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Education and Human Development,
Volume 30

Motivation in Learning

Edited by Jian-Hong Ye, Liying Nong, Li Wang, and Weiguaju Nong

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Published in London, United Kingdom

Motivation in Learning
http://dx.doi.org/10.5772/intechopen.1003372
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First published in London, United Kingdom, 2025 by IntechOpen
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British Library Cataloguing-in-Publication Data
A catalogue record for this book is available from the British Library

Motivation in Learning
Edited by Jian-Hong Ye, Liying Nong, Li Wang, and Weiguaju Nong
p. cm.

This title is part of the Education and Human Development Book Series, Volume 30
Topic: Education
Series Editor: Katherine Meltzoff
Topic Editors: Delfín Ortega-Sánchez and Carlos Pérez-González

Print ISBN 978-1-83634-149-9
Online ISBN 978-1-83634-148-2
eBook (PDF) ISBN 978-1-83634-150-5
ISSN 2755-9513

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IntechOpen Book Series

Education and Human Development

Volume 30

Aims and Scope of the Series

Education and Human Development is an interdisciplinary research area that aims to shed light on topics related to both learning and development. This Series is intended for researchers, practitioners, and students who are interested in understanding more about these fields and their applications.

Meet the Series Editor

Katherine Meltzoff received her BA in Psychology from Trinity College, in Connecticut, USA and her Ph.D. in Experimental Psychology from the University of California, San Diego. She completed her postdoctoral work at the Yale Child Study Center with Dr. James McPartland. Dr. Meltzoff' doctoral dissertation explored neural correlates of reward anticipation to social versus nonsocial stimuli in children with and without autism spectrum disorders (ASD). She has been a faculty member at the University of California, Riverside in the School of Education since 2016. Her research focuses on translational studies to explore the reward system in ASD, as well as how anxiety contributes to social challenges in ASD. She also investigates how behavioral interventions affect neural activity, behavior, and school performance in children with ASD. She is also involved in the diagnosis of children with ASD and is a licensed clinical psychologist in California. She is the Assistant Director of the SEARCH Center at UCR and is a faculty member in the Graduate Program in Neuroscience.

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Dr. Liying Nong is an associate professor at Hezhou University and Master Supervisor at Jishou University. She excels at applying various theories in ethnology and pedagogy research, primarily focusing on empirical studies. She has presided over 6 provincial scientific research and teaching projects, 2 municipal and hall-level scientific research projects, 4 school-level projects. She has won 1 school-level Teaching Achievement Award, 1 first-rate course, 1 first prize in the school-level Teaching Innovation Competition, participated in 1 National Education Science Planning Project, and several municipal and hall-level projects or above. In addition, she has published 35 papers, including 9 papers in SSCI and Chinese core journals, one monograph, and several textbooks.

Dr. Li Wang is an associate professor and serves as the Vice Dean of the School of Education and Music at Hainan Vocational University of Science and Technology. Her main research fields include vocational education teachers' and students' career development and educational informatization. She has been selected as an in-house talent for the "Nanhai New Star" project in Hainan Province. She has published 9 academic papers as the first author (including 2 in SSCI) and has approved 3 decision-making consultation reports. She has received a provincial teaching achievement award and has been responsible for 1 provincial-level project and 1 school-level project. She has also participated in multiple provincial and ministerial-level projects.

University of Foreign Languages. With expertise in innovative teaching and interdisciplinary research of pedagogy and psychology, Nong specializes in experimental research and empirical research on education. At present, he has published 16 academic papers in high-level domestic and international journals, among which 10 papers (including 2 as the first author and 2 as the corresponding author) are published in SSCI and SCI journals, and 2 papers are published in CNKI, with a total citation over 100 times on Google Scholar, demonstrating a solid foundation in interdisciplinary research. Meanwhile, Nong also serves as a peer reviewer for various SSCI and SCI journals, including Scientific Reports, Frontiers in Public Health, Frontiers in Psychology, and Acta Psychologica. He has successfully led one municipal and departmental research project and one university-level research project. Furthermore, he has been a key participant in completing a key project of the National Educational Sciences Planning Project of the Ministry of Education and a Guangxi Higher Education Undergraduate Teaching Reform Project.

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Preface

Learning is always a core activity in forming cognitive abilities and personality traits in people's growth process, and motivation is the key psychological mechanism that drives learning behaviour. Therefore, motivation in learning is an important area of research in educational psychology. It not only determines the initiation and continuation of learning but also affects the effectiveness and depth of learning. The complexity of motivation in learning lies in its multidimensional composition and dynamic changes, making its in-depth study an important area of research in psychology, education and other disciplines. Under the title *Motivation in Learning*, this book systematically analyses the nature of motivation and its formation mechanism and manifestations in different learning (educational) contexts. The book attempts to provide a comprehensive and dynamic introduction to the application and interpretation of the theory of motivation in learning and to provide a solid theoretical foundation for subsequent research.

Based on cutting-edge research in contemporary motivation theory, this book emphasises the importance of stimulating and sustaining motivation in learning by integrating theory and practice. Based on empirical and critical research, it aims to provide practical guidance for educators, learners and their supporters. It is hoped that implementing these strategies will be effective in enhancing motivation for learning, which in turn will contribute to the overall development of learners' knowledge acquisition, skills enhancement and personal growth.

This book comprises seven chapters, including reviews, perspectives and original research. The authors illustrate and review the research experiences or perspectives of scholars in China, Italy, Greece, Spain, Botswana, Ghana, Iran, and Nigeria to enable government agencies, social organisations, professionals, scholars and the general public to better understand the current state of research on motivation in learning in countries at different levels of development.

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Acknowledgements

This work was supported by First-Class Education Discipline Development of Beijing Normal University (Grant Numbers: YLXKPY-XSDW202408, YLXKPY-ZYSB202201) and the Priority Self-financed Project of the 2025 Annual Programs in the 14th Five-Year Plan of Guangxi Educational Science (Grant Numbers: 2025B098).

Chapter 1

A Bibliometric Analysis of Online Learning Motivation Using CiteSpace

Yanxuan Liu and Jian-Hong Ye

Abstract

Online learning motivation has received growing attention over the past decades. This chapter focused on online learning motivation research published between 2003 and 2024 and used CiteSpace to conduct a bibliometric analysis of 175 journal articles from the Web of Science. This chapter outlines the research intellectual map, such as the most prolific modern institutions, popular regions/countries, keyword co-occurrences, timezone, and burst detection. The results of the study are: (1) In terms of publications, America is the most productive region, followed by China and Turkey. (2) Mississippi State University and Bartin University are the most productive institutions. (3) Six themes emerged: moderating role, teacher support, learning online, academic achievement, positive academic emotion, and graduate students. Support, attitudes, perceptions, adoption, self-efficacy, and others are the hotspots. By organizing the literature on academic mobilities using CiteSpace, our study adds to the pertinent body of literature and provides useful references to practitioners and researchers who wish to learn more about this topic.

Keywords: bibliometrics, CiteSpace, online learning motivation, research review, visualization

1. Introduction

Motivation has been researched over 60 years since Gardner and Lambert [1] first studied it from a social psychological perspective, and theories of motivation have an increasingly important role to play in education. Bandura was the first to conceive and test social cognitive theory experimentally (SCT; [2]). His work resulted in a paradigm change in our understanding of the learning process, where self-efficacy is a crucial motivating factor for people to participate in and continue learning [3]. Training motivation, turnover, productivity, self-set objectives, goal commitment, and goal level are further areas where motivation research has demonstrated a renewed interest in a particular motivation theory—expectancy theory [4]. According to the theory, an individual's behavior is motivated by anticipated outcomes. An individual is likely to choose the behavioral choice with the strongest motivation forces (MF) while making a decision. In fact, according to Vroom's [4] VIE model, valence and instrumentality are crucial to comprehending motivation

in addition to expectancies. Vygotsky's [5] Sociocultural Theory, on the other hand, highlighted the importance of social interaction and cultural context in shaping cognitive development and motivation. These theories, along with others, paved the way for the development of Self-Determination Theory (SDT) by Ryan and Deci. From an SDT perspective [6], academic motivation refers to the drive to engage in educational activities and pursue goals. This theory underscores intrinsic motivation, extrinsic motivation, and the satisfaction of basic psychological needs (autonomy, competence, and relatedness) for fostering sustained engagement and optimal functioning in various domains, including academics. Intrinsic motivation involves participating in an activity for the pleasure derived from it [7], while extrinsic motivation occurs when engaging in an activity for a specific outcome or external reward.

In the rapidly evolving digital educational landscape, understanding online learning motivation is essential for enhancing student engagement and success in virtual classrooms. Previous studies have revealed inconsistent findings regarding the levels of motivation in online learning environments. Students' learning practices can be significantly impacted by learning motivation, particularly in online education that is contextualized by pandemics. Nevertheless, participants have tended to negatively evaluate the efficacy of online learning, as they often lack the motivation to engage in online learning and to deal with the different issues in the online environment [8]. On the other hand, both teachers and students thought that online learning had a good effect on their drive to learn. Teachers gave motivation and knowledge acquisition a favorable evaluation both before and after online lectures. They believed that when students learned through the online method, they became more efficient, more motivated, and actively involved [9].

Thus, the following queries were raised by the thorough research that has already been done: (1) Which study themes regarding the motivation of online learning have emerged over the past 20 years? (2) How have these motivations changed throughout time? (3) How do the themes relate to one another? (4) Which works of literature have marked a significant turning point or achievement? and (5) Which research frontiers are more recent? Reviews of online learning motivation have been done before, but they were primarily based on the traditional induction and summary approach of literature analysis. However, it is challenging to understand the full structures and hints "hidden" in the literature because of the small sample size in traditional review analysis.

Bibliometric analysis (BA), a potent instrument for exposing the dynamic performance of scholarly publications, statistically examines the features of literature on a particular topic using a range of statistical techniques [10, 11]. The visual BA of study developments in an area can be done with CiteSpace as it has the ability to precisely analyze a significant number of research publications as well as to conduct a comprehensive analysis of development patterns and hot spot alterations in a certain subject [12]. Because of this, it is frequently utilized in bibliographic analysis for particular subjects. For example, the publication characteristics and citation influence of a journal during a 30-year period were summarized by Ji et al. [13] and Fu et al. [14].

The results of the systematic review reported in this work are presented using CiteSpace and the dynamic BA approach to visually analyze online learning motivation studies conducted in the WoS core dataset between 2003 and 2024. The following scientific questions are addressed:

1. Which research themes about the motivation of online learning surfaced between 2003 and 2024?

2. How has the field of online learning motivation research changed over time?

3. Where are the hotspots for research on motivation in online learning?

The volume, features, and potential of international research papers that concentrate on online learning motivation were examined in this work using bibliometric analysis through a descriptive research lens. Co-occurrence, timezone, and burst detection were among the keywords utilized to methodically examine the topics and development of the study, revealing hotspots and new trends, and offering research references. Therefore, the purpose of this study was to use CiteSpace to conduct a bibliometric analysis in order to shed light on how research tendencies in this field have changed over time. With the current body of evidence as a guide for future study and development, the results provide important insights into the trend of online learning motivation.

2. Research design

2.1 Method and tools

A quantitative investigation into the publications related to a certain issue is known as bibliometric analysis [15]. A deeper comprehension of the information and conceptual framework at the heart of any particular research issue is made possible by this approach [16]. By using this cognitive process, researchers can perform a continuous systematic review of a particular area to explore its beginnings and development and to predict the future course of study [17].

Because of its capacity to evaluate literature and generate several kinds of metrics and indicators of evolving scientific topics, bibliometric analysis has become increasingly popular and is frequently carried out using CiteSpace [18]. This method aids in mapping, mining, investigating, organizing, and presenting the knowledge domain at a broad, macro level by visualizing it. Computer software has only lately gained broad attention in a number of research fields, including social commerce [19], hospitality [20, 21], and research demonstrating the theoretical landscape of ubiquitous computing [22]. These studies have demonstrated the benefits of employing CiteSpace to identify focus areas, important trends, and new topics within a cognitive framework. The graphical method reduces users' cognitive load while providing a more thorough and objective analysis than the traditional qualitative approach. The graphical method does not, however, seek to replace conventional processes in systematic reviews. Rather, it aims to provide a computational approach that is easily implemented with higher precision and effectiveness.

As previously stated, this study employed CiteSpace 6.3R1 to disclose the development and areas of interest in the study of online learning motivation, through the use of cluster analysis, keyword co-occurrence (Timezone), burst detection, and strategic diagrams. The software parameters were set as follows (**Table 1**):

2.2 Data source and process

We examined 175 journal articles on academic mobility published in the Web of Science (WoS) between 2003 and 2024 using bibliometrics and the CiteSpace

Analysis type	Timespan	Slice length	Node types	Selection criteria
Institutions Distribution of Published Papers	2003–2024	1	Institution	g-index (k = 25)
Country/Region Distribution of Published Papers	2003–2024	1	Country	g-index (k = 25)
Research Themes	2003–2024	1	Keyword	g-index (k = 8)
Research Evolution	2003–2024	1	Keyword	g-index (k = 25)

Table 1.
Input parameters and default settings for CiteSpace analysis in this research.

program. Due to its extensive collection of prestigious publications covering broad scholarly fields and its status as one of the most extensive archives covering the years 1900 to the present, the WoS database was utilized [23]. Additionally, WoS has long been acknowledged as the most reputable and trustworthy indexing method for technical and scientific publications, offering valuable information about the most important and pertinent research [24]. According to van Leeuwen [25], it is also generally regarded as the best source of data for bibliometric research. WoS acts as a path connecting a variety of literature from various domains by acting as a citation index, enabling scholars to track their research progress while navigating these cross-disciplinary affiliations.

Citation Indexes, also known as WoS Core Collection (WoSCC) databases, were the main source of the data used in this study. The following elements were

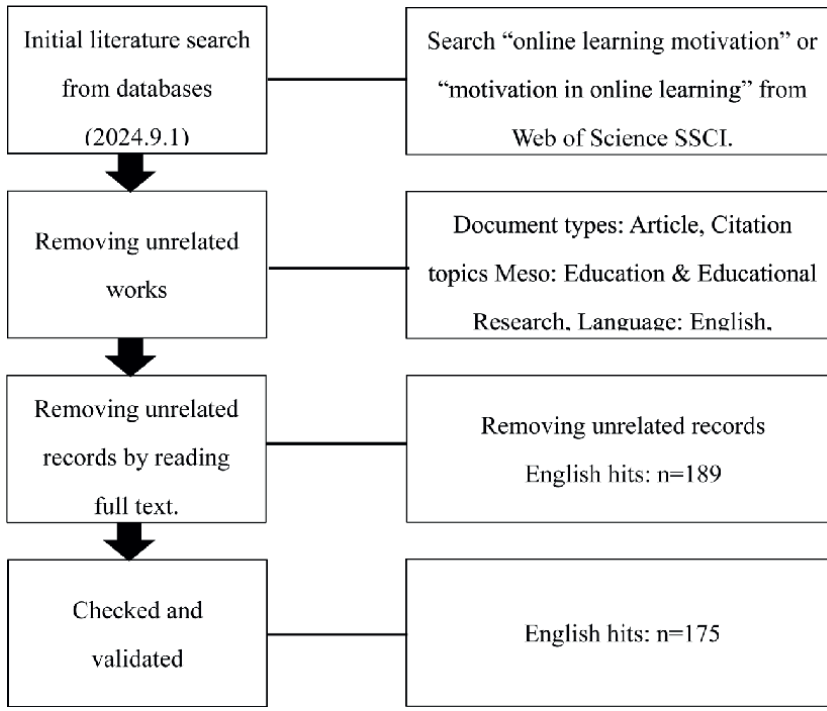

Figure 1.
A schematic illustration of the process of literature inclusion and exclusion.

among the terms used in the search by article titles, abstracts, and keywords: "online learning motivation" or "motivation in online learning." We were able to acquire 3450 articles in total based on these terms. The results excluded book reviews, meetings, editorials, and novels, as the data were restricted to peer-reviewed journal articles. Each article's title and abstract were screened to see if the results and the paper's main idea were consistent in order to ensure the accuracy of the samples. Additionally, irrelevant results were not taken into consideration. In light of this, we extracted 175 publications in total between 2003 and 2024. To guarantee precision following format conversion, the WoS information was screened to remove duplicates. **Figure 1** illustrates the process of literature inclusion and exclusion.

3. Findings

3.1 Temporal distribution of published papers

Counting the number of academic publications in a field is one way to gauge its level of scientific development. It is possible to accurately evaluate the discipline's current state of research on this subject, and its development dynamics and trends may be further predicted by calculating the temporal distribution figure of the quantity of literature.

The core set of research from 2003 to 2024 that was selected for study from the WoS database is displayed in **Figure 2**. This figure's red dotted line represents a curve based on the yearly publishing of online learning motivation, while the blue line represents the number of literature recorders.

The research on online learning motivation went through three stages of development, as shown in **Figure 2**: the starting stage (2003–2009), the growth stage (2010–2019), and the rapid stage (2020–2024).

Fewer than two articles were published each year during the first phase, which ran from 2003 to 2009, and the quantity of articles was comparatively constant. In 2003, online learning was still in its infancy, with only a few platforms available to students. Platforms such as Moodle and MIT OpenCourseWare (OCW) emerged as pioneers in the field, offering students access to a wide range of courses and resources. During this period, online learning was primarily seen as a supplementary tool to traditional classroom learning, rather than as a replacement. Students' motivation and volition during this early stage of online learning were influenced by several factors, including the novelty of the medium, the flexibility it offered, and the quality of the educational content.

On average, the number of annual publications was greater than six during the second, or growth, stage, which lasted from 2010 to 2019. The advent of Massive Open Online Courses (MOOCs) in the mid-2010s marked a significant turning point in the evolution of online learning. Platforms such as Coursera, edX, and Udacity offered students from around the world access to high-quality educational content from top universities and institutions. This period also saw the emergence of hybrid learning models, which combined online and face-to-face instruction. Students' motivation and volition during this period were enhanced by the increased accessibility and variety of courses offered through MOOCs and hybrid learning models. However, challenges such as high dropout rates and the need for better support structures for online learners remained. According to Hershkovitz

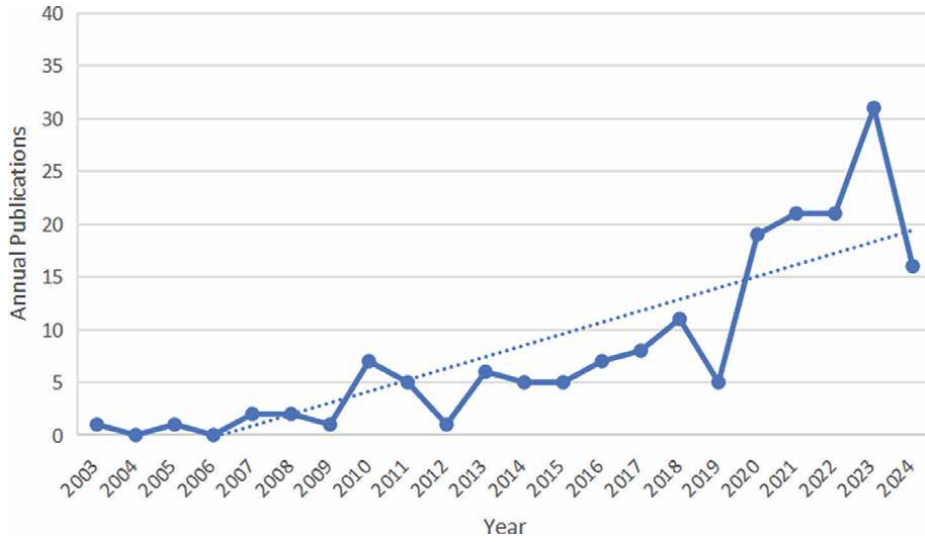

Figure 2.
Annual publication statistics of online learning motivation (2003–2024).

and Nachmias [26], who looked at the recorded learning activity of 1189 students in 1897 courses, 46% of students either slowed down or stopped using the internet entirely during the academic year.

