	.087	.015	.405	.69	.225	.018
4.Being curious	.455	.132	.134	3.452	.00	.371	.153
5.Being planned	1.011	.087	.434	11.588	.00	.581	.462
R= .662	R2=.44	Adjusted R2= .43					
F(4-494)= 96.37	p= .000						

According to the multiple linear regression analysis results in Table 3; it was determined that the tendencies of being patient, open-minded, curious, and planned were in a significant relationship with MLS total scale scores. The four stated predictive variables significantly explain 44% of the total variance within MLS scores (R=.662. R2= .44 p<.01). According to standardized regression coefficients (β), predictive variables' relative order of importance is being planned, being patient, being curious and being open-minded. When the t test results regarding the significance of the regression coefficients are examined; it is seen that the tendencies to be planned, to be patient and to be curious are significant predictors of metacognitive learning strategies (p<.01), while the tendency to be open-minded is not a significant predictor of metacognitive learning strategies (p=.69>.05). The results regarding the level of predictive variables of planning strategies are presented in Table 4.

Table 4. Multiple Regression Analysis Results on Planning Strategies Subscale Score and Predictive Variables

Variable	**B**	**Standard Error B**	**β**	**t**	**p**	**Zero-order r**	**Partial r**
Constant (Planning)	4.040	.921	-	4.388	.00	-	-
2.Being patient	.186	.033	.254	5.663	.00	.427	.247
3.Being open-minded	-.044	.032	-.055	-1.362	.17	.110	-.061
4.Being curious	.018	.049	.015	.372	.71	.229	.017
5.Being planned	.368	.033	.452	11.292	.00	.555	.453
R= .597 R2=.36 Adjusted R2= .35 F(4-494)= 68.52 p= .00							

According to the multiple linear regression analysis results in Table 4; it has been determined that the tendencies of being patient, being open-minded, being curious, and being planned are in a significant relationship with the planning strategies subscale scores. The stated four predictive variables significantly explain 36% of the total variance within planning strategies scores (R=.597. R2= .36 p<.01). With regard to the standardized regression coefficients (β), the relative importance order of the predictor variables on planning strategies is as; tend to be planned, patient, curious, and open-minded. When the t test results regarding the significance of the regression coefficients are examined; it is seen that the tendencies of being planned and being patient are significant predictors of planning strategies (p<.01), while the tendencies of being curious and being open-minded are not significant predictors of planning strategies (p=.71; p=.17>.05). The results on prediction level of predictive variables for organizing strategies are presented in Table 5.

Table 5. Multiple Regression Analysis Results on Organizing Strategies Subscale Score and Predictive Variables

Variable	**B**	**Standard Error B**	**β**	**t**	**p**	**Zero-order r**	**Partial r**
Constant (Organizing)	1.823	1.111	-	1.641	.10	-	-
2.Being patient	.110	.040	.126	2.778	.01	.388	.124
3.Being open-minded	.029	.039	.030	.741	.46	.192	.033
4.Being curious	.211	.059	.149	3.560	.00	.335	.158
5.Being planned	.430	.039	.443	10.944	.00	.539	.442
R= .586 R2=.34 Adjusted R2= .34 F(4-494)= 66.61 p= .000							

In line with the multiple regression analysis results in Table 5, it has been put forward that tendencies to be patient, open-minded, curious, and planned are in a significant relationship with organizing strategies subscale scores. The four predictive variables explain 34% of the total variance in organization strategies scores (R=.586. R2= .34 p<.01). According to the standardized regression coefficients (β), the relative importance order of the predictive variables on organizing strategies is the tendencies to be planned, patient, curious, and open-minded. Analyzing the t test results regarding the significance of regression coefficients, it is seen that being planned, patient and curious tendencies are significant predictors on organizing strategies (p<.05) whereas the tendency to be open-minded is not a significant predictive on organizing strategies (p=.46>.05). The results regarding the level predictive variables predict monitoring strategies are shown in Table 6.

Table 6. Multiple Regression Analysis Results on Monitoring Strategies Subscale Score and Predictive Variables

Variable	**B**	**Standard Error B**	**β**	**t**	**p**	**Zero-order r**	**Partial r**
Constant (Monitoring)	5.054	.909	-	5.558	.00	-	-
2. Being patient	.182	.032	.279	5.624	.00	.419	.245
3. Being open-minded	.070	.032	.098	2.197	.03	.266	.098
4. Being curious	.116	.049	.110	2.392	.02	.302	.107
5. Being planned	.091	.032	.125	2.826	.01	.284	.126
R= .460 R2=.21 Adjusted R2= .21 F(4-494)= 33.17 p= .000							

With regard to multiple linear regression analysis results in Table 6; it has been identified that tendencies to be patient, open-minded, curious, and planned are in a significant relationship with monitoring strategies subscale scores. Mentioned four predictive variables explain 21% of the total variance in monitoring strategies (R=.460. R2= .21 p<.01). According to standardized regression

coefficients (β), the relative importance order of predictive variables on monitoring strategies is as; tendency to be patient, planned, curious and open-minded. When the t test results regarding the significance of the regression coefficients are examined; it is seen that the tendencies of being patient, being open-minded, being curious, and being planned are significant predictors of the monitoring strategies (p<.05). The results regarding the prediction level of the predictive variables for the evaluation strategies are presented in Table 7.

Table 7. Multiple Regression Analysis Results on Evaluation Strategies Subscale Score and Predictive Variables

Variable	**B**	**Standard Error B**	**β**	**t**	**p**	**Zero-order r**	**Partial r**
Constant (Evaluation)	4.434	.732	-	6.058	.00	-	-
2.Being patient	.072	.026	.143	2.764	.01	.279	.123
3.Being open-minded	-.020	.026	-.036	-.775	.44	.098	-.035
4.Being curious	.109	.039	.134	2.792	.01	.243	.125
5.Being planned	.122	.026	.219	4.726	.00	.311	.208
R= .370 R2=.14 Adjusted R2= .13 F(4-494)= 19.64 p= .000							

According to the multiple linear regression analysis results in Table 7; it has been found out that the tendencies of being patient, being open-minded, being curious, and being planned are in a significant relationship with the evaluation strategies subscale scores. Four predictive variables significantly explain about 14 percent of the total variance in evaluation strategies scores (R=.370. R2= .14 p<.01). Up to the standardized regression coefficients (β), the relative importance order of predictive variables on evaluation strategies is tendencies to be planned, patient, curious and open-minded. Examining the t test results regarding the significance of the regression coefficients it is seen that the tendencies to be planned, to be patient and to be curious are significant predictors of evaluation strategies (p<.001), while the tendency to be open-minded is not a significant predictor of evaluation strategies (p=.44>.05).

Discussion

It was aimed to determine tendencies to be open to learning (TOL) and metacognitive learning strategies (MLS) of students at faculty of education and analyze predictive relationships between related variables. The obtained descriptive statistics results within the study show that students frequently use metacognitive learning strategies, and tendencies to be open to learning are at a high level. Also in the studies metacognitive learning process and cognitive awareness strategies were analyzed, it was determined that teachers and pre-service teachers frequently use cognitive awareness strategies (Ay & Baloğlu-Uğurlu, 2016; Baykara-Özaydınlık, 2018; Deniz, 2015; Güven & Çevik-Kılıç, 2021; Tümen-Akyıldız & Donmuş-Kaya; 2021; Zhang & Seepho, 2013), that cognitive awarenesses and learning to learn competencies are at high level (Alkan & Erdem, 2012;

Durmuşçelebi & Kuşuçuran, 2018). In the literature, no studies on the tendency to be open to learning were analyzed, have been found. On the other hand, in the research of Yavuz-Konokman and Yanpar-Yelken (2014), openness to learning as a sub-dimension of the attitude toward learning was examined and it was determined that the level of being open to learning of pre-service teachers was above the average. In other studies in the literature, it is seen that lifelong learning tendencies, which include dimensions related to being open to learning, are examined. The results of these studies show that pre-service teachers have a high level of lifelong learning tendencies (Bilici & Bağcı, 2020; Bulaç & Kurt, 2019; Yenice & Alpak-Tunç, 2019; Pilli, Sönmezler, & Göktan, 2017; Recepoğlu, 2021). It is seen that these results reached through the literature support the study's results.

In the results of regression analysis; it was found out that tendency to be open to learning significantly predicts MLS total scores. It is seen that the tendency to be open to learning significantly explains 36% of the change in MLS. It was determined that being planned, patient and curious tendencies forming the tendency to be open to learning are significant predictors on MLS, the tendency to be open-minded is not a significant predictor on MLS. According to this, it is seen that a significant part of the total variability in the metacognitive learning strategies of pre-service teachers stems from their tendency to be open to learning. These results show that being open to learning is a crucial variable in activating metacognitive learning strategies.