A turning point was reached in 2020 when the number of articles per year surpassed almost 20 and was growing quickly. In 2021, there were 20 articles published annually; in 2023, there were more than 30. It is clear that since 2020, research on the motivation of online learning has advanced quickly. Recent years have seen a shift toward personalized learning and the integration of artificial intelligence (AI) into online education. Platforms such as Khan Academy and DreamBox use AI algorithms to tailor educational content to individual students' needs and learning styles. This focus on personalized learning has had a significant impact on students' motivation and volition. By providing students with customized learning experiences that cater to their unique needs and interests, online education has become more engaging and relevant. Furthermore, AI-driven technologies have enabled online platforms to offer real-time feedback, adaptive assessments, and progress tracking, which have further enhanced student engagement and motivation.

The rise in literature generally follows an exponential development pattern. Wang [27] asserts that an exponential growth in the number of yearly publications may indicate that this area's growth trend is not yet reached. This suggests that this area of study is still in its early stages of growth. As scholars continue to examine motivation in online learning, new theories, approaches, and technologies can surface. Therefore, it is possible to draw the conclusion that based on this quantitative study of annual publications, research on the use of online learning motivation remains promising.

Note. Frequency here refers to the number of publications in the institutions.

3.2 Space distribution of published papers

The distribution of published papers by institutions and nations serves as a gauge of each nation's and institution's level of research production.

3.2.1 Institutions distribution of published papers

The top five productive institutions are further detailed in **Table 2**. Mississippi State University is clearly at the top because, with five publications in 2011, it is shown with the highest font size. Because there are several authors working on the topic, it is evident that academic research at these institutions is productive.

3.2.2 Country/region distribution of published papers

The cooperative academic ties between countries or regions can be seen by looking at the geographical spread of published papers, offering a fresh perspective on how a nation or region affects academic advancement, and facilitating a comprehensive understanding of the concept of national geographic division in the field of academic mobility. A map of the highly productive research nations and academic mobility zones is shown in **Figure 3**.

America is clearly the most productive area in terms of the quantity of published articles, as seen in **Figure 3** and **Table 3**. These visuals indicate that the United State's nodal circle radius is larger than that of other countries/regions, with 46 nodes, followed by China with 41 nodes, and Taiwan Province of China, which has 24 nodes.

Additionally, **Table 3**, which lists the top 10 producing nations and regions, demonstrates that developed nations and regions—such as the United States and South Korea—are increasingly involved in studies on academic mobility, whereas only three developing nations—China, Turkey, and Saudi Arabia—are included. It may be that China is on the list because the Chinese government has made a commitment to luring bright foreign students by enacting policies and offering substantial financial incentives [28].

In addition to frequency, intermediary centrality is another important nodal metric that gauges a node's ability to link with other nodes [29]. High intermediary centrality nodes (which range from 0 to 1) are important linkages between two or more groups that exhibit a transition pattern [29]. In terms of academic mobility, the United Nations and Saudi Arabia have the highest intermediary centrality in **Table 3** (0.14), suggesting that they are crucial in establishing connections and working together with scholars in other nations.

3.3 Research themes

The structures and traits of the research field can be concisely revealed by the development of the research themes. An exploratory method for locating and

Frequency	Year	Institutions
5	2011	Mississippi State University
5	2017	Bartin University
4	2010	National Taiwan University of Science & Technology
4	2019	Central China Normal University
4	2021	University of Hong Kong

Table 2.
Top 5 productive institutions (frequency ≥ 4).

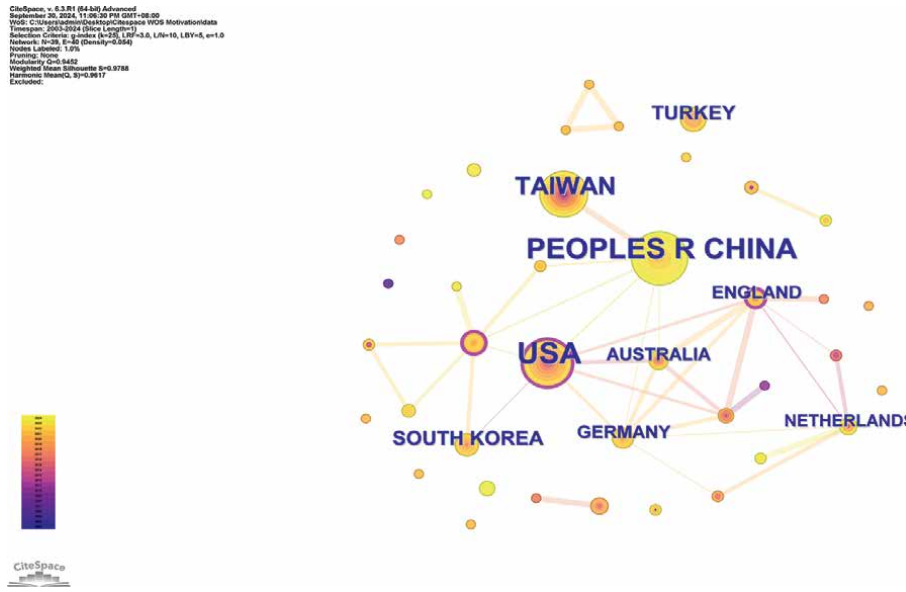

Figure 3.
Map of country/regions' distribution of published papers.

No	Country (region)	Frequency	Centrality
1	USA	46	0.14
2	People's Republic of China	41	0.1
3	Taiwan	24	0
4	Turkey	12	0
5	South Korea	12	0
6	Germany	8	0.1
7	England	8	0.1
8	Australia	8	0.01
9	Netherlands	7	0.06
10	Saudi Arabia	5	0.14

Table 3.
Top 10 productive regions/countries in the online learning motivation field.

analyzing the categorization of noteworthy terms and backgrounds in certain academic domains is literature cluster analysis. Olawumi and Chan [30] stated that in order to determine the topic distribution and organizational structure of study fields, a number of techniques are utilized to convert the gathered data into multiple structured clusters. Consequently, cluster analysis makes it possible to determine the evolution rules of research themes and sort out the knowledge relationships across a large body of literature.

The keywords from 175 publications were clustered using Cite Space 6.3.R1. Since there were few comparable studies conducted prior to 2003 and the reference quality was low as a result of the lack of study, the time frame was defined as 2003–2024. In order to

analyze research themes, the data from the previous 22 years were chosen, with a time slice of 1 year and a g index of k = 8. Based on the LLR technique, cluster analysis revealed that seven clusters, 114 nodes, and 570 connections produced a Density of 0.0885 and Q = 0.3537. **Table 4** displays the seven research clusters and keywords.

Given that **Table 4**'s nine clusters display content that is repetitious and comparable, such as "Learning Online" and "Online Learning," we combined the two clusters into one. Thus, we combined the seven clusters and keywords mentioned above to produce six research themes based on the cluster analysis results, that is, Moderating Role, Teacher Support, Learning Online, Academic Achievement, Positive Academic Emotion, and Graduate Students.

1. Moderating role. The first theme includes motivation self-monitoring, self-directed learning, multiple online role-playing games, as well as conjectural analysis. Most studies consider online learning motivation as a mediating variable in their research.

2. Teacher support. The second theme includes college EFL learners, predictive effect, controlled motivation, and assisting adult online chemistry students. This is necessary as online learning motivation requires the encouragement and guidance of teachers. Therefore, online learning motivation tends to generally need teacher support for this purpose.

3. Learning online. The third theme includes regulating interest, potential motivation, performance trade-off, different online peer-feedback approaches, and so on.

No	Size	Centrality	Year	Label	Keywords
1	18	0.673	2015	Moderating Role	Motivation Self-Monitoring; Self-Directed Learning; Multiple Online Role-Playing Game; Conjectural Analysis
2	18	0.592	2016	Teacher Support	College EFL Learners; Predictive Effect; Controlled Motivation; Assisting Adult Online Chemistry Students
3	16	0.836	2011	Learning Online	Regulating Interest; Potential Motivation; Performance Trade-Offs; Different Online Peer-Feedback Approaches
4	16	0.796	2017	Online Learning	COVID-19 Pandemic; Self-Regulated Learning Strategies; Learning Support; Online Learning Motivation
5	15	0.663	2016	Academic Achievement	Learning-Related Soft Skills; Online Business Students; Social Skills; Managerial Role Differences
6	12	0.644	2020	Positive Academic Emotion	Offline Learning Motivation; Self-Monitoring Self-Management; MOOC Learners; Internet Use
7	10	0.882	2008	Graduate Students	Comparative Analysis; Motivational Beliefs; Predicting Satisfaction; Instructional Quality

Table 4.
Main clusters and keywords of online learning motivation (2003–2024).

4. Academic achievement. The fourth theme includes keywords, such as learning-related soft skills, online business students, social skills, and managerial role differences.

5. Positive academic emotion. The fifth theme includes but is not limited to self-monitoring self-management, MOOC learners, offline learning motivation, internet use, and research from diverse group perspectives.

6. Graduate students. The final subject focuses on student characteristics including motivating beliefs, satisfaction prediction, and so forth. Students' perceptions of online learning motivation, such as instructional quality, are also included in this theme.

3.4 Research evolution

Representative words that characterize an article's main ideas are called keywords, and their high frequency of co-occurrence could reveal the focus of a certain field of study. The primary research issue of online learning motivation can be identified with the aid of keyword co-occurrence analysis. The keyword co-occurrence network is visualized in this research from a timezone viewpoint. **Figure 4** displays the keyword co-occurrence timezone diagram.

The graph includes keywords that have appeared over five times in the last 22 years. The keyword's initial appearance is represented by the time period. From 2003 to 2005, achievement and distant learning were the primary subjects of online learning motivation [31, 32]. From 2006 to 2008, the research topic gradually evolved into dimensions of online learning [33] and methods to improve online learning motivation [34, 35]. From 2009 to 2011, the research topic began to center around models for online learner motivation in programs drawing on Deci and Ryan's self-determination theory [36, 37]. It was during this period that more empirical methods

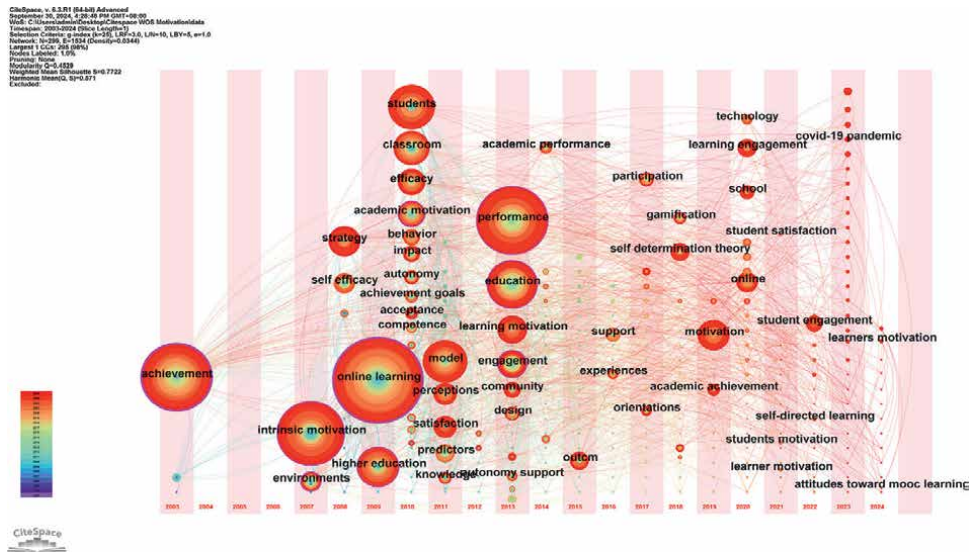

Figure 4.
Online learning motivation research evolution (2003–2024).

were used to study the role and influencing factors of online learning motivation [38]. Between 2012 and 2014, the topic of factors influencing online learning motivation remained a hot issue, such as students' Internet self-efficacy [39], and mobile communication tool support [40]. What is more, this period saw the emergence of more topics focused on students' regulation of online learning motivation [41]. The implementation of online learning motivation in online courses, including MOOCs and other massive open courses, was the main focus of the study from 2015 to 2017 [42]. From 2018 to 2020, comparative studies on learning motivation and outcomes between online and offline learning emerged [43]. Moreover, with the outbreak of the COVID-19 pandemic, online learning received tremendous attention, and research on the factors influencing online learning motivation became more in-depth and systematic, such as teacher online feedback [44], and forum-based online teaching [45]. Over the past 4 years (2021 to 2024), research topics have centered on the mediating role of online learning motivation [46–48]. Additionally, studies have examined how students' learning performance might be enhanced by online learning motivation [49], online creativity generation [50], and other aspects [48, 51].

3.5 Research hotspots

The significant rise in keywords or cited material might be seen as a reflection of the dynamic nature of a research issue. According to Chen [17], the referenced literature or burst keywords reveal the areas of interest for researchers. The term "explosion" suggests that, during a given time period, a potential theme has attracted or is now attracting massive interest from scholars. It is an indication of a rapidly developing study field because it can investigate emerging trends, according to Li et al. [20, 21] and Pollack and Adler [52]. Since 2020, research on the motivation of online learning has been expanding quickly. In order to find the new hot spots in recent years, CiteSpace was used to analyze pertinent literature from 2020 to 2024 for burst detection. The top 10 burst terms, their burst strength, and their start and finish times are displayed in **Table 5**.

According to the keyword burst detection results, the predictors and support have the highest burst intensity. This shows that in recent years, researchers have begun to focus on the influencing factors of online learning motivation and their impact on online

Keywords	Strength	Time
Support	1.66	2020–2021
Predictors	1.66	2020–2021
Validation	1.33	2020–2021
Online Education	1.33	2020–2021
Attitudes	0.66	2020–2021
Perceptions	0.52	2020–2021
Adoption	0.51	2020–2022
Self-Efficacy	1.89	2021–2022
Achievement Emotions	0.75	2021–2022
Self Determination Theory	1.17	2022–2024

Table 5.
Burst detection of online learning motivation: 2020–2024 (Top 10).

learning. Self-efficacy, achievement emotions, and self-determination theory continued to be explored from 2021, demonstrating that researchers started to focus on students' viewpoints and the connection between online learning motivation and other elements. Additional keywords highlight the difficulties and advantages of motivating students to learn online as well as their attitudes, perceptions, and adoption.

By comparing the keywords and citations' burst detection findings, we discovered that common themes centered on the elements influencing students' motivation for online learning and its advantages for their academic success, such as enhancing their aptitude and learning efficiency.

4. Discussion and inspiration

4.1 Implications

The findings of this bibliometric analysis of online learning motivation have several profound implications for both theoretical development and practical application within the field of education.

First, the dominance of American institutions in producing research on online learning motivation underscores the need for international collaboration. While the United States leads in terms of publications, the increasing contributions from China and Turkey highlight the global interest in this topic. This suggests potential for collaborative efforts across continents to pool resources, share methodologies, and enhance the robustness of research findings. Such collaborations could foster a more comprehensive understanding of cultural nuances influencing online learning motivation, enabling the creation of culturally sensitive educational strategies. Additionally, it is essential to acknowledge that the infrastructure and conditions for internet access, which form the backbone of online learning, vary considerably across countries and regions. Different nations exhibit diverse levels of internet hardware and software development, along with varying network conditions. For instance, while some regions may boast extensive and advanced internet networks facilitating seamless access to a wide range of educational resources, others might struggle with limited connectivity and restricted access to certain platforms and content. This variability in internet access and infrastructure can influence students' motivation to engage in online learning, as their ability to access educational materials and interact with diverse, global content may be hindered. In this context, it is interesting to note that countries with higher research productivity in the field of online learning motivation, such as the United States, which tends to have a larger nodal circle radius, may also experience regional disparities in internet access. These disparities can affect students' full participation in online learning environments, potentially impacting their motivation levels. By exploring these regional differences in both internet infrastructure and research output, we can gain a more nuanced understanding of the factors shaping online learning motivation worldwide.

Second, the identification of Mississippi State University, Bartin University, and National Taiwan University of Science & Technology as the most productive institutions indicates the presence of dedicated research hubs. These institutions could serve as models for others seeking to establish or strengthen their research programs in online learning motivation. By examining their research methodologies, funding strategies, and institutional support structures, less productive institutions might identify pathways to enhance their own productivity and impact.

Third, the emergence of six distinct themes—moderating role, teacher support, learning online, academic achievement, positive academic emotion, and graduate students—provides a structured framework for future research. Each theme represents a critical aspect of online learning motivation that requires deeper exploration. For instance, the moderating role suggests the need to investigate how various factors can either enhance or hinder motivation. Understanding these moderators can help educators design interventions that mitigate demotivating factors and promote motivational ones.

Lastly, the prominence of keywords such as support, attitudes, perceptions, adoption, and self-efficacy underscores the importance of psychological and sociocultural factors in shaping online learning motivation. This implies that educational interventions should not only focus on technological advancements, but should also address the human dimensions of learning, such as fostering a supportive learning environment, encouraging positive attitudes, and enhancing learners' self-efficacy.

4.2 Inspiration

The insights derived from this study offer inspiration for educators, researchers, and policymakers working to improve online learning experiences.

First, the recognition of teacher support as a pivotal theme encourages educators to adopt more supportive roles in online learning environments. This could involve regular check-ins with students, providing personalized feedback, and creating opportunities for social interaction and collaboration, which are often lacking in online settings. By fostering a sense of belonging and connection, educators can significantly enhance students' motivation to learn online.

Furthermore, the emphasis on academic achievement and positive academic emotions highlights the need for outcomes-based assessment and the promotion of a positive learning mindset. Educators can design assessments that not only measure knowledge acquisition, but also assess students' ability to apply what they have learned in real-world contexts. Additionally, incorporating elements of gamification, such as rewards and badges, can help generate excitement and engagement, thereby boosting academic emotions and motivation.

The focus on graduate students as a specific group within the research landscape serves as a reminder that online learning motivation is a multifaceted construct that may vary across different learner populations. Graduate students, in particular, may face unique challenges such as balancing work, family, and studies, which can affect their motivation. Understanding these challenges and designing tailored interventions could improve retention rates and completion rates among graduate students in online programs.

Lastly, the use of bibliometric analysis as a research tool in this study demonstrates its potential for mapping the intellectual structure of a field and identifying emerging trends and gaps. This methodology can inspire other researchers to conduct similar analyses in other educational domains, fostering a more interconnected and data-driven approach to research. By systematically reviewing and synthesizing existing knowledge, researchers can build upon past achievements, identify untapped areas, and pave the way for innovative solutions that address contemporary educational challenges.

In conclusion, the implications and inspirations drawn from this study emphasize the complexity and multidimensional nature of online learning motivation. By fostering international collaboration, adopting supportive educational practices, addressing

the unique needs of diverse learner populations, and leveraging advanced research methodologies, the field can continue to evolve, enhancing the quality and effectiveness of online learning experiences worldwide.

4.3 Limitations

It is noted that the study has certain limitations. First off, this study made exclusive use of CiteSpace, even though there are other bibliometric visualization programs available. CiteSpace can extract the evolution and hotspots of the research area; however, if data analysis was conducted using other software, the findings might be different. Second, there can be some unavoidable variations in the forecast of prospective subjects and upcoming patterns. These limitations could be addressed in future research to validate the results of this investigation.

5. Conclusion

This document presents the findings from the BA of studies on online learning motivation in the WoS core collection. We thoroughly reviewed 175 works of literature on the motivation of online learning and investigated the development of research themes, hotspots, and possible subjects in this area. A more thorough literature evaluation complements this BA in online learning motivation. This study found that:

1. There were three phases in the development of research on the motivation of online learning: the early stage (2003–2009), the growing stage (2010–2019), and the rapid stage (2020–2024). The exponential development tendency of this field of study suggests that new topics and directions will continue to be developed and that the current body of research is not saturated.

2. The six themes of research from 2003 to 2024 are: academic achievement, pleasant academic feeling, learning online, moderating role, teacher support, and graduate students.

3. The growth of research objects, fields, content, and techniques are the four ways that the study of online learning motivation has changed between 2003 and 2024.

4. The recently emerging area of this field was investigated by burst detections. These detections not only underscored the enduring relevance of traditional research focuses such as support (including institutional and peer support), attitudes toward online learning, learners' perceptions of the online environment, adoption of online learning tools and platforms, and self-efficacy in online settings, but also revealed the emergence of additional significant dimensions such as Self-Determination Theory (SDT). These findings provide a framework for understanding how learners' intrinsic and extrinsic motivations are shaped by their psychological needs for autonomy, competence, and relatedness. Researchers are increasingly examining how these psychological needs are met or thwarted in online learning environments, and how this impacts learners' motivation, engagement, and persistence.

Funding

This work was supported by the First-Class Education Discipline Development of Beijing Normal University: Excellence Action Project (Grant Number: YLXKPY-XSDW202408) and 2024 Beijing Normal University's Teachers' Teaching Development Fund Project (Grant Number: 2024125).

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Chapter 2

Enhancing Motivation for Learning through Effective Adoption of Moodle LMS: Insights from the University of Botswana

Alfred Mutanga and Lovie Edwin Seru

Abstract

This chapter explores the pivotal role of the Moodle Learning Management System (LMS) in enhancing student motivation and engagement at the University of Botswana. Drawing on comprehensive data from the 2023–2024 Moodle LMS Adoption, the chapter delves into the varying levels of Moodle adoption across different faculties, highlighting both successes and challenges. It examines the impact of digital learning tools on student participation, course activity, and educational outcomes. The chapter also discusses strategic recommendations for improving Moodle utilization, such as faculty training, enhanced technical support, and the integration of interactive features. By addressing these areas, the chapter aims to provide valuable insights into how universities can leverage technology to foster a motivating and effective learning environment.

Keywords: Moodle LMS, eLearning adoption, student engagement, digital learning, University of Botswana

1. Introduction

The University of Botswana has embarked on a transformative journey to integrate digital learning into its academic environment through the adoption of the Moodle Learning Management System (LMS). This initiative represents a strategic effort to harness technology in education, aiming to enhance motivation for learning by providing a dynamic, interactive, and flexible platform that facilitates engaging educational experiences. Research indicates that the implementation of Moodle LMS in higher education can significantly improve students' motivation and engagement in learning [1, 2]. By offering a variety of interactive tools such as forums, quizzes, and multimedia content, Moodle enables a more active and participatory learning experience, which is essential for fostering student motivation in today's digital age [3]. This introduction sets the stage for a detailed exploration of Moodle's impact on learning motivation at the University of Botswana during the 2023/2024 Second Semester.

The integration of Moodle at the University of Botswana reflects a broader trend in higher education, where digital platforms are increasingly used to supplement traditional teaching methods and create blended learning environments [4]. Research demonstrates that when effectively adopted, Moodle not only serves as a repository for course materials but also as a space for collaborative learning, thus encouraging students to take an active role in their education [5]. However, the success of such initiatives depends on the extent to which faculties and instructors leverage Moodle's features to create motivating and engaging learning experiences. This chapter examines how different faculties at the University of Botswana have adopted Moodle, drawing on literature that underscores the importance of technology-enhanced learning environments in promoting student motivation [6].

The primary goal of this chapter is to assess how the Moodle LMS has been adopted across faculties, identify patterns of usage, and suggest strategies to optimize Moodle's potential as a tool for enhancing student motivation. Studies have shown that students are more likely to engage and persist in their studies when learning platforms like Moodle are used to create interactive and personalized learning experiences [7, 8]. Therefore, by examining key metrics such as course activation rates, enrollment figures, and the types of activities used within Moodle, this chapter aims to provide a comprehensive analysis of the current state of digital learning at the University of Botswana. Such an analysis is crucial, as it identifies both the strengths and weaknesses of Moodle's implementation, offering insights that can guide future efforts to enhance student motivation through digital learning [9].

In light of the growing emphasis on e-learning, understanding how Moodle contributes to student motivation is more important than ever. This chapter not only highlights the successes and challenges encountered by different faculties but also provides strategic recommendations for improving the use of Moodle as a motivation-enhancing tool [10, 11]. By addressing areas where Moodle adoption has been less effective and suggesting best practices, the chapter aims to support the University of Botswana's goal of creating an inclusive and engaging digital learning environment that meets the diverse needs of its students. This analysis will ultimately contribute to a more effective integration of Moodle, ensuring that it serves as a catalyst for motivated and successful learning experiences across the university.

2. Literature review

The adoption of Moodle LMS in higher education has proven to be an effective tool for enhancing motivation among students in various learning environments. As a versatile and adaptable platform, Moodle offers features that contribute to increased autonomy and engagement in language courses [1]. For instance, it has been demonstrated that Moodle significantly enhances learner motivation in English courses by creating an engaging e-learning environment, which fosters autonomy [1].

Similarly, research has highlighted the platform's effectiveness in enhancing motivation due to its communication features, accessibility, and cost-effectiveness, indicating that Moodle's interactive nature plays a pivotal role in maintaining student interest [2]. Furthermore, the incorporation of gamification tools within Moodle shows the potential for increasing student motivation and engagement, which aligns with pedagogical practices in teaching [3].

The impact of Moodle on English as a Foreign Language (EFL) learning has also been examined in various contexts. It was found that Moodle activities significantly

improved Yemeni teachers' EFL learning experiences by enhancing their language skills and motivation, especially in areas with limited access to traditional instruction [4]. This suggests Moodle's applicability in diverse educational settings to promote motivation and skill acquisition.

Innovative teaching methods facilitated by Moodle, such as asynchronous learning using forums, workshops, and wikis, have been shown to diversify educational processes and boost student motivation [5]. Implementing these features allows teachers to make the learning process more engaging and effective [5]. The adoption of Moodle in e-learning enhanced learning motivation by making distance learning more interactive and fun, thus encouraging educators to utilize the platform for meaningful engagement [6].

The positive influence of Moodle on students' attitudes toward learning is evident in an EFL classroom context, as students who used Moodle displayed a more positive attitude toward learning, which subsequently led to improved grades and motivation [7]. This is further supported by research that showed gamification in a Moodle course led to significantly higher student engagement and better academic results, indicating the enduring relevance of gamification as a motivation-enhancing tool in non-STEM hybrid e-learning courses [8].

In physics education, the adoption of historical and biographical approaches through Moodle increased student motivation for independent activity by 39.7% [9]. These approaches not only enhance students' interest in physics but also in the history of the subject, demonstrating Moodle's capability to enrich content delivery and motivation in specialized fields [9].

Further exploration into the role of Moodle in blended learning environments concluded that combining Moodle with Google Classroom fosters an individual educational environment that enhances student motivation and engagement [10]. This blended approach encourages more active participation and provides a structured system for knowledge assimilation. Additionally, the implementation of instructional design for a flipped classroom using Moodle has the potential to increase student motivation by optimizing the use of the platform for self-directed learning [11].

Moodle's role in developing professional competencies has also been analyzed, serving as an effective tool for enhancing students' motivation to learn foreign languages in professional contexts [12]. This shows the platform's ability to adapt to diverse subject areas and contribute to professional competency development.

Furthermore, the development of Moodle-based interactive multimedia has been shown to increase learning innovation and motivation among students [13]. Interactive multimedia tools within Moodle can be effectively integrated into civic education, making the learning process more dynamic and motivating [13].

Incorporating interactive content such as H5P into Moodle has been found to have a positive impact on student motivation, especially in language learning, offering opportunities for creating engaging and interactive learning experiences [14]. Lastly, using Moodle as an educational IT tool effectively enhances students' motivation for learning language-specific purposes, particularly when the content is well-developed and interdisciplinary approaches are employed [15].

In summary, the reviewed literature indicates that Moodle LMS is an effective tool for enhancing learning motivation across different educational settings. Its adaptability to various pedagogical practices, gamification, multimedia integration, and role in developing professional competencies highlight its value as a motivation-enhancing platform in higher education.

3. Methodology

The data for this chapter was collected through a comprehensive analysis of the Moodle LMS database at the University of Botswana. The aim was to understand the extent of Moodle adoption and engagement across various faculties during the 2023/2024 Second Semester. This process involved a systematic approach to ensure that the findings presented were accurate and reflective of real usage patterns, thus providing a reliable foundation for assessing Moodle's role in enhancing motivation for learning.

The data was directly sourced from the Moodle LMS database, which stores detailed information about course categories, student enrollment, and the types of activities used in each course. To ensure efficiency and accuracy, the technical team prepared the database for data extraction by setting up specific data access pathways, known as "indexes." These indexes acted as filters that allowed for quicker and more precise access to relevant information, ensuring that the extracted data was both comprehensive and accurate.

A carefully designed data extraction technique was implemented, focusing on key aspects such as course categories, activity levels, student enrollment, and types of learning activities. This process helped identify how each course was organized within Moodle, determine whether courses were active or inactive, capture the number of students enrolled, and assess the range of activities (e.g., quizzes, assignments, forums) used to engage learners. The data was filtered to focus specifically on the 2023/2024 Second Semester, ensuring that the analysis was current and relevant to the university's digital learning environment.

The key data points collected included the course path (which showed the course's position within the university's academic structure), course names, the total number of enrolled students (providing insights into course popularity and engagement), and the types of activities used in each course. This targeted approach ensured that the data accurately reflected the use of Moodle across different faculties, forming the foundation for the analysis presented in this chapter.

4. Overview of Moodle LMS adoption across faculties

The literature review highlights Moodle's potential to enhance motivation across various learning environments, aligning with the varied landscape of digital engagement observed at the University of Botswana. Studies indicate that Moodle's interactive features significantly contribute to learner engagement and motivation [1, 2]. This finding corresponds with the positive adoption rates in faculties that have successfully integrated Moodle, as seen in the Centre for Academic Development (CAD) with its 72% activation rate. Similarly, the mixed success across faculties, such as the Faculty of Business and the Faculty of Health Sciences, is indicative of the challenges identified in the literature where certain departments may face barriers in fully leveraging Moodle's capabilities to foster motivation [2, 6, 8].

4.1 Faculty-specific analysis

The faculty-specific analysis provides a comprehensive understanding of the varied engagement levels with the Moodle LMS across different faculties at the University of Botswana. By examining the adoption rates, student participation, and

challenges encountered by each faculty, this section reveals the areas where Moodle has been effectively integrated as well as those that require strategic improvements. This analysis not only highlights the faculties that have successfully leveraged Moodle's features to enhance learning but also identifies faculties where engagement has been less effective, offering valuable insights for targeted interventions.

Integrating findings from relevant literature on effective Moodle utilization, the analysis underscores how factors such as faculty training, resource allocation, and the use of interactive features play a crucial role in fostering student motivation and engagement. By comparing each faculty's engagement with established best practices, this section provides actionable recommendations to maximize Moodle's potential as a tool for enhancing learning outcomes and creating more dynamic, student-centered educational experiences across the university.

4.1.1 Centre for Academic Development (CAD)

The Centre for Academic Development (CAD) at the university has demonstrated a commendable level of engagement with Moodle, as evidenced by a 72% activation rate. This high activation rate indicates effective use of Moodle's interactive features, such as quizzes, forums, and multimedia content, which align with literature emphasizing the importance of these elements in fostering student engagement and motivation. CAD's strong performance in Moodle adoption is further demonstrated by the fact that 56 out of 75 tracked courses fall within the 2–99 students' enrollment range, showing a healthy level of student participation. However, despite the success in active course engagement, CAD has 21 non-active courses, representing about 28% of its offerings, indicating room for improvement in ensuring consistent engagement across all courses.

Interestingly, only four of the CAD courses fully meet the set Moodle requirements, suggesting that while Moodle's features are being used, there's a need to align more courses with the platform's optimal standards to maximize its potential. The literature underscores that proper training and structured guidance can significantly enhance Moodle's utilization, suggesting that CAD could benefit from targeted interventions to further increase course activation rates and motivate learning. Addressing these gaps can help CAD maintain its position as a leader in Moodle adoption, enhancing the overall quality of digital learning experiences (**Figure 1**).

4.1.2 Centre for Continuing Education (CCE)

The Centre for Continuing Education (CCE) presents a critical situation, with all 116 tracked courses classified as non-active. This complete inactivity suggests significant challenges in engaging both instructors and students, which could be attributed to a lack of training or awareness of Moodle's potential benefits. The absence of active courses aligns with findings in the literature that highlight the importance of training and support in ensuring effective LMS adoption. Despite having enrollment numbers, CCE's courses are not leveraging Moodle's interactive features, which diminishes the opportunity to foster motivation and engagement.

Moreover, only 2 courses have more than 100 students enrolled, indicating potential areas for growth if these courses could be activated and optimized. The literature recommends structured interventions, such as faculty training programs and targeted strategies to boost course activation rates, which can significantly enhance engagement and motivation within the CCE. By prioritizing training and the integration of

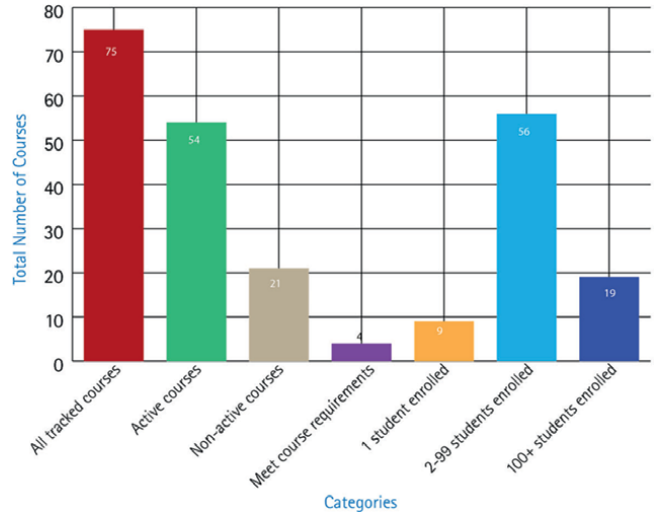

Figure 1.
Centre for academic development course summary.

interactive Moodle features, CCE could transform its approach, encouraging active participation and improving overall educational outcomes (**Figure 2**).

4.1.3 Faculty of Business

The Faculty of Business displays a mixed level of Moodle LMS utilization, with only 48 out of 174 courses actively engaged, resulting in an activation rate of around 28%. Despite this, a significant number of students participate in the courses, with 105 courses recording enrollment between 2 and 99 students. This finding suggests

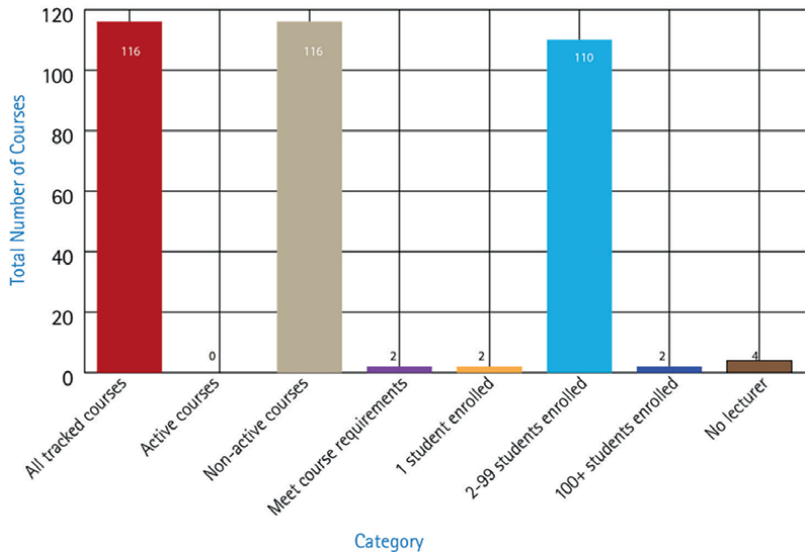

Figure 2.
Centre for continuing education course summary.

that when courses are active, they attract a healthy level of engagement, indicating a latent potential for enhanced Moodle utilization if activation rates can be improved. However, 20 courses have no students enrolled, pointing to challenges in course visibility, relevance, or promotion.

The Faculty of Business could benefit from strategies such as incorporating gamification and interactive tools, which have been shown to significantly boost student motivation. Additionally, addressing the issue of the nine courses lacking lecturers can help enhance course delivery and engagement, ultimately leading to improved activation rates and more effective use of Moodle's capabilities (**Figure 3**).

4.1.4 Faculty of Education

The Faculty of Education has a relatively low activation rate of 34%, with only 155 out of 447 courses being actively engaged. This low rate of Moodle adoption is concerning, given the faculty's substantial course offerings, and suggests that students may not be fully benefiting from Moodle's interactive and engaging features. However, it is noteworthy that 31 courses have enrollments exceeding 100 students, indicating that there is significant interest in certain courses. This aligns with literature emphasizing the need for integrating interactive activities to increase motivation and engagement.

The high number of inactive courses (292) suggests a need for targeted interventions, such as enhanced training for instructors on how to effectively use Moodle's tools and resources to create engaging learning experiences. This approach could transform inactive courses into dynamic and engaging platforms, thus fostering greater student motivation and participation (**Figure 4**).

4.1.5 Faculty of Engineering and Technology

With a Moodle course activation rate of only 30%, the Faculty of Engineering and Technology shows considerable room for improvement in terms of engagement and utilization. Out of 305 tracked courses, 214 remain non-active, which highlights challenges in motivating learners and effectively integrating Moodle's features into

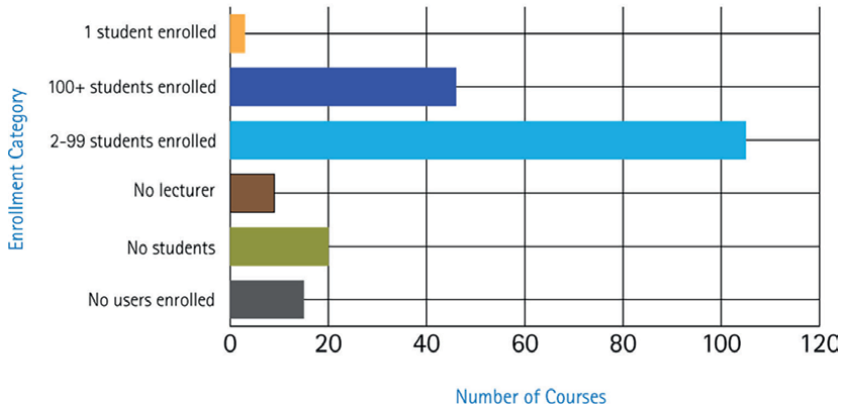

Figure 3.
Faculty of business enrolment distribution.