Considering the theoretical framework, these expected results are difficult to discuss in terms of empirical research findings. Because there is no study in the literature directly examining the relationship between the tendency to be open to learning and metacognitive learning strategies. However, although the study groups vary, there are studies proving that metacognitive learning strategies and cognitive awareness skills show a significant relationship with critical thinking skills and tendencies (Amin, Corebima, Zubaidah, & Mahanal, 2020; Durmuşçelebi & Kuşuçuran, 2018; Demir & Kaya, 2015; Sadeghi, Hassani, & Rahmatkhah; 2014; Sepahvand, vd., 2017), openness to experience (Ang, Van-Dyne, & Koh, 2006; Öztürk, 2021; Sepahvand vd., 2017; Soliemanifar, Behroozi, & Moghaddam, 2015) and lifelong learning tendencies (Demir & Doğanay, 2019). Öztürk's (2021) research results also show that openness to experience, which is defined as a personality trait, significantly predicts metacognitive knowledge and metacognitive regulation within the scope of cognitive awareness. These results indirectly support the study's findings.

Examining regression analysis results in terms of predictive variables, tendencies to be patient and planned were found to be significantly predicting the whole metacognitive learning strategies. In the other results obtained, it was detected that the tendency to be open-minded is not a significant predictor on MLS total score and planning, organizing, and evaluating strategies while the tendency to be curious is not a significant predictor on planning strategies. This result puts forward that tendency to be open-minded only effective in activating monitoring strategies. When the related literature has been analyzed, it is seen that tendencies to be open-minded and curious are also included within the scope of critical

thinking tendencies (Facione, 1990; Facione, Facione, & Giancarlo, 2000; Merma-Molina, Gavilan-Martin, & Urrea-Solano, 2022). The results of the studies concerning the issue show that there is a significant relationship between critical thinking tendencies and metacognitive skills (Sadeghi et al., 2014; Sepahvand, et al., 2017; Soliemanifar et al.,2015). However, that tendencies to be open-minded and curious are not significant predictors on some metacognitive strategies in this study differs from the results in the literature. Open-mindedness is an important affective feature that requires being sensitive to various views and considering different perspectives in encountered situations (Insight Assessment, 2017). It is stated that open-minded individuals focus on the whole, they adhere to the principles of rationality while making decisions about the solution of problems, they change their views when the evidence is sufficient, and they tend to seek certainty about the solution (Ennis, 1985; Bailin, Case, Coombs, & Daniels, 1999). Since this situation requires questioning the alternatives before making a decision, it is easier for open-minded individuals to reach the foreseen goals (Merma-Molina et al., 2022). Within the scope of the open-mindedness subscale used in the research, some items necessitate questioning and controlling prejudices to consider different perspectives (Tunca-Güçlü et al., 2022). In this context, affective processes that tend to be open-minded should be monitored, questioned, and controlled. Monitoring strategies in the context of metacognitive strategies are also related to monitoring the process regarding making sense of information, comparing different types of information needed in the learning process, and questioning this information by comparing it with prior knowledge (Namlu, 2004). In this sense, it is observed that monitoring and deciding activities form the basis for the monitoring process (Hertzog & Dunlosky, 2011). Therefore, it is necessary to question and monitor affective processes within the tendency to be open-minded and to monitor and control cognitive processes in monitoring strategies. The tendency to be open-minded is only a significant predictor of monitoring strategies can be associated with the prominence of monitoring and control mechanisms among the main purpose of both variables.

Being curious, another predictive variable of the study reflects the tendency to get new information independent from any expectation and learn new things (Kökdemir, 2003). According to Berlyne's (1954; 1960) curiosity theory, there are two types of curiosity as perceptual and epistemic curiosity. It is stated that there are two types of epistemic curiosity related to learning and memory characteristics, as specific and diverse. While specific curiosity includes in-depth research on a specific topic, diverse curiosity shows itself as a general research-analysis behavior (cited in Fulcher, 2004). In this sense, it is seen that attractive situations are handled in a more general and broader framework through diverse curiosity while in specific curiosity the tendency to seek depth in searching for information is at the forefront. The items in the tendency to be curious subscale are associated with turning to topics that they find interesting and worth researching to support formal and informal learning processes (Tunca-Güçlü et al., 2022). In the dimension of planning, one of the metacognitive strategies, individuals are expected to carry out preparatory work on a subject to be learned. In this context, while in-depth examination of research areas developing the potential of individual within the

tendency to be curious comes to the fore (Meadows, 2006), planning strategies require the determination of learning objectives that would guide the monitoring the process based on the subject and planning for these objectives (Marzano et al., 1988). In this process, there are activities such as determining the strategies suitable for the learning purpose and predicting the planned time for the learning process (Meijer, Veenman, & van Hout-Wolters, 2006). It is seen that planning strategies are mostly related with specific curiosity a type of epistemic curiosity, in this context, individuals should handle the information they found worth researching with an in-depth understanding. However, the tendency to be curious was not a significant predictor on planning strategies within the study could be due to pre-service teachers' perceiving curiosity as a general research-analysis behavior. In a study conducted with university students, it was found out that students tended to different issues other than analyzing the information in-depth and their curiosity tendencies do not show continuity (Demirel & Diker-Çoşkun, 2009). Besides, it is indicated that curiosity has dynamics differ in individualist and collectivist societies and sensitive to cultural differences (Acun, Kapkıran & Kabasakal, 2013; Aschieri, Durosini, & Smith, 2020). These results reached within the literature; support the view that the tendency to be curious not being a significant predictor on planning strategies could be associated with sample characteristics.

The regression results regarding predicted variables indicate that four predictive variables forming TOL significantly explain 36% of the change in planning strategies, 34% of the change in organizing strategies, 21% of the change in monitoring strategies, and 14% of the change in evaluation strategies. Within this scope, it was put forward that the most predicted variable by the tendency to be open to learning together is planning strategies, and the least predicted variable is evaluation strategies. Planning one of these strategies; includes activities regarding the preparation of necessary conditions for learning. In organizing strategies, the necessary topics and key concepts for mental preparation for the learning task should be arranged according to metacognitive schemes. While monitoring and controlling the learning process is necessary for monitoring strategies; evaluation strategies involve the activities that require an individual to decide the effectiveness of his/her learning process (Namlu, 2004). Flavell (1979) distinguishes these strategies hierarchically and states that planning strategies are used before starting the task, monitoring strategies are used during the execution of the task, and evaluation strategies are used after the completion of the task. In this sense, it is seen that there is a hierarchical, interactive, and systematic structure between planning, organizing, monitoring, and evaluation strategies used in metacognitive processes.

It was found out that also the power of tendencies to be open to learning predict metacognitive strategies decrease in a systematic structure from planning strategies towards evaluation strategies. This shows that individuals open to learning more tend to use strategies to plan the learning task and structure mental processes. However, it is obvious that this tendency does not show a stable structure; relatively decrease in monitoring and evaluating metacognitive processes. The results of different studies supporting this view; indicate that higher education

students use planning and organizing strategies more than monitoring and evaluation strategies (Baykara-Özaydınlık, 2018; Deniz, 2015; Güven & Çevik-Kılıç, 2021; Namlu, 2004; Langdon et al., 2019; Yang, 2009; Yılmaz & Baydas, 2017; Zhang & Seepho, 2013). In Diker-Coşkun and Demirel's (2012) study, it was determined that higher education students are making an effort to participate in lifelong learning activities, but they are not determined to conclude their optional learning situations. These results obtained are seen to support the findings of the study.

Conclusions and Implications

Consequently, it was found out that students frequently use metacognitive learning strategies, and their tendencies to be open to learning are at a high level. It was concluded that the tendency to be open to learning significantly predicts the total scores got from the metacognitive learning strategies scale. That the tendencies to be patient and planned significantly predict all of the metacognitive learning strategies was put forward. It was detected that the tendency to be open-minded is not a significant predictor on planning, organizing, and evaluation strategies while the tendency to be curious is not a significant predictor on planning strategies. It was concluded that the most predicted variable by the predictive variables together was planning strategies, and the least predicted variable was evaluation strategies.

That tendency to be open to learning significantly predicts metacognitive strategies show that teaching practices supporting being open to learning are needed in gaining these strategies. In this sense, primarily affective features reflecting tendencies to be planned, patient, curious, and open-minded should be included in the objectives of teacher education. The content for these purposes should be supported with intriguing elements, interesting and controversial topics.

It is suggested to use activities that require in-depth research of the content from different sources, questioning and evaluating the content reached to integrate these goals and content with metacognitive strategies. That the variables the least predicted by the dimensions forming the tendency to be open to learning are evaluation strategies indicates that is necessary to increase the activities focused on evaluating and reflecting the learning task in teacher education programs. In line with this, it is recommended that students monitor the learning tasks they are responsible for, this process should be supported by practices in which student decisions and their reflections are evaluated. It is thought that evaluation tools such as self-evaluation forms, peer evaluation forms, reflective letters, and diaries that can be used within the scope of formative practices will also contribute to the development of pre-service teachers' reflective thinking skills.

These obtained results are limited to data gathered from students studying in the faculty of education. In this context, descriptive and predictive studies can be conducted to examine the tendency of teachers to be open to learning and the metacognitive strategies they use. In addition to this, it is considered that qualitative and mixed design research examining the relationship of tendencies to

be open-minded and curious with the metacognitive learning process in-depth were necessary.

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