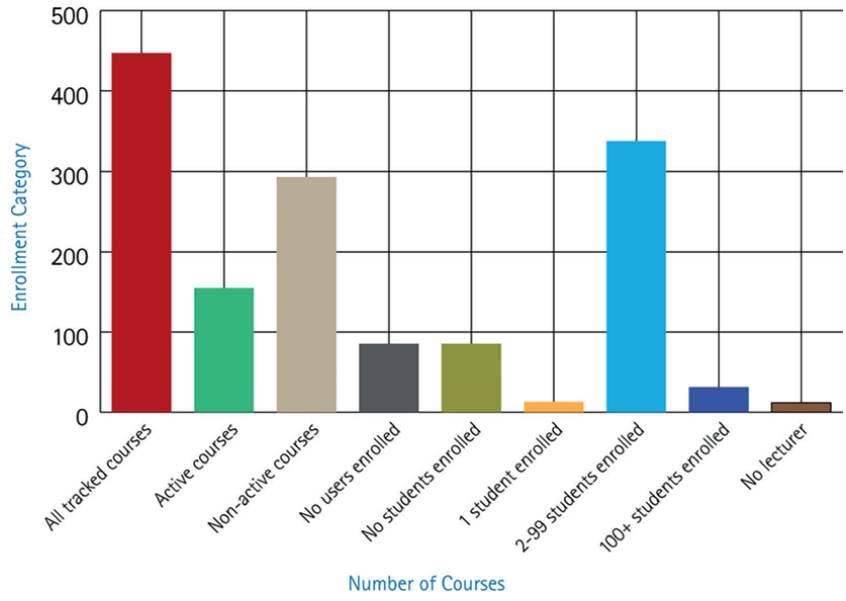

Figure 4.
Moodle LMS adoption by the faculty of education.

the curriculum. The presence of 79 courses with no student enrollment further emphasizes the need for strategic initiatives to address engagement issues, potentially through enhanced course marketing, better lecturer involvement, and more interactive Moodle activities.

Implementing recommendations from the literature, such as integrating gamified elements and encouraging the use of discussion forums and collaborative projects, can help increase student motivation and improve course activation rates in this faculty. These strategies would align with the observed benefits of Moodle as an effective tool for fostering a motivating and engaging learning environment (**Figure 5**).

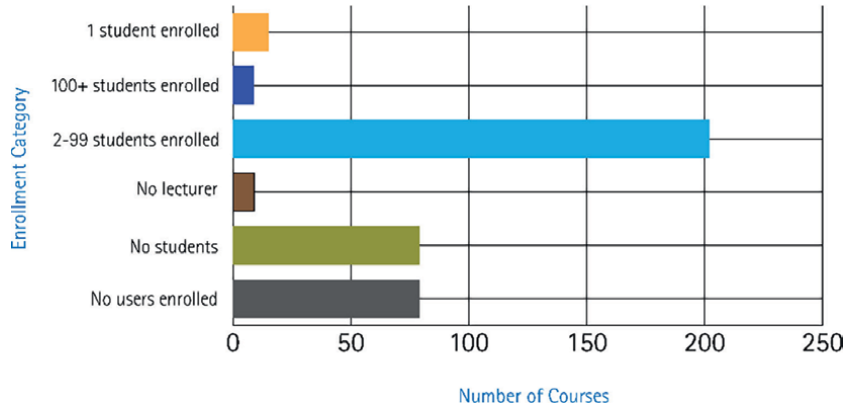

Figure 5.
Faculty of engineering enrolment distribution.

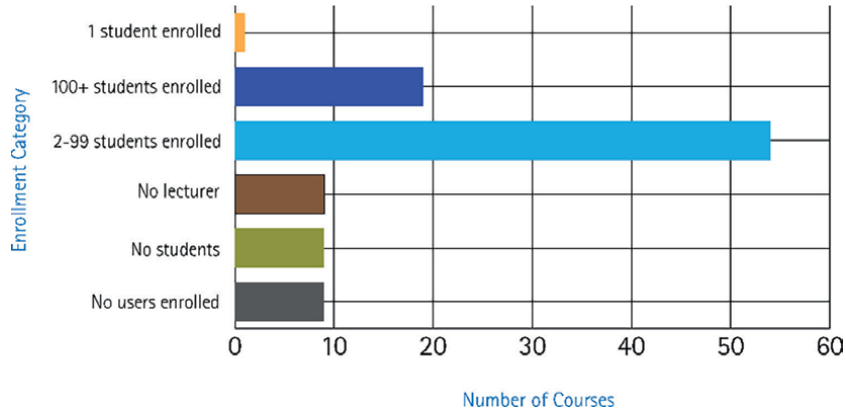

Figure 6.
Faculty of health sciences enrolment distribution.

4.1.6 Faculty of Health Sciences

The Faculty of Health Sciences demonstrates a moderate level of engagement with Moodle, with 50% of its courses being active (42 out of 83). This balance reflects a faculty that has embraced Moodle's capabilities to a certain extent, but there is still potential for improvement. The presence of 41 non-active courses indicates opportunities for increased engagement, particularly by integrating more interactive and engaging features into the course design.

Improving coordination and support for course activation could help the Faculty of Health Sciences enhance student engagement and motivation. Targeted training for instructors, as well as the integration of multimedia and interactive activities, can create a more dynamic and effective learning experience, thereby increasing the activation rate of Moodle courses (**Figure 6**).

4.1.7 Faculty of Humanities

The Faculty of Humanities has one of the lowest activation rates, with only 24% of its courses actively engaged (91 out of 379). This low engagement suggests that many courses could benefit from strategies to improve motivation and interaction, as recommended in the literature. The 288 inactive courses present an opportunity to revitalize the faculty's Moodle adoption, potentially by focusing on comprehensive training for instructors to effectively utilize Moodle's interactive features.

By encouraging the use of forums, quizzes, and multimedia content, the Faculty of Humanities could significantly improve student engagement and motivation, thereby increasing the activation rates of Moodle courses and enhancing the overall learning experience (**Figure 7**).

4.1.8 Faculty of Medicine

The Faculty of Medicine shows no active courses out of the 12 tracked, indicating a complete lack of engagement with Moodle's capabilities. This 0% activation rate

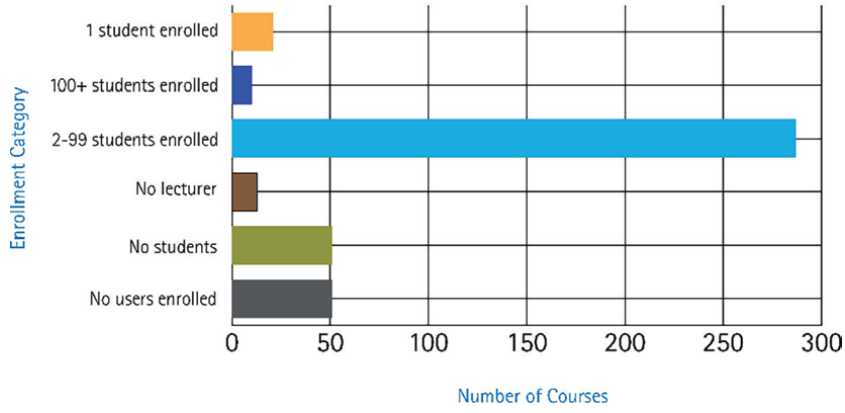

Figure 7.
Faculty of humanities course enrolments distribution.

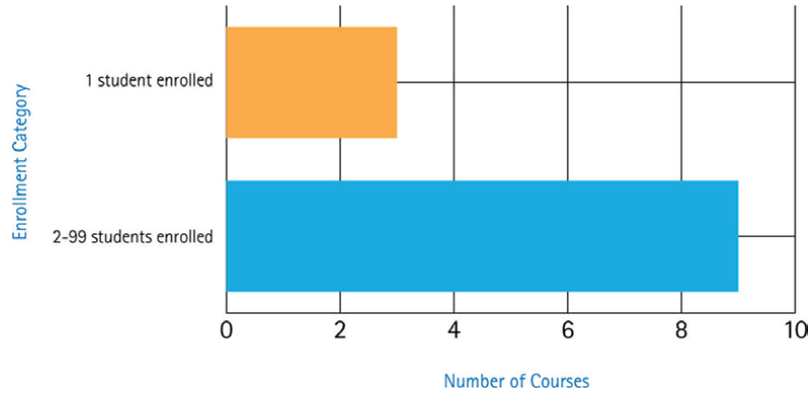

Figure 8.
Faculty of medicine course enrolment distribution.

highlights missed opportunities for utilizing Moodle as a tool to enhance learning experiences and motivation. Immediate interventions, including targeted training and familiarization with Moodle's features, are essential to improve course activation and student engagement (**Figure 8**).

4.1.9 Faculty of Social Sciences

The Faculty of Social Sciences has a relatively balanced engagement with a 53% activation rate (149 active out of 282 courses). While this is a positive sign, the 133 non-active courses highlight areas for improvement. Addressing these inactive courses could further enhance Moodle's role as a motivational tool within the faculty, aligning with literature findings that emphasize the benefits of interactive learning environments (**Figure 9**).

4.1.10 School of Graduate Studies

The School of Graduate Studies exhibits a particularly low activation rate of 10%, with only 86 active courses out of 864. This high number of inactive courses suggests

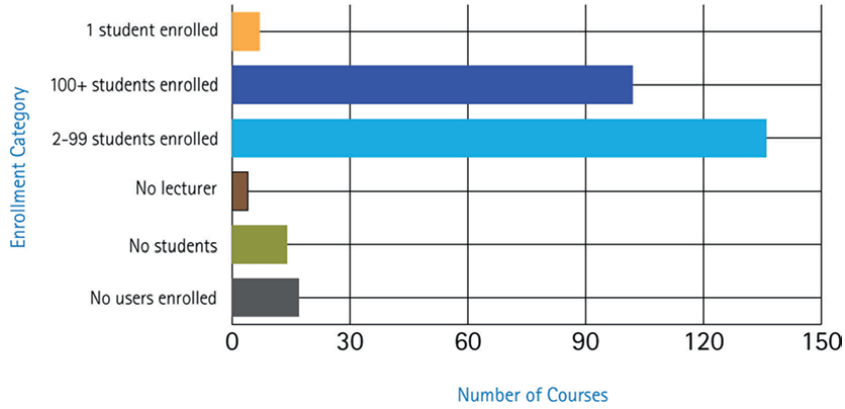

Figure 9.
Faculty of social sciences course enrolment distribution.

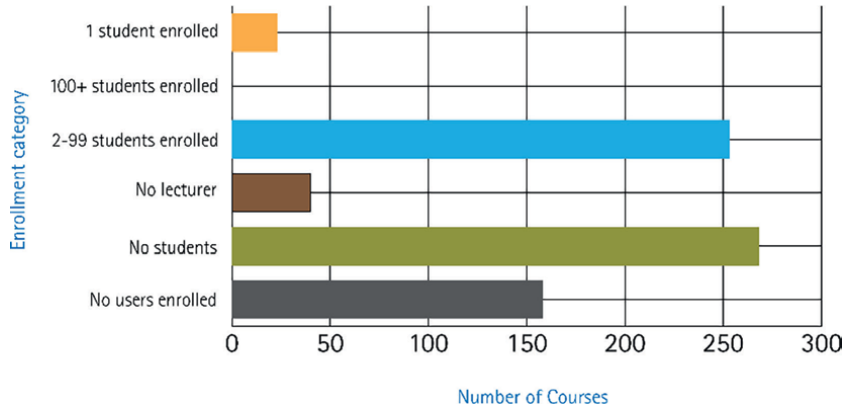

Figure 10.
School of graduate studies course enrolment distribution.

a need for targeted support and improved course management strategies. By implementing literature-recommended strategies, such as enhanced training and support, the School of Graduate Studies could significantly improve Moodle adoption and engagement (**Figure 10**).

4.1.11 Faculty of Science

The Faculty of Science showcases a relatively high activation rate of 62%, with 181 active courses out of 293 courses. This demonstrates effective use of Moodle in enhancing learning motivation. However, there are still 109 non-active courses, indicating that further implementation of best practices could ensure all students benefit from a motivating digital learning experience.

Overall, the faculty-specific analysis highlights varying levels of Moodle adoption and engagement across the university. While some faculties have demonstrated effective use of Moodle, others require strategic interventions to realize its full potential as a tool for enhancing motivation and learning outcomes (**Figure 11**).

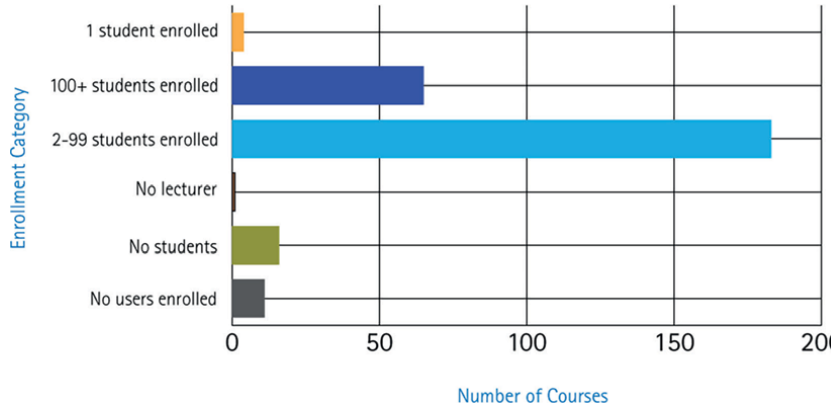

Figure 11.
Faculty of science course enrolment distribution.

5. Measures implemented by the Educational Technology Unit to enhance Moodle LMS adoption

The Educational Technology Unit (EduTech) at the University of Botswana has implemented several measures to increase the adoption of Moodle LMS across the institution, focusing on enhancing lecturers' skills, providing instructional design support, and offering comprehensive training workshops. One of the key strategies has been the provision of eLearning workshops that equip academic staff with the necessary skills to design and build their courses effectively using Moodle. These workshops cover a wide range of topics, such as "Course Implementation in Moodle LMS," where participants learn to set up courses, manage resources, create assessments, and monitor course activities. The workshops aim to ensure that lecturers are comfortable navigating Moodle and can create engaging and interactive online learning experiences.

Additionally, EduTech offers instructional design support to assist academic staff in developing engaging, interactive online, blended, and face-to-face learning interactions. The support includes guiding lecturers in the use of both synchronous and asynchronous teaching and learning strategies, as well as helping them explore emerging technologies to enhance the student learning experience. Workshops like "Instructional Design for eLearning" and "Multimedia for eLearning" further train lecturers on integrating multimedia elements into their courses, making the learning process more dynamic and motivating for students. The ETU also provides training on using plagiarism detection tools, such as PlagScan, and how it integrates with Moodle, thereby promoting academic integrity. These initiatives collectively help lecturers harness Moodle's full potential, leading to increased adoption and more effective use of the LMS for teaching and learning.

6. Conclusions and strategic recommendations

The chapter's conclusions and recommendations for enhancing Moodle adoption and motivation align with literature findings that stress the importance of regular

training workshops, recognition programs, and ongoing monitoring [3, 5]. These strategies are crucial for maximizing Moodle's potential as a tool for motivating learning across all faculties at the University of Botswana. The literature emphasizes that fostering a culture of eLearning excellence will help ensure that Moodle becomes integral to teaching and learning, thus enhancing motivation [14, 15].

7. Conclusion

The journey toward enhancing motivation for learning through Moodle LMS at the University of Botswana presents both successes and challenges. While some faculties have integrated Moodle effectively, others require targeted interventions to realize its full potential as a motivating educational tool. By implementing the recommendations outlined, the university can foster an environment where Moodle is used to create engaging and interactive learning experiences, ultimately enhancing motivation and learning outcomes. Through ongoing support, training, and a commitment to digital excellence, the University of Botswana can establish itself as a leader in digital learning and provide students with a future-ready educational experience.

Acknowledgements

The development of this chapter on Moodle LMS adoption at the University of Botswana was made possible by the dedicated efforts of staff from the Educational Technology Unit, Centre for Academic Development. We are grateful to Lindah Grace Ntutunyane, Bonno Getrude Paya, and Violet Hesinah Maretele for their meticulous data management, and to Dennis Mabalane for his leadership in coordinating course design. Special thanks also go to Baboloki Mabophiwa for enhancing the chapter's visual clarity. Their collective contributions have been invaluable in advancing digital learning across the university.

Conflict of interest

None.

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Chapter 3

The Dynamics of L2 Motivation in Iranian Contexts: Theoretical Perspectives, Research Trends, and Contextual Influences

Hojjat Jodaei

Abstract

Motivation has consistently been considered an important factor in language learning, significantly influencing the process in ways that are universally acknowledged. This review article aims to investigate L2 motivation from a theoretical and applied perspective, in Iranian contexts. The study makes use of a critical analysis of the related concepts in L2 motivation studies including definitions of L2 motivation, importance of studying L2 motivation, major L2 motivation theories, current trends in L2 motivation research, and L2 motivation research in Iranian contexts. The findings indicated that current L2 motivation research in Iranian contexts has examined several aspects, including the effects of cultural and social factors on language learning motivation, the influence of language policies and planning, and the impact of individual variables such as age, gender, and educational background. Furthermore, language policies and planning in Iran have also been identified as influential factors in L2 motivation. In general, research on L2 motivation in Iranian contexts offers important insights into the intricate relationships among cultural, social, and personal factors that influence language learning motivation. By understanding these dynamics, educators, and policymakers can develop more effective strategies to enhance L2 motivation and promote successful language learning outcomes in Iran.

Keywords: L2 motivation, L2 motivation theories, learner motivation, L2 motivation in Iranian contexts, language learning motivation

1. Introduction

Motivation has long been known as a critical issue in language acquisition, having undeniable impacts. It is a broad concept that resists a simple definition, and its complexity increases in the context of language acquisition. In fact, "among the psychological constructs related to L2 learning, none has generated as much literature as motivation" ([1], p. 58). As an important determinant of success in learning a second or foreign language, motivation "serves as the primary impetus to begin L2 learning and later acts as

the driving force to sustain the often lengthy and tedious process" ([2], p. 1). Moreover, all other factors involved in second language acquisition rely on motivation to some degree ([3], p. 203).

Throughout L2 instruction history, the research on L2 motivation has witnessed many changes in scope, conceptual backgrounds, and methods, and has developed into a complicated field of study [4–7]. Changes in emphasis have led to the development of new theoretical themes and the creation of novel motivational theories, which have deepened our comprehension of the motivational underpinnings of language acquisition. Since factors like personal characteristics and cultural backgrounds can influence second language (L2) motivation models, this can result in notably diverse conclusions.

Motivation as a multifaceted concept is the most prevalent notion for explaining the success or failure of a language learner [7–12]. According to Oxford and Shearin [13], motivation helps learners to be exposed to the target language, the learning strategies the learners take, the kind of interaction with the target audience, and their ability to retain L2 skills after completing their language studies.

Success in L2 learning is frequently linked to motivation. As a multifaceted construct, motivation has been defined in various ways by researchers across psychology and other social science disciplines. "Finding 'what moves a person to make certain choices, to engage in action, to expend effort and persist in action' such basic questions lie at the heart of motivation theory and research ([9], p. 3)." As [14] states, no agreement has been reached on the exact definition of motivation.

Within the behavioristic framework, the focus on motivation aimed to understand what triggers a dormant organism to become active. In this process, the behavioristic approach applied findings from animal studies to human behavior. The key to this approach was the reward system that helped learners to achieve the language learning goals. In the cognitive development theory, motivation is perceived as "a built-in unconscious striving towards more complex and differential development of individual's mental structure" ([13], p. 23). The transition from behavioristic to cognitive theories shifted the emphasis from "what" motivates behavior to "why" it occurs. As a result, terms such as stimulus and aspiration from behaviorism were substituted by concepts such as instrumentality, integrativeness, and orientation in cognitive theories, which have since become key elements in research on individual differences. Contemporary definitions of motivation incorporate these constructs into their frameworks.

According to Gardner, motivation in this context encompasses a blend of effort, a strong longing to achieve objectives, and favorable attitudes toward the language learning experience [10]. This statement closely relates to language learning, as it involves effort, desire, the reasons behind behaviors, and the emotions connected to learning a second language. Specifically, motivation in second language acquisition is related to how much the learner works to achieve a specific goal or to become a fully integrated member of the target community. The desire to reach a defined goal and the effort made to attain it are crucial components of motivation. Gardner [10] argues that a simple definition of motivation is not possible. That is to say, abundant definitions in the related literature have not led to a conclusive result, and many do not consider all factors related to motivation.

In modern research on L2 motivation, it is often understood as a combined influence of various motives. That is "on a continuum from zero to strong" [15]. Dörnyei suggests that further research is needed to investigate higher-level gatherings of cognition, affect, and motivation acting as "wholes" [16]. This is contrary to the

traditional view toward L2 motivation in which the researchers conceptualize the term linearly. An example of this combined integration of different factors in second language acquisition (SLA) study is Dörnyei's [15, 16] notion of "ideal" and "ought to selves." He states that motivation is responsible for the people's intention to do something, their willingness to continue that action, and their effort in pursuing it [9]. Regarding language learning, for instance, the intention, the desire to continue the action, or the effort in pursuing the action may be internal or external, intrinsic or extrinsic, and instrumental or integrative.

Dörnyei and Ottó [17] define L2 motivation as "the dynamically changing cumulative arousal in a person that initiated, directs, coordinates, amplifies, terminates, and evaluates the cognitive and motor processes whereby initial wishes and desires are selected, prioritized, operationalized, and (successfully or successfully) acted out" (p. 65). Seidel and Shavelson [18] argue that it is the determined attempt toward an aim. Baumeister [19] defines motivation as "any internal process that energizes, directs, and sustains behavior." (p. 2). Schunk et al. [20] describe it as a process in which a directed behavior is initiated and continued. Richards and Schmidt [21] describe L2 motivation as the driving force behind actions in various situations. In the realm of language learning, a key distinction is drawn between orientation, which pertains to the underlying reasons for learning a language, and motivation, which includes the learner's attitudes, aspirations, and readiness to invest effort in acquiring the second language. Dörnyei [2] defines motivation as the reasons for engaging in and maintaining that effort.

Studying motivation is not as simple as it might appear. While it can be rewarding, it also presents its own set of challenges. The difficulties in studying motivation primarily stem from the inherent characteristics of the concept. Motivation is not a fixed trait; rather, it is dynamic and continually evolving. Bui and Teng [22] examine the intricate motivational dynamics of multilingual learners in language acquisition. Their study supports the newly proposed dual-motivation system theory and aims to enhance the understanding of multilingual learning. Given the unobservable, multifaceted, and dynamic nature of L2 motivation [23], a range of research methodologies is essential. Additionally, exploring motivation as an interdisciplinary field requires foundational knowledge in areas like psychology, language education, and linguistics. An understanding of psychology is particularly important, as motivation fundamentally concerns language learners as human beings, which is the primary focus of psychology. The study of motivation also benefits from some knowledge of language education and linguistics as it focuses on the use of language in a specific context by a learner.

Many factors play an important role in L2 learners' level of motivation. These factors include but are not limited to, contextual factors, teachers, stakeholders, and materials from both micro and macro perspectives, as well as factors related to the nature of motivation (e.g., intrinsic or instrumental). Some of these factors are well-researched through motivation studies in the related literature, and some need more research. The impact of teachers' motivational behaviors on students' motivation and achievement, particularly the dynamic interaction between teachers and learners, has not been thoroughly studied yet. As Dörnyei and Ushioda [9] point out, "Until very recently, the issue of teacher motivation had received rather little attention in educational psychology" (p. 158). This issue is important, as it has been found that, if a teacher is motivated to teach, his or her students will be likely motivated to learn.

Context has always been a crucial factor in L2 learning research, especially in studies focused on motivation [16, 24–26]. From a psychological standpoint, context is influenced by the (inter)relationship between the individual and their social

environment. According to Dörnyei and Ushioda [9], there are two perspectives on the complexity of the social environment and the self: the individualist perspective and the societal perspective. While the former focuses on the micro perspective (i.e., an individual's attitudes and social environment), the latter focuses on the macro aspects (i.e., macro contextual factors such as sociocultural norms). Hence, context can be defined as both the broad sociocultural context and the micro-cultural context.

2. Theoretical framework

2.1 Major L2 motivation theories

The motivation to learn a second (L2) or foreign language is among the most extensively studied topics in second language education research. As Dörnyei and Ushioda [9] describe, the study of motivation in second language learning research has emerged as an independent field of study. That is to say, motivational research in second language studies has not evolved directly from the theories of motivation in general education or psychology. The research in L2 motivation has been developed to answer social, psychological, and behavioral aspects of second language learning. During the history of motivational studies, the research into this area has moved through different phases and theories. Dörnyei and Ryan [27] argue that, over the past decade, "[motivation] has been subject to the most thorough theoretical overhaul" (p. 72).

Gardner [10], recognized as a leading expert in the field of motivation research, mentions three periods of L2 motivation research, namely, early history, modern history, and current history. He defines the early history of motivation research in second language acquisition as the period from the inception of this field up to 1972, which is highlighted by the works of Gardner and Lambert. Modern history spans from 1972 to 1985, during which Gardner introduced the socio-educational model of L2 learning in 1985. This model highlights the importance of attitudes and motivation in language learning. This period also saw the impactful publication of Gardner's book, Social Psychology and Second Language Learning: The Role of Attitudes and Motivation [28]. Furthermore, when Gardner [28] developed the Attitude/Motivation Test Battery (AMTB), some disagreements appeared, and there were developments in the related fields. Many of the early studies in the relevant literature (see Refs. [29–31]) focused on the use of Gardner's model of L2 learning. As Bernaus and Gardner [29] conclude, "Although these studies have used different conceptualizations of motivation, they all found a relationship between motivation, L2 achievement, and other indexes of learning." (p. 387). The result of the research initiative by Gardner has focused on the development of a formal model that describes the influence of attitudes and motivation on second language learning. Gardner [30] observes that although this model has undergone changes over the years, notable similarities persist between its earlier and more recent iterations. Within this framework, integrativeness and attitudes toward the learning environment are two interrelated factors that affect motivation in second language acquisition and contribute to language achievement. Gardner [30] present an alternative model that builds directly on Gardner's socio-educational model. This new model demonstrates that integrativeness and attitudes toward the learning context shape students' motivation, while motivation, language anxiety, and attitudes toward the learning environment influence students' performance on English assessments. Additionally, several authors [5, 7, 9, 27] have identified three main historical phases

of L2 motivation. It should be noted that these periods were not developed from each other, and were not sequentially and linearly related but enjoyed some overlaps in the macro and micro perspective.

2.2 Early theories of L2 motivation (1959–1990)

As Ushioda [7] states traditional L2 motivation studies focus mainly on trait levels of motivation and the relationships between individual differences variables and language achievement. The initial stage of L2 motivation theories was mostly based on the work of Gardner and his associates in Canada. The social-psychological perspective continued up to the early 1990s. During this period, Gardner and his colleagues (e.g., [32–34]) published various studies on the role of attitude and motivation in L2 acquisition. The central theme of the social-psychological period was the exploration of dichotomous distinctions, such as integrative versus instrumental motivation, intrinsic versus extrinsic motivation, and motivation versus orientation. The key notion of this approach toward L2 motivation is characterized by the assumption that learners' attitudes toward L2 affect their language learning behavior and affective factors (i.e., motivation) are significant factors in successful L2 learning.

2.2.1 Gardner's socio-educational model

L2 learning is a social-psychological process, making it worthy of study. L2 motivation has its roots in the early research of Lambert and Gardner, conducted in the Canadian bilingual context. They consider L2 motivation as a factor that mediates between different cultural communities to enhance or hinder intercultural communication and affiliation [9]. This view has been referred to as the "social psychological perspective," which highlights non-cognitive (affective) factors such as motivation that were considered as an influential factor in L2 learning success. The Gardners' Socio-Educational Model sought to identify the conditions influencing second language acquisition. The model has been revised several times since its initial proposal [10, 35, 36]. However, its core constructs have largely remained consistent. It was the leading theory in the initial motivation studies and has shaped L2 motivation research and practice for more than about two decades.

2.2.2 Instrumental and integrative motivation

Students have numerous different motives for studying a foreign or a second language. Sometimes, they study a language for practical reasons, while at other times; they have a special attraction toward a particular language and its people. Language teachers are often very conscious of the career advantages that language proficiency can bring, but to many language learners, studying the language is only an abstract responsibility obligatory for an academic degree. Since the foundational work of Gardner and Lambert in 1972, both language teachers and researchers have acknowledged the crucial role of motivation in language learning. Gardner and Lambert developed the most widely used framework for understanding the various motivations that language learners typically possess. Gardner's [28] concepts of instrumental and integrative orientations have been extensively utilized in research on L2 motivation. A key reason for the influence of Gardner's model is his contribution to the development of the Attitude/Motivation Test Battery (AMTB), which has been broadly applied in the realm of L2 motivational studies (e.g., [29, 30, 37, 38]).

2.2.3 Gardner's socio-educational model's challenges

Although the socio-educational model has had a significant role in the mainstream of SLA research, many researchers have subjected it to both theoretical and methodological criticisms (e.g., [16, 39, 40]). The main criticism can be related to the content validity of the instruments, such as AMTB. Dörnyei [15] contends that the sub-components of motivation blur the distinction between the mental experience of being motivated and actual behaviors. Additionally, some researchers argue that the Attitude/Motivation Test Battery (AMTB) is mainly suitable for a bilingual country like Canada. Consequently, the research primarily addresses second language learning rather than foreign language learning, making it less applicable in foreign language contexts. The third disapproval of the socio-psychological model of language learning motivation is related to terminological misunderstandings.

2.2.4 The cognitive-situated decade (the 1990s)

Impressed by the cognitive theories in educational psychology, scholars made the 1990s a course of transformation, as interest shifted and were transformed from a socio-psychological view to a cognitive, educational view. The cognitive-situated period [15] emphasized the alignment of L2 motivation with its counterpart theories in cognitive psychology and paved the way for changing from a macro perspective of L2 learning to a micro perspective of situated-specific language learning context [9]. Nevertheless, in this period, the social-psychological perspective was not rejected, and the significance of Gardner's macro perspective on the educational context was not disregarded. Instead, a new reconceptualization of L2 motivation emerged. In this era, the learning environment in the micro perspective (i.e., the classroom environment) was considered to have a great influence on learning behavior. Hence, a great need for L2 motivation theories to meet these issues was realized.

2.2.5 Self-determination-theory

Self-determination theory [41] posits that meaningful engagement in activities has several specifications self-regulation, self-determination, and autonomy. This theory differentiates between different types of motivation (i.e., intrinsic and extrinsic). Dörnyei [15] states, "It has been one of the most influential approaches in motivational psychology, and several attempts have been made to the L2 field to incorporate certain elements from the theory to explain L2 motivation" (p. 76). In the late 1990s, Noels and his associates (e.g., [42–45]) developed an organized research program, in line with the overall thrust of the cognitive-situated period.

Noels [45] argued that motivation consists of three main components: intrinsic orientation, extrinsic orientation, and a motivation. These components lie on a continuum from self-determination to non-self-determination. Individuals possessing a high level of self-determination tend to demonstrate greater autonomy in their learning, leading to enhanced achievement.

2.2.6 Intrinsic motivation

Intrinsic motivation is the determination to complete an activity purely to do so [46–48]. This type of motivation is associated with a person's feelings regarding the completion of a specific activity and is characterized by the desire to engage in that

activity because it is enjoyable and fulfilling [49]. Intrinsic motivation arises from a sense of internal satisfaction and enjoyment. It originates within the learner and is closely linked to their identity and overall well-being. Noels et al. [42] classify intrinsic motivation, a component of self-determination theory, into three types: (a) intrinsic motivation for knowledge, which refers to the pleasure of learning new information; (b) intrinsic motivation for accomplishment, which involves the fulfillment of reaching goals; and (c) intrinsic motivation for stimulation, which pertains to the enjoyment gained from engaging in the task itself. Ehrman, Leaver, and Oxford [50] assert that learners with intrinsic motivation derive their rewards from the enjoyment of the learning tasks themselves and experience a sense of competence while doing the task. In other words, intrinsically motivated individuals are primarily driven by internal factors rather than external ones.

2.2.7 Extrinsic motivation

Extrinsic motivation is related to behaviors performed to reach a specific outcome, such as getting a reward or evading a punishment [49]. In comparison to intrinsic motivation, extrinsic motivation can be considered as a continuum that ranges from non-self-determination to self-determination. According to the self-determination theory, motivation is classified into three levels from unwillingness to passive compliance to active personal commitment. External regulation refers to learners' efforts and actions aimed at achieving external rewards and benefits related to the task, meaning their behaviors are driven by the need to meet external demands or secure externally imposed rewards. The actions taken in this context are motivated by external pressures (e.g., someone learning a language to avoid feeling embarrassed for not knowing it). Identified regulation, in contrast, is motivated by personally significant reasons, such as the understanding that an activity is essential for achieving a valued goal (e.g., individuals learning a second language because they see it as vital for their educational growth). Those who are identified as regulated engage in the learning process due to the intrinsic values and benefits it offers.

2.2.8 Amotivation/demotivaiton

In self-determination theory, amotivation refers to a "lack of motivation resulting from realizing that there is no point" [51]. Deci and Ryan [41] express amotivation as a relative absence or lack of motivation that stems from the individual's feelings of incompetence and helplessness while coping with different tasks. In self-determination theory, amotivation is defined as a "lack of motivation resulting from the perception that there is no purpose" [52]. It operates independently of both types of motivation.

2.2.9 Criticisms of self-determination theory

The validity of the self-determination theory has not been well-established. Within self-determination theory, Vandergrift [53] studies the relationship between motivation and achievement and notices that no upfront pattern representing a development of increasing self-determination is obvious. He concludes that the self-determination framework proposed by Noels and her colleagues may not apply to adolescent learners. In an experimental study involving college students, Vohs and Schooler [54] discovered that providing individuals with an excessive number of choices could have detrimental impacts on their ability to self-regulate. Specifically,

this overabundance of options can result in diminished self-regulation, a decreased willingness to participate in activities, and reduced persistence in their efforts.

Some researchers contend that there is no distinct separation between different types of motivation, as delineated in self-determination theory, and the concepts of integrative and instrumental motivation found in Gardner's socio-educational model. Intrinsically motivated learners take pleasure in the language learning process, whereas, as Gardner [38] noted, integratively motivated students find a higher level of satisfaction in their classes. In contrast, extrinsically motivated individuals engage in learning primarily for external reasons; their motivation is influenced by factors such as earning rewards or avoiding negative consequences. Similarly, those who are instrumentally motivated pursue learning for practical benefits, such as securing a job. Ultimately, the lines between integrative and intrinsic motivation and instrumental and extrinsic motivation can sometimes become quite indistinct.

2.2.10 Goal theories

Originating from educational psychology, "Goals have always been a central feature of L2 motivation research" [15]. A goal refers to the reason or purpose that an individual has for the learning process. Goals affect individuals' performance in the sense that they:

- Focus attention on specific activities;
- Motivate individuals to put in effort;
- Encourage persistence with tasks;
- Influence learners' strategic approaches.

Locke and Latham [55] identify two significant theories of goals within motivational research: goal-setting theory and goal-orientation theory. Locke [55] argues that there is a crucial relationship between goal-setting and performance, indicating that the establishment of goals influences various aspects, including the level of performance, the effort expended to achieve those goals, the strategies employed, and the persistence demonstrated. While motivational research primarily focuses on goal-orientation theory, Dörnyei [15] observes that "language learning goals have typically been referred to as orientations" (p. 9). Nonetheless, the concept of "orientations" as defined by Gardner and Tremblay [33] has not been directly linked to the various goal theories that have become prominent in educational psychology.

2.2.11 Attribution theory

According to Dörnyei [15], attribution theory, as presented by Weiner [56] has achieved: "a special status among contemporary motivation theories in psychology because this was the first theory that successfully challenged Atkinson's classic achievement motivation theory in the 1970s" (p. 79). Attribution theory was the dominant theory in research on student motivation in the 1980s. This theory is important to SLA research since it can explain many cases of language-learning failure [57]. Attribution is also significant in the sense that, as Hsieh and Schallert [58] note, it plays a significant role in shaping learner motivation.

Some researchers in the area of second language acquisition (SLA) motivation examine attribution theory through four key factors: ability, effort, perceived task difficulty, and luck (e.g., [56, 59]). Brown [60] distinguishes between internal factors, such as ability and effort, and external factors, like luck and task difficulty. His theory links future accomplishments and successes to these factors, interpreting this relationship as a type of causal attribution (for instance, effort leads to achievement, or ability results in success). From this perspective, the background of language learners significantly influences their future achievements and can serve as a reason for their successes. Additionally, attributions are shaped by cultural contexts; learners from different cultural backgrounds may attribute their successes or failures to varying factors.

2.2.12 Classroom-oriented model

The classroom learning context is highly intricate, and according to Dörnyei [51], "no single motivational principle can capture this complexity" (p. 13). To effectively predict outcomes in a classroom setting, a more intricate model that simultaneously accounts for various constructs from motivational theories is necessary. In this regard, Dörnyei's [51] classroom-friendly model theorizes L2 motivation across three stages: the language level, the learner level, and the learning situation level. The mentioned levels match the three key concepts of any language-learning development—learner, teacher, and context—and at the same time include the three different constructs present in the earlier theories: the social dimension, the personal dimension, and the educational dimension. In this context, the language level denotes the most overarching feature of the concept, thoroughly aligned with Gardner's ideas of integrative and instrumental motivation, and emphasizes the social features of L2 motivation. The learner level includes the individual differences among learners, showing a multifaceted interaction between effects and cognitions which leads to steady personality traits. In contrast, the learning situation level emphasizes motivational factors that are specific to the classroom environment. This feature is similar to the intrinsic and extrinsic motivations described in self-determination theory. Additionally, the learning situation level can be linked to Gardner's idea of attitudes, specifically attitudes toward the learning environment that can be practically applied within the classroom setting.

2.2.13 Autonomy theory

Learner autonomy in L2 education emerged from motivational studies from the cognitive-situated period (e.g., [61, 62]). Ushioda [63] argues that autonomous learners seem to be more motivated and subsequently experience better achievement. Linking autonomy to motivation, the author suggests that there is a critical connection between autonomy and a few instructive speculations of inspiration which may account for the claimed control of autonomy. Studies on autonomy and motivation in general education (e.g., [41, 64, 65]) conclude that autonomous learners have the capacity to be motivated, can shape and reshape their learning goals, and are able to apply learning strategies and metacognitive strategies to the learning process. A learner's active engagement with the learning process is the main concern of autonomy and motivation. Autonomous and motivated learners are more likely to take part in the learning process [63]. Overall, the study of the interface between motivation and autonomy is important as "it has continued to generate much

attention, evolving through the process-oriented period of L2 motivation research with its focus on motivational self-regulation, and moving into the current socio-dynamic period" ([9], p. 58).

2.3 Socio-dynamic period

Linear approaches to L2 motivation consider the notion from a positivistic point of view. These approaches have good explanatory and predictive power. The generalizability and applicability of the models to the wider context are the focus of these frameworks. The focal point of the linear models to L2 motivation is on a small number of influential variables; over time, such a view came to be considered reductionist and parsimonious. Linear models are now understood as a selective, partial account of motivation. In this view, language learning is seen to involve "idealized abstractions or bundles of variables behaving and responding in theoretically predictable ways" ([9], p. 75).

The socio-dynamic period of L2 motivation commenced in the early twenty-first century and extends to the present. This period primarily emphasizes the situated dynamic aspects of L2 motivation, particularly the temporal dimensions of motivation. Scholars proposed theories of L2 selves, such as the L2 motivational self-system [15] and complex dynamic systems approach in this period. Based on the work of Dörnyei and Ushioda [9], three perspectives shaped the situative perspectives on motivation, namely, sociocultural theory, self-regulatory perspectives, and the complex dynamic systems approach. From the sociocultural theory, learning is not the final output but is the result of the interactive interplay between the learner and their micro/macro context. The focus of self-regulation theory is a dynamic interaction between motivation as a process and context as a process. The concept of "self" is central to self-regulation theory. Learners as the manifestation of the "self" interact dynamically with the "context." "Self," in this sense, means the learners' personality, emotion, and learning behavior. Self-regulation theory focuses on the reciprocal interaction between the "self" and the "context."

The most current theory in L2 motivation, the complex dynamic systems approach, considers "context as a process" as its central notion. The theory goes beyond the causative linear effect of contextual influences on the learning behavior or learners' affective factors, and instead focuses on the regulations of possible "interactive processes." Dörnyei and Ushioda [9] argue that complex dynamic system perspectives view motivation as an interrelated notion to a dynamic external context and internal cognitive attributes. In this multifaceted view toward L2 motivation, there are numerous, unpredictable and changing interplays between system constituents. Interrelatedness and changeability are two essential conditions required to turn a simple system into a highly complex one. Dörnyei and Ushioda [9] refer to this notion as a double pendulum, in which the simple system consists of only two constituents, and then, as it moves, the system turns into a developmental trajectory indicating a highly complex and unpredictable behavior. The traditional view toward L2 motivation considers motivational factors as distinct, individual differences factors operating in isolation, while from the dynamic situated perspective, motivational factors act as a whole.

Dörnyei [5] calls the shift from the cognitive-situated period to the complex dynamic movement a "radical reformulation." In this reformulation, language learning is a sociocultural and socio-historical process rather than a cognitive psycholinguistics process [9]. This reformulation is also affected by the growth of English as a lingua franca, in which English is more widely used as a common means of

communication. In this view, as Dörnyei and Ushioda [9] suggest, traditional concepts of L2 motivation such as integrativeness and attitudes toward the target community have lost their meaning because there is no particular reference to the target culture and English is seen as a basic educational skill like computer skills or literacy that is not specific to a particular community. In their influential work, *Teaching and Researching Motivation*, Dörnyei and Ushioda [9] present three conceptual frameworks for examining the socio-dynamic period of L2 motivation: a person-in-context relational view of motivation, the L2 motivational self-system, and motivation analyzed through the lens of a complex dynamic systems perspective.

2.3.1 A person-in-context relational view of motivation

The limitations of linear approaches in researching L2 motivation led to scholars in educational psychology entering a period shaped by considering individuals in context. The linear approaches in the mainstream of L2 motivation research commenced with work on cognitive factors such as ability and aptitude and then, for the subsequent three decades, continued to affective factors, chiefly through the efforts of Gardner and his colleagues in the 1990s. It took several decades for research on L2 motivation to evolve to reach its current position. During these decades, research in L2 motivation was developed, expanded, and reformulated due to the dominance of cause-effect relationship studies. The focus of this debate in educational psychology was on the question of "whether motivation is primarily a cause or an effect of learning" [66]. However, the issue of motivation is much more complex and is influenced by many internal and external factors; establishing a cause-effect relationship is shallow of a complex topic. Creating a cause-and-effect relationship of motivation ignores "time" and phases of motivation. L2 motivation changes over time, either at the micro level (e.g., language learning experience in an intensive course) or at the macro level (e.g., language learning process during educational life). Cause-effect linear relationship of motivation has been discussed in the tradition of positivism and the reductionism view of motivational psychology. The focus in this view subdivides learners into different dichotomies of motivated/unmotivated learners, instrumental/integrative oriented learners, and high-confident/less-confident. The view also tends to consider the complexity of situated and temporal variables, which may play an important role in motivating individuals. This is why linear models offer only a limited and incomplete understanding of motivation, failing to capture its complex reality [66]. The influence of significant shifts in motivational and educational psychology, coupled with the recognition of these limitations, has given rise to situated approaches to L2 motivation.

Situated approaches to L2 motivation consider context and related contextual factors (such as a classroom or cultural setting) in relational approaches rather than linear ones. Linear models have dealt with contextual factors as independent variables affecting L2 motivation. Linear formulations disregard the dynamic aspect of context and motivation in which the relationships are shaped by continuous and overhanging actions and reactions. On the other hand, the "relational approach is not concerned with identifying 'variables and tracing cause-effect relationships" [67]. Instead, it focuses on the dynamic and changing aspects of context and motivation. In this view, as Ushioda [26, 68] argue, relationships are unique because every person and every context is unique. Since every context of language learning is unique, different motivational models and strategies are required. For instance, motivational factors and strategies necessary in a military context are far from those appropriate in a school

or regular context. Therefore, it is worthwhile to study L2 motivation separately in a range of learning contexts.

2.3.2 The L2 motivational self-system

As proposed by Dörnyei [16], the L2 motivational self-system provides the main dimensions of L2 motivation. The framework is influenced by the notion that foreign language learning is different from learning other academic subjects and therefore different paradigms from those adopted in educational and psychological fields should be applied. Considered a natural progression from Gardner's integrative motivation theory, and influenced by psychological theories of the self-used by Dörnyei [69], the L2 motivational self-system aims to conceptualize L2 motivation. Dörnyei's [69] L2 motivational self-system includes three dimensions: The ideal L2 self, the ought-to self, and L2 learning experience. Ideal L2 self refers to the ideal image a person has in learning a foreign language. This ideal image can be a powerful motivator because it can reduce the distance between the actual and the ideal self. Ideal L2 self is closely associated with traditional integrative/instrumental motivation. The ought-to self "concerns the attributes that one believes one ought to possess to meet expectations and to avoid negative outcomes" ([16], p. 29). For instance, if a language learner does a task for the sake of their teacher's confirmation or because they want to please the teacher with good performance, the ought-to self is the main motivational factor behind this learning. This dimension is equal to extrinsic motivation in the tradition of L2 motivation since it is influenced by external rewards. The L2 learning experience focuses on the "situated, executive motives related to the immediate environment and experience" ([16], p. 29). It is not linked to self-image but to the context in which the learning process happens. Situation-related motives are influential immediate contextual factors affecting L2 motivation. The learning environment motivates some language learners since the setting in which learners learn a language affects learners' attitudes and learning. The L2 learning experience is correlated with traditional intrinsic motivation.

2.4 L2 motivation research in Iranian contexts

2.4.1 Overview of existing studies

Motivation plays a vital role in language learning and is frequently examined across various contexts globally. In recent years, there has been an increasing focus on understanding L2 motivation specifically within Iranian contexts, given Iran's rich and diverse linguistic landscape that encompasses multiple language communities [70–72].

Research on L2 motivation in Iranian contexts has focused on various aspects, including the influence of cultural and social factors on language learning motivation (e.g., [6, 73, 74]), the impact of language policies and planning on motivation [75, 76], and the role of individual variables such as age, gender, and educational background (e.g., [77–79]).

One of the key findings in L2 motivation research in Iranian contexts is the significant role of cultural and social factors in shaping language learning motivation. Iran is a multilingual country with Persian as the official language and several minority languages spoken in different regions. This linguistic diversity has implications for L2 motivation, as learners navigate between different language communities and

negotiate their linguistic identity. Studies have highlighted the importance of considering these cultural and social factors in understanding L2 motivation in Iran.

Furthermore, language policies and planning in Iran have also been identified as influential factors in L2 motivation. The status and prestige associated with different languages, as well as the availability of language learning resources, can impact learners' motivation to learn a second language. Research has examined how language policies, particularly regarding the promotion of Persian as the dominant language, have affected L2 motivation and language learning outcomes in Iran.

Individual variables such as age, gender, and educational background have also been explored in L2 motivation research in Iranian contexts. Studies have investigated how these factors interact with motivational variables to shape language learning attitudes and behaviors. For example, research has shown that adult learners in Iran may have different motivational patterns compared to younger learners and that gender differences in L2 motivation exist within the Iranian context.

Overall, L2 motivation research in Iranian contexts provides valuable insights into the complex interplay of cultural, social, and individual factors in shaping language learning motivation. Understanding these dynamics enables educators, and policymakers to develop effective strategies to enhance L2 motivation and promote successful language learning outcomes in Iran.

2.4.2 The key finding of L2 motivation studies in Iran

Understanding the motivations that drive individuals to learn a second language (L2) has been a significant area of research within the field of applied linguistics. In Iran, where English and other foreign languages play pivotal roles in education, employment, and social mobility, the study of L2 motivation holds particular relevance. This article aims to review and synthesize the key findings of L2 motivation studies conducted in Iran, shedding light on the factors influencing Iranian learners' motivation to acquire and use a second language.

Research on L2 motivation in Iran has identified several key factors that influence learners' motivation (e.g., [80]). One prominent factor is instrumental motivation, driven by practical reasons such as educational requirements, career opportunities, and economic advancement. Iranian learners often perceive proficiency in English or other languages as essential for academic success and professional growth, leading to strong motivational drives. Additionally, integrative motivation plays a crucial role, particularly among younger learners and those engaged in cultural exchanges or international communication. Integrative motivation stems from a desire to connect with speakers of the target language and to gain insights into their culture, fostering a deeper appreciation and motivation for language learning.

Cultural factors also significantly impact L2 motivation in Iran [77]. The cultural prestige associated with certain languages, particularly English, influences learners' perceptions of language value and their motivation to achieve proficiency. Moreover, societal expectations and familial attitudes toward language learning contribute to shaping learners' motivations, with parental encouragement often playing a pivotal role in sustaining motivation among younger learners.

2.4.3 Methodological approaches in Iranian L2 motivation studies

Studies on L2 motivation in Iran employ diverse methodological approaches, including surveys, interviews, and qualitative analyses. Surveys are frequently used

to quantify motivational factors and their relative importance among learners, while qualitative approaches delve deeper into learners' perceptions, attitudes, and experiences regarding language learning motivation. Mixed-methods approaches are also common, providing comprehensive insights into the complex interplay of motivational factors in different educational contexts across Iran.

Understanding the nuanced motivations of Iranian learners has profound implications for language teaching practices. Educators can leverage learners' instrumental motivations by integrating real-world tasks and career-oriented language skills into curricula, thereby enhancing learners' engagement and motivation. Similarly, promoting integrative motivation through culturally relevant materials and activities fosters a deeper appreciation for language and culture among learners. Addressing the challenges associated with L2 learning motivation in Iran, such as motivational fluctuations and learner demotivation, requires a multifaceted approach. Educators and policymakers can implement motivational strategies tailored to learners' diverse needs and aspirations, thereby creating supportive learning environments conducive to sustained language learning success.

2.5 Conclusion

Studying L2 motivation in the context of language education in Iran holds several practical implications that can significantly enhance language teaching and learning strategies. These implications revolve around understanding and effectively leveraging motivational factors to optimize educational outcomes. Here are some practical implications:

Tailoring curriculum and materials: Understanding the motivational factors influencing Iranian learners allows educators to tailor language curricula and materials accordingly. For instance, emphasizing practical, career-oriented language skills can resonate strongly with learners driven by instrumental motivation. Integrating culturally relevant content and activities can enhance integrative motivation, fostering deeper engagement and connection with the language.

Motivational strategies: Educators can employ various motivational strategies based on empirical findings. Techniques such as goal-setting, feedback mechanisms, and creating a supportive learning environment that acknowledges cultural values can enhance learners' motivation and persistence in language learning.

Teacher training and professional development: Insights from L2 motivation studies can inform teacher training programs in Iran. Educators can be equipped with strategies to recognize and respond to individual motivational profiles among students. Professional development workshops can focus on fostering motivational climates in classrooms and implementing effective motivational techniques.

Policy and curriculum development: Policymakers can use research on L2 motivation to inform language education policies and curriculum development initiatives. This includes revising language education policies to align with learners' motivational needs and preferences, and ensuring that educational goals are relevant and achievable.

Fostering a positive learning environment: Establishing a supportive learning atmosphere is essential for maintaining motivation among students. Educators can promote a classroom culture that celebrates language learning achievements, respects diverse motivations, and encourages peer support and collaboration.

Addressing demotivation: Understanding the factors that contribute to learner demotivation, such as overly challenging tasks or lack of perceived progress, allows

educators to proactively address these issues. By identifying and mitigating sources of demotivation, educators can help maintain learners' enthusiasm and commitment to language learning. Enhancing Cross-cultural Understanding: L2 motivation studies in Iran also highlight the role of language learning in promoting cross-cultural understanding. Educators can design activities that encourage learners to explore and appreciate different cultures through language, thereby enhancing both linguistic and intercultural competence.

Monitoring and evaluation: Continuous monitoring and evaluation of motivational factors can guide ongoing improvements in language education practices. Regular feedback from learners can yield important insights into the effectiveness of motivational strategies and identify areas for improvement. In conclusion, investigating L2 motivation within the framework of language education in Iran provides valuable insights that can guide curriculum development, teaching methods, teacher training, policy formulation, and the establishment of supportive learning environments. By acknowledging and addressing learners' motivational needs, educators can foster more engaged, motivated, and successful language learners in Iran.

Future research in L2 motivation studies can explore several promising avenues to deepen our understanding and improve practical applications in language education. Here are some suggestions for future research: Conducting longitudinal studies can provide insights into how L2 motivation evolves among Iranian learners. Tracking motivational changes from beginner to advanced proficiency levels and across different educational stages (e.g., primary school, secondary school, university) can reveal critical periods and factors influencing motivation trajectories. Furthermore, integrating quantitative and qualitative methods can offer a comprehensive understanding of L2 motivation. Quantitative surveys can quantify motivational factors, while qualitative interviews and observations can provide rich insights into learners' experiences, attitudes, and perceptions regarding language learning motivation in Iran. Moreover, Comparative studies can investigate how motivational factors differ across languages (e.g., English, French, German) and educational contexts within Iran. Comparisons between urban and rural areas, public and private educational institutions, and different age groups can uncover nuanced variations in motivational patterns and their implications for language education. Also, exploring the influence of specific contextual factors, such as educational policies, curriculum frameworks, societal attitudes toward languages, and the role of media and technology, can deepen our understanding of how external factors shape L2 motivation among Iranian learners.

Conducting experimental studies to test the effectiveness of motivational interventions in enhancing L2 motivation is crucial. Research can explore the impact of various strategies (e.g., goal-setting, feedback mechanisms, cultural integration activities) on motivation levels and language learning outcomes among Iranian learners. Investigating teachers' perspectives on L2 motivation can provide valuable insights into how educators perceive and address motivational challenges in the classroom. Understanding teachers' beliefs, practices, and strategies for motivating learners can inform professional development programs and improve classroom practices. L2 motivation from cross-cultural and international perspectives can enrich our understanding of universal and culturally specific motivational factors. Comparative studies with learners from different cultural backgrounds can highlight commonalities and differences in motivational profiles and shed light on effective strategies for promoting motivation across diverse contexts. Considering neuroscientific approaches and utilizing neuroscientific methods (e.g., brain imaging techniques) to investigate the neural correlates of L2 motivation can provide physiological

insights into motivational processes. Understanding how motivation is neurologically instantiated can offer novel perspectives on enhancing motivation in language learning. Furthermore, investigating factors contributing to demotivation and resilience in language learning can help educators develop targeted interventions to prevent demotivation and support learners in overcoming motivational setbacks. In addition, collaborative research projects involving educators, policymakers, and researchers can bridge the gap between theory and practice. Applied research initiatives can test motivational theories in real-world educational settings and facilitate the translation of research findings into effective pedagogical strategies.

In conclusion, L2 motivation studies in Iran reveal a complex interplay of instrumental and integrative motivations influenced by cultural, societal, and educational factors. By synthesizing the key findings of these studies, this article underscores the importance of understanding learners' motivations for effective language teaching and curriculum development in Iran. Moving forward, continued research and innovative pedagogical approaches can further enhance our understanding and application of L2 motivation theories in the Iranian educational context, ultimately fostering more successful language learners and proficient language users. By exploring the mentioned research avenues, L2 motivation studies can advance theoretical understanding, inform evidence-based practices in language education, and ultimately enhance language learning outcomes among Iranian learners and beyond.

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Chapter 4

Motivation for Learning Geosciences: The Teaching-Learning Process – Analysis, Evaluations, and Proposals

Susanna Occhipinti

Abstract

The fragility in teaching and learning geosciences worldwide is well known, despite clear data show how geological issues are present in many countries and even though geosciences are deeply implicated in the UN's 2030 SDG, including environmental issues, global warming, and economic aspects like georesources or critical raw materials. This study delves into the complexities of teaching and learning of Earth Sciences, recognizing its historical and intrinsic challenges and intricate interconnections among geoscience sectors. The result is a fragmented discipline, lacking a cohesive epistemological identity, even in curricula, hindering the metacognitive approach essential for constructing reasoned knowledge. Curricula often rely on information transmission, impeding the development of skills and competencies crucial for understanding geosciences, which present unique challenges, due to phenomena not easily replicable through conventional methods. A substantial modification of methodological approaches and a radical curriculum revision are needed to promote the understanding of processes and complexities of global dynamics, to replace the current fragmentation of notions, often reduced to a checklist of names. Promoting connections between geology, history, and society; identifying tools to motivate and excite students; and fostering collaborations between schools and universities are priorities to build bridges toward a new vision of a science for the Earth.

Keywords: Earth Sciences, epistemology, curriculum, top-down, educational approaches

1. Introduction

Learning is an innate tendency in a developing organism.

Curiosity, especially among younger students, about the natural world around them, and the endless "whys" they ask their parents and teachers, indicate a desire to know, to explore, and to learn.

However, the spontaneous curiosity that drives the learning process in the early years of school is too soon replaced by the obligation to follow a structured curriculum. Learning shifts from asking "whys," and their answers, to absorbing formal, organized content, within traditional teaching-learning models. Consequently, the natural desire to explore and discover inevitably loses its spontaneity, leading to the need to motivate students in their learning. The natural sciences, which study the world around us, life and nature, its regular laws and unexpected exceptions, as well as marvelous phenomena, and dramatic events that never cease to amaze should inherently inspire curiosity and motivation to learn due to the richness of stimuli they provide. Unfortunately, this is not often the case; many studies and surveys have shown that curiosity and the desire to discover, and therefore to learn, quickly diminish, particularly in the field of geosciences.

A recent study by Budak and Ceyhan [1] found that students' engagement and interest in Earth Sciences declined significantly as they progressed through school, emphasizing the need for more interactive and inquiry-based approaches. Similarly, Lyon et al. [2] highlighted that traditional teaching methods often fail to capture students' intrinsic motivation, particularly in subjects perceived as challenging or less relatable. Moreover, research by Huguet et al. [3] suggests that fostering curiosity in students requires a deliberate shift in pedagogical strategies, integrating hands-on experiences and real-world applications to re-engage them with scientific inquiry. Such findings underline the importance of not only maintaining curiosity but actively cultivating it to enhance learning outcomes in the natural sciences, particularly geosciences.

If dinosaurs and volcanoes are a source of curiosity, iconic objects and extraordinary phenomena that stimulate the desire to discover and learn, the motivation if fueled by spontaneous and innate curiosity. However, when the school system begins to introduce more complex phenomena, such as the Earth's internal structure and the internal and related processes, volcanoes lose their allure and rocks, with their genesis and structure, revert to being seen as mere stones, lacking in interest and certainly not inspiring passion.

This disengagement is observed in many countries and particularly affects the topic of natural hazards, despite data clearly showing how widespread environmental and geological issues are globally. This occurs even though geosciences are deeply involved in several Sustainable Development Goals (SDGs) [4] established by the international community as part of the UN 2030 Agenda for Sustainable Development. Geosciences are essential to understand environmental issues, including risk factors such as global warming or extreme weather events, as well as economic aspects such as georesources for the energy transition or the search for critical raw materials.

The teaching and learning process of geosciences is characterized, almost everywhere in the world, by a substantial weakness that requires a careful analysis of its causes. This chapter explores the motivation behind learning geosciences, including a comparative evaluation with other disciplines to understand these critical issues. It analyzes the teaching-learning process, evaluates current strategies, and is an attempt to present some proposals for improvements to enhance student engagement and understanding.

Furthermore, aspects related to the support of these considerations can be provided by the self-determination theory (SDT), which emphasizes the importance of autonomy, competence, and relatedness to foster intrinsic motivation. In the context of geoscience education, applying SDT can encourage students to take control of their learning process by developing a sense of autonomy. For instance, as will be discussed later, giving students the opportunity to explore real-world environmental challenges, such as climate change or resource depletion, through self-directed projects allows

them to not only develop a deeper interest in the subject but also feel responsible for contributing to global solutions. Therefore, integrating SDT into geoscience teaching strategies can help counteract the current disengagement, nurturing intrinsic motivation and a personal connection to the subject matter.

Similarly, the transformative learning theory (TLT), which focuses on encouraging critical reflection, will be considered crucial for transformative learning experiences. In geosciences, this could involve guiding students through critical discussions about the socio-political implications of environmental issues, such as how different regions are disproportionately affected by natural hazards or how energy transitions impact economies. Engaging students in reflective dialogs, TLT fosters a deeper understanding of the complexity of geoscientific topics and their broader social relevance. Encouraging critical reflection allows students not only to acquire knowledge but also to challenge their pre-existing assumptions and values, leading to a more enduring transformative learning experience.

Above all, it has sought to investigate whether using appropriate communicative modalities, methodological approaches, and content selection has led to more meaningful learning processes, distinct from those achieved through traditional approaches.

2. Analysis

This study sought to analyze the complexities surrounding the teaching and learning of Earth Sciences, acknowledging its historical and intrinsic challenges. These challenges stem from a combination of factors, including misconceptions about the discipline, common both in schools and in society, and perceptions that view Earth Sciences as an arid and less-applicable discipline. Additionally, there are curricular challenges in comparison with other scientific disciplines, which involve important educational and social issues.

In many countries, despite being affected by dramatic natural phenomena such as volcanic eruptions, earthquakes, landslides, floods; by an increasingly extensive exploitation of the soil, with the consequent impoverishment of resources; by the rise in temperatures, which leads to severe droughts; by increasingly extensive soil exploitation; by rising temperatures leading to severe droughts; and by exceptional meteorological events causing hydrogeological instability, there is a lack of widespread knowledge about the geological and hydrogeological characteristics and dynamics essential for risk prevention and reduction [5, 6]. Despite this, Earth Sciences continue to occupy a marginal space within many ministerial school curricula worldwide, a space that is shrinking rather than expanding. To comply with ministerial mandates, teachers often present only minimal content, offering a partial and disconnected image of the discipline, detached from the context of cause-and-effect relationships, cycles, and flows. For students, rocks, minerals, volcanoes, and earthquakes often represent the founding nodes of Earth Sciences, sometimes the only topics presented, which are developed in a highly structured, hierarchical sequence, neglecting the richness and complexity of the discipline.

It is crucial to research the causes behind the undervaluation of Earth Sciences in education and their lack of appeal to students and teachers. The issue is not merely one of blaming schools, teachers, or their teaching methods but recognizing systemic challenges such as inadequate teacher preparation and time constraints [7].

Geosciences are a field with critical and fundamental implications for understanding our planet and addressing major global challenges such as climate change,

natural disasters, and resource management. However, in analyzing the teaching and learning the process of geosciences, difficulties emerge, in both knowledge transmission by teachers and acquisition by students due to the discipline's interdisciplinary nature and its often complex and abstract concepts. Earth Sciences are characterized by intricate interconnections between research areas, ranging from petrography, mineralogy, geophysics, and structural geology to intertwining with other scientific disciplines. This interaction, which could represent a strength if properly leveraged, often translates into a fragmented discipline, lacking a cohesive epistemological identity. This fragmentation makes Earth Sciences inherently fragile compared to other disciplines, not only in the development of school curricula but also in the selection of university courses and, ultimately, in professional choices. This extends to curriculum development, hindering the metacognitive approach essential for the construction of reasoned knowledge. Too often, teaching devolves in a sequential transmission of information, which does not foster the development of skills and competencies crucial for the understanding of Earth Sciences [8].

Clearly, communication tools should move beyond traditional, often overused transmission methods, experiment with more effective learning processes, adopt meaningful laboratory practices consistent with the nature of this science, and perhaps even seek out elements that inspire passion and orientation toward these study paths.

Identifying not only approaches but also topics that foster interest and motivation can be decisive in promoting study paths that lead to coherent professional opportunities. In the race to choose university courses among scientific disciplines, in fact, Earth Sciences are often overtaken not only by the "hard" sciences but also by biology, which increasingly leans toward "high-tech" specialties potentially seen as ingredients of an elixir of life. By experimenting with these different approaches, we can also analyze and, when possible, interpret how the student learning process occurs.

3. The learning process in Earth Sciences

The learning process in Earth Sciences involves complex cognitive processes that students must internalize and adapt, customizing them in relation to their own learning style, to achieve knowledge and understanding of the necessary concepts. According to their unique learning styles to effectively grasp and understand essential concepts, it is crucial to employ appropriate strategies, whether personal or formalized, to organize and prioritize these concepts and details. However, the construction of knowledge—and consequently, the learning process and teaching strategies—demands careful attention. Integrating insights from psychology and neuroscience can significantly enhance our understanding of how motivational factors, such as autonomy and competence, impact learning outcomes. For instance, research by Deci and Ryan [9] on self-determination theory demonstrates that when students feel a sense of autonomy in their learning, it activates areas of the brain associated with intrinsic motivation and reward, leading to deeper engagement and retention of information. Additionally, Bandura's [10] work on self-efficacy highlights that a sense of competence, which arises from successfully tackling challenging tasks, can boost students' belief in their abilities and encourage them to take on more complex problems. By applying these psychological principles to Earth Sciences education, educators can create an environment that not only fosters motivation but also enhances cognitive processing, ultimately leading to more meaningful and lasting learning experiences.

The structure of knowledge acquisition typically follows a predetermined path, influenced by external factors such as curricula, textbooks, teaching methods, and communication styles. Teaching processes are often more effective when they employ a spiral approach, revisiting content recursively to deepen understanding and build a network of phenomena that reflect the complexity of knowledge. In this way, understanding complex phenomena happens gradually, much like building knowledge brick by brick or learning to read and write letter by letter [11].

However, the scientific curriculum, often dictated by ministerial guidelines and textbook structures, can risk becoming a mere catalog of isolated ideas. Although it starts with basic concepts, it may lack coherence and relevance. Ministerial programs followed by corresponding textbooks typically ensure that students first build a foundation with minerals and rocks, then move on to larger-scale phenomena such as volcanoes and earthquakes, and finally explore global dynamics with plate tectonics. While this sequence appears logic, it often risks fragmentation for several reasons.

First, Earth Sciences cannot be viewed in isolation; they are deeply interconnected with other scientific disciplines: for example, students cannot fully comprehend the topic of minerals without a basic knowledge of chemistry. Similarly, analyzing atmospheric properties requires knowledge of the gas laws formulated by Boyle, Charles, Gay-Lussac, and Avogadro, while understanding the rheological properties of the asthenosphere necessitates familiarity with principles proposed by Young and Hooke.

Furthermore, analyzing the different variables of a complex system separately risks dismantling the system itself, as a system exists and functions through the interaction of its parts. As a result, the classical scientific method, which breaks down phenomena into independent modules, is not always applicable in Earth Sciences.

Moreover, alternative approaches, which do not rely on formalized teaching strategies, or different sequences, may not guarantee specific levels of learning but can foster metacognitive skills. These skills empower students to take control of their learning, stimulate interest and curiosity, and by contextualizing knowledge and events, make learning more tangible and relevant to their lives.

Additionally, learning pathways can be constructed where scientific discoveries and historical events are intertwined, influencing each other. In this context, students can explore how natural disasters, like volcanoes, earthquakes, and meteorites, impact and have directly shaped human history, directly influencing the history of humanity, offering unexpected connections and cause-and-effect relationships that stimulate curiosity and cross-disciplinary skills.

However, it's important to consider potential drawbacks or conditions under which these strategies might be less effective. For instance, while alternative approaches that eschew formalized teaching methods can stimulate interest and curiosity, they may also lead to a lack of structure that some students require to thrive. Without clear guidance, certain learners might struggle to navigate complex systems or make meaningful connections between scientific discoveries and historical events. Additionally, if not carefully designed, these strategies could inadvertently reinforce misconceptions, as students might prioritize narrative or contextual elements over rigorous scientific understanding. Moreover, the emphasis on intertwining scientific discoveries with historical events, while enriching, may risk overwhelming students with information. If students are not adequately prepared to synthesize and analyze these connections, they could become confused or disengaged.

A balanced perspective would include a careful consideration of the conditions that might hinder the success of these approaches, ensuring that all students receive the support they need to fully benefit from an integrated learning experience.

4. Evaluations: Earth Sciences and other scientific disciplines taught

The use of different methodological approaches, educational pathways, and intra- and interdisciplinary connections allows for the evaluation of teaching effectiveness in terms of both the quality and the quantity of student learning, especially when compared to more traditional methods.

Although research in this area is ongoing, some experiences suggest that it is possible to introduce topics and methodologies that not only engage students but also make it easier for them to understand concepts that might otherwise seem abstract or less relevant.

Unfortunately, this does not necessarily lead students to pursue university studies in geosciences. Their priorities often lie in identifying topics and methodologies that not only interest them but also lead to career paths with more coherent professional opportunities and higher salaries.

In the "competition" among scientific disciplines, Earth Sciences are being overtaken not only by the "hard sciences" but also by biology, which is increasingly oriented toward new branches of the discipline and seen as promising avenues for "fountain of youth" discoveries.

In many educational systems, the same teacher is responsible for teaching both biology and Earth Sciences, usually based on ministerial curricula designed to ensure a balanced relationship between the two disciplines. These subjects are closely intertwined in many topics, such as the connection between soil and biosystems, the relationship between biological and geological evolution, and the impact of climate change on the environment. However, in many contexts, biology appears more prevalent and attractive and seems to offer clearer and more lucrative career paths [12]. Biological sciences, particularly fields like biotechnology, biochemistry, and medical research, have direct implications for human health and well-being.

Medical advancements, treatments for diseases, and biotechnological innovations often capture public attention and student interest. Biological risks, especially infectious diseases, represent an invisible and pervasive threat that affects anyone, anywhere, making them highly personal and relevant over a prolonged period, fostering a collective sense of vulnerability. The inability to predict exposure to such risks heightens anxiety and a sense of helplessness [13].

The greater impact of biological risks on public sentiment compared to geological risks can be attributed to their sustained visibility, personal relevance, psychological threat, and media coverage. For instance, the COVID-19 pandemic had a more profound impact on public sentiment than even dramatic geological events like eruptions or earthquakes. Even when the latter caused comparable or higher fatalities. The common perception is that biological risks have a more significant impact on public sentiment because geological events, while sudden and destructive, are visible, and their impacts are more immediately understandable and tangible.

Moreover, catastrophic geological events, while devastating, tend to fade from public attention once the immediate crisis has passed and recovery begins. Geophysical events typically affect specific regions rather than the entire global population and receive intense media coverage only during and immediately after the event. As time passes, they disappear from the headlines. The NIMBY (Not In My Backyard) principle applies particularly effectively to such phenomena, where interest wanes when one's own backyard is not affected.

Even in other fields, such as climate change, the role of biology in developing sustainable practices, such as biofuels and conservation efforts, often receives more

emphasis because it has a direct and tangible impact on human health, agriculture, and environmental conservation [14]. The immediate benefits of biological research, such as new medical treatments and sustainable agricultural practices, are clear and valued by society. The biotechnology sector and the pharmaceutical industry also receive substantial investments in biological research for drug development, driving rapid advancements and high-profile successes.

While geosciences have evolved into specialized and interdisciplinary subfields, the advancements and applications in biology are often more well known. Biologists and organizations associated with biological sciences are often more adept in science communication, making complex topics understandable and engaging for the public [15].

The benefits of geoscientific research, such as improved natural disaster prediction, sustainable resource management, and understanding climate change, are often indirect and long term. However, this comparison highlights the need for a different approach, as the disciplines are different, as are student perceptions and the very nature of the science. Therefore, it is essential to clarify and deepen the understanding of the nature of science, enabling us to navigate the intricacies of the Earth's system and interpret its complexities.

5. The nature of the Earth Sciences: A need for a strong epistemology

Changing common perceptions, modifying school curricula, influencing political decisions, and shaping media narratives are challenges beyond our immediate control. However, as teachers, professors, and communicators, we can implement essential solutions to shift this widespread perception. This involves a deep exploration of the Nature of Science and its epistemology [16].

By carefully analyzing the characteristics of Earth Sciences—focusing on the nature of knowledge, its validity, foundations, and the processes through which it is acquired and justified—we can identify more effective educational paths. These paths should aim to impart meaning and significance to knowledge acquisition through investigative and exploratory methodologies. Although, Earth Sciences are relatively young as a formal discipline, their roots can be traced back to the foundational work of pioneers like Steno, Hutton, Lyell, and Argan in the eighteenth and nineteenth centuries. These early scientists laid the groundwork for modern geology by reconstructing Earth's geological history [17].

At the dawn of the twentieth century, the concept of Earth as a complex system shaped by the interactions of its various components started to take form. However, a unifying theory that integrated the different branches into a cohesive whole had yet to emerge.

At the dawn of the twentieth century, the concept of Earth as a complex system shaped by the interactions of its various components began to take form. Throughout the twentieth century, numerous scientists focused on their individual fields, working on models with a reductionist approach rather than embracing the interconnected knowledge and complexity needed for a comprehensive theory of the discipline.

It took nearly 70 years for the theory of plate tectonics to emerge. While it provided a unified explanation for many of Earth's major phenomena, it did not fully unify the fragmented field of Earth Sciences. The discipline remains divided into various branches, each dealing with different environments—land, air, water, space, soil, subsoil—yet all closely interconnected. This fragmentation is both a weakness and a strength of Earth Sciences [18].

Earth Sciences are characterized by an exceptional scope in both space and time, promoting competencies, skills, and knowledge of great significance: the perception of deep space, ranging from Earth's core to the Solar System's boundaries and beyond, and the understanding of deep time, from the Solar System's formation to the present and into the future.

In this complex context, where intricate relationships, flows, and connections abound, every aspect of Earth's system is interconnected. Each geological event, natural phenomenon, or even a simple rock fragment is crucial to understanding the system's structure and history. However, it is equally important to unify these disparate elements into a coherent framework, recognizing that the relationships between them form a complex system. Each relationship must be studied, analyzed, and understood in terms of its structure, history, and transformations. These relationships must be integrated into a unified vision, for they collectively constitute a complex system, even if some connections are difficult to understand due to their irregularity and lack of repetition.

The combination of random processes, nonlinear interactions, unity, and complexity is the fundamental element of the epistemology of Earth Sciences. As in all scientific disciplines, a strong epistemology is necessary to address the core principles of the discipline, the conditions that allow the construction of scientific knowledge, and the methods used to achieve this knowledge.

Understanding the nature, purpose, foundations, and research methods of Earth Sciences enables us to comprehend how knowledge is acquired, assess its validity, and derives meaning from observation and experimentation.

6. Proposals

In many international contexts, the teaching of Earth Sciences remains an unfulfilled obligation.

Although it is present in many national curricula, as per data collected in a recent survey, many teachers acknowledge that the discipline is not taught. Typically, only basic notions—such as minerals, rocks, and occasionally volcanoes and earthquakes—are covered, particularly volcanic phenomena, due to their exceptionality and the extraordinary scenic effects they produce.

While these topics represent essential foundational knowledge, they do not convey the complexity of geological phenomena or the cause-effect relationships linking these phenomena with their geological and geographical contexts, global dynamics, and plate tectonics.

As a result, students often lose sight of the overall picture, recognizing only the consequences of geological phenomena, without understanding their underlying causes, which affect the student and imprint in the memory only *if and when* the phenomenon affects directly or indirectly in some way. This differs from the perception of biological phenomena, which are often more immediately relevant to students.

Therefore, the methodological approaches used, the teaching tools available, and even the sequence of contents presented must be analyzed and reevaluated, to make Earth Sciences a focal point for understanding cross-disciplinary and multidisciplinary concepts and phenomena—often unpredictably interconnected and to make the subject both accessible and engaging, as it too often is not.

This shift in teaching methods is particularly relevant in our current era, where catastrophic events occur frequently and dramatically. Although these events are part

of the cyclical normality of geological dynamics, they often lead to extraordinary tragedies.

Using these events as learning tools is particularly effective in demonstrating that Earth Sciences is an exciting and dynamic field. It helps students understand fundamental concepts of cause-effect relationships and complexity, much like how Thomas Kuhn described plate tectonics in his work [19]. He characterized plate tectonics as a revolutionary theory that required a complete rethinking of major geological themes, from tectonics and orogeny to biogeography.

6.1 Using models and hands-on approaches

To achieve objective, verifiable knowledge and meaningful learning, experimental sciences rely on the experimental scientific method, which involves data collection, hypothesis formulation, and rigorous mathematical analysis. This method is considered essential for science, as many thinkers argue that if it cannot be applied to a context, it is not science, and the theory remains unverifiable. However, applying this method to most Earth Sciences phenomena presents significant challenges.

Geological phenomena such as landslides, avalanches, earthquakes, eruptions, or orogenesis cannot be reproduced under identical conditions to yield the same results, nor can they be fully replicated in a laboratory setting. Even when rocks are recreated in a lab, the results are similar but not identical to those found in nature. As a result, mathematical models and virtual simulations of events like landslides or earthquakes become necessary and often effective tools, though they have limitations due to the unpredictable variables introduced by reality.

In experimental sciences, meaningful learning is facilitated through laboratory teaching, which prioritizes direct experience over the mere transmission of theoretical knowledge. "Laboratory" here refers not just to physical spaces and equipment but to methodologies involving reasoning, exploration, experimentation, error, and reworking [20].

Models play a crucial role in many scientific disciplines, including Earth Sciences, where they help understand aspects of the Earth that are too small, too large, or otherwise inaccessible for direct observation. By using strategic simplifications, models assist in grasping complex systems. Common models in Earth Sciences include representations of geologic structures, volcanoes, faults, the water cycle, the Earth's interior, and plate margins. However, while models facilitate understanding, there is a risk of trivializing or oversimplifying systems and problems [21–23].

Earth Sciences offer numerous opportunities for exploration through models or simulations. Examples include studying seismic waves with springs, illustrating plate margin evolution with simple converging or diverging panels, visualizing convection currents with chocolate pudding, and simulating debris deposition with pipe sections. To prevent oversimplification and ensure effectiveness, models should encourage operational and investigative approaches. They should be analyzed as a whole and integrated appropriately into the complex system.

Models should stimulate observation, hypothesis formulation, reasoning, and the development of general rules, while incorporating various variables and maintaining certain constants. Despite their simplicity, these tools have proven to be effective in promoting understanding of global dynamics and natural phenomena. Although they do not always facilitate practical experimentation and investigative methodologies, they succeed in intriguing students of different educational levels and promote specific skills through the manipulation of materials.

Progressing to more complex models, possibly with software support, and contextualizing them within personal, school, regional, or national contexts enhance their effectiveness in understanding phenomena [24, 25].

6.2 Changing the sequence

Motivating students to engage with the geosciences and raising awareness of geo-environmental issues—both within education and broader society in Italy and in many nations around the world—requires careful consideration of curriculum development.

The sequence in which topics are introduced can significantly influence students' understanding and interest. Given the nature of the discipline, as discussed earlier, the traditional teaching approach should be reconsidered to enhance both the teaching path and the resulting learning outcomes.

The sequence commonly used in many curricula can often be illogical. For example, students may be asked to study and identify metamorphic rocks—a complex task even for specialists—before they understand the context of global tectonics. Similarly, the study of volcanoes might address their structure and activity while leaving the discussion of causes and chemistry to the end of the curriculum.

Typically, a bottom-up approach is employed starting with fundamental concepts like minerals and rocks before progressing to more complex phenomena such as volcanoes, earthquakes, and eventually plate tectonics.

Of course, by starting with simpler concepts, students can gradually build their knowledge, making it easier to grasp more complex ideas as they progress. Students develop a solid understanding of basic geological materials and processes: initial topics, such as minerals and rocks, are tangible and can be explored through hands-on activities, such as rock identification and mineral analysis, making learning more interactive and engaging. Furthermore, this basic knowledge is fundamental to understanding more complex geological phenomena, and the gradual increase in complexity helps manage the cognitive load, allowing students to build knowledge step by step.

However, the initial focus on basic concepts may seem dry or less exciting to some students, potentially leading to a lack of interest before they reach more stimulating topics like volcanoes and earthquakes. Moreover, without a general understanding of plate tectonics, students might struggle to see how these foundational topics fit into the broader picture of Earth's dynamic systems.

It might be helpful to reverse the traditional sequence, from the particular to the general. An alternative might be a top-down approach, starting with the complexity of global dynamics to provide a general picture and then delving into specific phenomena, materials, and concepts. By reorganizing the structure of Earth Science teaching and focusing on a more integrated, engaging, and student-centered approach, it is possible to improve understanding and make learning more meaningful and effective.

By presenting the big picture first, students can appreciate the relevance and interconnectedness of subsequent topics. Starting with plate tectonics—a dynamic and global concept—can capture students' interest early on, making subsequent studies of rocks and minerals more meaningful. This approach helps students understand why earthquakes and volcanoes occur, providing a compelling context for further study and making the overall learning experience more focused and connected to real-world phenomena [26].

By understanding the broader context first, students can better appreciate how details such as rocks and minerals fit into broader geological processes, whereas starting with minerals and rocks may be perceived as dry and less exciting, especially for a student already disinterested in systematic learning. For instance, instead of merely classifying metamorphic rocks, students could investigate why metamorphosis occurs, how the structure changes, and where such processes might happen. This inquiry-based approach encourages a deeper understanding of the causes behind geological phenomena rather than just memorizing definitions and classifications.

Ultimately, the aim is to promote a deep and integrated understanding of geosciences that highlights the importance and interest of studying Earth's dynamic systems. A top-down approach can be more flexible and adaptable, allowing the teachers to tailor lessons to students' interests and current events. This responsiveness can help maintain student attention and curiosity. Encouraging students to explore topics of interest to them within the framework of plate tectonics can foster a sense of discovery and excitement. This approach can help mitigate boredom, making learning feel more like an adventure than a chore. Combining elements of both approaches may be the most effective strategy. For example, introducing plate tectonics at the beginning to provide context and revisiting it after covering the core topics can capture students' interest from the start. This hybrid approach can promote engagement and interest in the geosciences, emphasizing their role in addressing global challenges like climate change, natural disaster management, and sustainable resource use.

Of course, expanding the case studies to include examples from online learning platforms could significantly enhance the relevance of teaching strategies in Earth Sciences, especially as digital learning environments allow for the integration of interactive tools such as virtual field trips, real-time data analysis, and simulations of geological processes, making the subject more accessible and engaging for a broader range of students.

6.3 Opening to new approaches by intersecting with other fields of research

In Earth Science teaching, knowledge is often presented as isolated entities, disconnected from the broader theory of plate tectonics. These phenomena are thus presented peripherally, only as effects of plate convergence or divergence, rather than as integral parts of the overall dynamics that explain their existence. This fragmentary perception of Earth Sciences contributes to the feeling that the discipline is composed of disjointed contents, responsible for tragic events in human history but lacking scientific coherence. This limited perspective severely limits the attractiveness, interest, and desire to discover, research, and become passionate about the subject.

Earth Sciences should be viewed as a unified field, interconnected with various scientific and humanistic disciplines, forming a complex system that spans space and time. A broader perspective is needed, one that integrates Earth Sciences with other fields of study. This involves developing connections and effectively managing information, to help students understand the intricate relationships between historical events of the twentieth century and scientific discoveries that contributed to the theory of plate tectonics [27, 28].

For instance, many discoveries that shaped plate tectonics theory would not have emerged without the specific historical contexts in which they were made. Conversely, scientific knowledge and discoveries have profoundly influenced history and various cultural and social spheres.

This new perspective should not replace the fundamental knowledge of geological phenomena, plate tectonics, natural hazards, and the atmosphere, which form the essential basis for understanding cause-effect relationships and complexity.

The entire history of the Earth, from its formation to the present day, is the result of numerous geological events—volcanic eruptions, earthquakes, meteorite impacts, landslides, and faults—that have radically transformed the natural environment, both geological and biological. These transformations range from slow processes, such as orogenesis or the opening of a fault, to rapid events like earthquakes.

Understanding the complexity and uniqueness of the Earth System and global dynamics through cause-effect relationships is crucial. While these concepts are clear to geologists, they are often poorly understood by students due to traditional, transmissive, didactic teaching methods. A reimagined learning path, built through logical steps and historical connections, can reveal how Earth Sciences provide a fundamental understanding of both past and recent historical or cultural events. These events are sometimes predictable and known, sometimes unforeseen. The aim should not surprise with great revelations but explain unexpected connections with the aim to prevent them from becoming mere anecdotes.

This new perspective can make Earth Sciences more fascinating for those who find them boring and unattractive, and more meaningful and fundamental for those who consider them marginal in the broader context of sciences. It is well known that volcanoes, and especially the products of their eruptions, have played a fundamental role in Earth's history. They are responsible not only for fundamental actions in the activation of plate tectonics but also for the contribution of many elements and chemical compounds, such as water vapor and carbon dioxide, which are the cause of the greenhouse effect and thus the habitability of our planet. In addition, volcanoes have contributed nutrients that have made the Earth's crust fertile. They have been the cause of mass extinctions and climate change and may even have played a role in the formation of the first organic molecules. However, eruptions throughout geological and historical eras have had different consequences, some predictable and some unpredictable. The countless relationships between the eruption of Tambora in early April 1815, now widely recognized even in school textbooks, clearly illustrate how the effects of such a significant geological event influenced history, as perhaps did the battle of Waterloo and the defeat of Napoleon, culture, and literature (e.g., the birth of Gothic literature with works like "Frankenstein" and "Dracula"), art (e.g., Turner's red sunsets), and society (e.g., mass migrations due to the agricultural crisis caused by low temperatures). Countless other examples demonstrate the profound connections between geological events and ethical, social, and even biological factors [29].

6.4 Promoting new research fields

New fields of research are rapidly emerging and evolving in both biology and the Earth Sciences. The traditional image of the geologist as a field surveyor—engaging in cartography, sample collection, and stratigraphic surveying—symbolizes the early days of the geosciences. While this remains an essential aspect of the discipline, requiring fieldwork and direct observations, geosciences are increasingly transforming into a high-tech field [30].

Emerging disciplines and advancements in technology are improving precision, efficiency, and analytical capabilities.

For example, Geoinformatics and Geographic Information Systems (GIS) are fundamental tools for analyzing and visualizing geospatial data and modeling the

subsurface in 3D. Remote sensing and Earth observation employ drones and lidars to map and monitor the Earth's surface, tracking environmental changes like deforestation and melting glaciers. Advanced geophysics and seismology use high-resolution seismic imaging to study the Earth's internal structure and provide real-time monitoring for earthquake prediction [31].

Other rapidly developing fields include geochemistry and subsurface microbiology, which examine chemical interactions between minerals and fluids in the subsurface and search for microbes in extreme environments. Geothermal energy and renewable resources focus on exploring and developing geothermal energy and studying its environmental interactions. Numerical modeling and simulation utilizes supercomputers to simulate geological processes and model fluid flows in reservoirs and aquifers [32, 33].

Geomechanics and geotechnical engineering study slope stability, as well as the prevention of geological hazards, using advanced sensors to monitor rock and soil deformation and sophisticated applications to simulate phenomena by varying the parameters of the factors involved. Palaeoclimatology and climate reconstruction analyze marine sediments and glaciers to reconstruct past climates and study stable isotopes to understand climate change. Geoarchaeology and ancient landscape research studies use geophysical and geochemical techniques to discover archeological sites and study the evolution of the landscape in relation to ancient human activities.

Even traditional fields like mineralogy are evolving, with research focused on discovering new minerals and materials for technological applications, including critical materials for advanced technologies like batteries and magnets. Forensic geology applies geological principles to legal and criminal matters by analyzing soil, mineral, and rock samples to determine origins and connections using petrography, mineralogy, and sedimentology [34, 35].

A particularly interesting but under-recognized field is geoethics, which studies and practices ethical principles in the geosciences, addressing the moral and social implications of geoscientific research. Geoethics emphasizes sustainable practices and the welfare of future generations, promoting public awareness and ensuring that geoscientific knowledge benefits society and protects the Earth [36, 37].

Knowledge and development of these disciplinary branches also in school curricula, presented through appropriate teaching and learning processes, can substantially change students' perception of geology or geosciences.

They would no longer view fields merely as the study of "stones and disasters," but rather as Earth and Environmental Sciences, intriguing and vital for understanding and responsibly managing our planet resources This shift underscores the importance of sustainable land use and conservation for future generations.

7. Conclusion

Curiosity is a natural characteristic of many students and can be a powerful driver of learning. However, solely relying on natural curiosity is not sufficient, as it can wane over time, especially when students encounter difficult or abstract concepts. Curiosity, which is most prominent among younger students, often leads to the exploration of concepts in a non-linear way. While this approach fosters discovery, it may not effectively support the acquisition of structured concepts, relationships, and processes, especially in formal education settings. This is particularly important in the sciences, where understanding fundamental concepts is crucial for application and future learning.

7.1 The importance of motivation in learning

When curiosity alone is no longer sufficient, additional strategies are needed to sustain motivation. These strategies help maintain students' interest and effort, encouraging them to engage with challenging materials. For example, connecting scientific concepts to real-world applications and aligning them with students' personal interests can be effective. Science requires sustained effort to grasp complex concepts and complete experiments, rather than simply memorizing facts. While younger students benefit from play and exploration, older students require relevance and autonomy in their learning. Therefore, motivational strategies should focus on the relevance to future aspirations, opportunities for independent research, and solving real-world problems. In the field of geosciences, these strategies can be particularly powerful.

7.2 Challenges in geosciences

Geosciences play a crucial role in understanding Earth processes and addressing global challenges such as climate change, natural disasters, and resource management. However, engaging students in geosciences can be challenging due to the subject's complexity and interdisciplinary nature. Traditional lecture-based approaches are still prevalent in geoscience education, which can hinder student engagement and understanding. Innovative teaching methods, such as inquiry-based learning, problem-based learning (PBL), and the use of technology, can enhance learning and motivation. However, the integration of interdisciplinary concepts and connections with real-world applications need further improvement.

To address these challenges, a radical curriculum overhaul is needed, along with proper teacher training and essential collaboration between the school system and academia. Curriculum design must emphasize the relevance of geosciences in addressing global challenges. Promoting active learning approaches, such as inquiry-based learning and PBL, can significantly increase student engagement. The use of digital tools and resources, such as virtual labs, interactive simulations, and algorithms for the classification of rocks, minerals, or sedimentary processes, can make geosciences more accessible and engaging. However, these tools must be used actively and interactively, rather than merely as substitutes for traditional learning processes. Just as using Google as a navigator can make us passive executors without a clear understanding of the context, observing and interacting with digital tools in geosciences allows students to place phenomena or processes in their proper context, whether real or virtual.

Future research could then focus on the effectiveness of various innovative teaching methods, such as inquiry-based learning and PBL, in improving student engagement and comprehension in geosciences. This could involve employing mixed-method approaches, combining quantitative measures (e.g., assessments of student understanding) with qualitative feedback (e.g., student interviews) to gain a comprehensive understanding of how these methods influence learning outcomes. The use of digital tools, virtual labs, and interactive simulations, such as field trips, could impact students' understanding of complex geoscientific concepts; researchers could assess the impact of these tools on student motivation and engagement compared to traditional teaching methods, utilizing control groups to draw clearer conclusions about their effectiveness. It will be essential to investigate how teacher professional development is crucial for equipping educators with the skills to implement motivational strategies effectively. Research could focus on the correlation between teacher training in innovative pedagogical methods and student outcomes, providing evidence for the necessity

of such programs. Additionally, studies could explore how connecting geoscience content to real-world applications affects student motivation and learning. Longitudinal studies could monitor student interest levels and engagement in geosciences before and after implementing curricula that emphasize the relevance of geosciences in addressing global challenges such as climate change or natural disasters. Finally, interdisciplinary approaches to geoscience education could examine the benefits of integrating geosciences with other disciplines, such as economics or social sciences, to provide a more holistic understanding of Earth processes and their implications.

Motivation remains, then, a critical factor for the success of geoscience learning. By analyzing current teaching-learning processes, evaluating existing methodologies, and proposing targeted strategies, educators can improve student engagement and learning outcomes in geosciences. Implementing these proposals requires a collaborative effort among teachers, academia, institutions, and policymakers to create an educational environment that fosters curiosity, critical thinking, and a passion for understanding Earth and its processes.

Acknowledgements

The author acknowledges the use of CHAT GCP for language polishing of the manuscript.

Conflict of interest

The author declares no conflict of interest.

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Chapter 5

Motivating Teachers in Active Methodologies Using Design Thinking: Learning Analytics

Adela García-Aracil and Rosa Isusi-Fagoaga

Abstract

Motivation is essential in human behavior and central to studying personal conduct. In educational contexts, motivation improves the teaching-learning process by encouraging teachers and students to achieve favorable impacts and positive results, hence reducing dropouts related to the Sustainable Development Goals for improving Quality Education. The issue of implementing active methodologies, which focus on placing students at the center of the learning process and making them the primary agents of discovery, is often seen as a substitute for traditional lectures. However, active learning methods complement and enhance conventional teaching approaches. Despite evidence showing that active learning improves students' comprehension and information retention, adoption of these methodologies remains limited. While this issue affects various levels of education, it is particularly significant in higher education. Often, degree programs rely heavily on theoretical content, creating a disconnect between theory and practice. This can result in poor performance and low success rates. In this chapter, through learning analytics, we explore how to motivate higher education teachers to apply active teaching-learning methods. Design thinking was the tool used to understand the teaching-learning process as it strongly emphasizes creativity, collaboration, and practical problem-solving, which align with the challenges and opportunities educators face in contemporary learning environments.

Keywords: active methodologies, teachers' motivation, quality education, design thinking, learning analytics

1. Introduction

Motivation drives individuals' actions and behaviors toward achieving goals in work and other life settings [1]. Efforts to enhance academic performance are unlikely to succeed without addressing teachers' motivation. When individuals are intrinsically (i.e., derived from within the person or from the activity itself) and extrinsically (i.e., derived from rewards, material possessions, prestige, or positive evaluations) motivated, they are more likely to deliver services efficiently and effectively to both their institutions and their stakeholders [2]. It is widely recognized that teachers'

instructional effectiveness is crucial to students' learning and academic success [3]. In this sense, motivated teachers look to improve their teaching methods, focusing on quality and productivity. In their pursuit of excellence, they employ diverse teaching strategies that meet student needs, ensuring that the learning objective outlined in the lesson is achieved effectively, making pedagogical methodology a crucial topic [4].

One of the major concerns in education is choosing the most effective teaching method to engage students. While lecture-based learning remains the most common approach for delivering theoretical content, other pedagogical strategies that promote more active involvement, such as problem-based, project-oriented, and case-based learning, can also be beneficial [5]. Additionally, educational technology plays a significant role in motivating both teachers and students by fostering engagement and supporting personalized learning experiences [3]. Platforms like Moodle or Blackboard enable students to access resources anytime and collaborate with peers, increasing their sense of autonomy and self-efficacy [5]. Online courses and virtual communities further inspire teachers to expand their skills and collaborate with global peers, enriching the teaching-learning process and motivating them to achieve greater effectiveness and satisfaction in their roles [2]. Furthermore, these methods can be integrated with collaborative learning, enhancing the educational experience [6].

One educational method that enhances collaborative learning is the design thinking approach [7]. The concept of design thinking was first introduced by Simon [8] as a way of thinking applied to complex problems, focusing on decision-making and problem-solving. Industrial design, architecture, and engineering further shaped design thinking. As this approach evolved, human-centered design emerged as a core principle, emphasizing empathy for users and deep insights into their needs. This development phase shifted the focus from designers as problem-solvers to involving end users in the creative process, ensuring that solutions were tailored to real-world needs [7]. In the late 1990s and early 2000s, design thinking was applied in areas beyond product design, particularly in business and education, to foster creativity and teamwork across disciplines [9]. Furthermore, results from the literature review on design thinking show that this approach is mainly associated with competency setting in terms of multidisciplinary collaboration, creativity, problem-solving, and empathy, particularly in higher education [1, 6–7, 10, 11]. However, some studies indicate a lack of systematic evaluation of design thinking outcomes and precise, performance-based metrics to assess its impact [12, 13].

In this chapter, we assessed part of the impact of a design thinking approach, analyzing how its implementation can increase teachers' interest in applying design thinking as a tool to increase students' engagement and teachers' competencies associated with this pedagogical approach. We study the Spanish context in the implementation of active teaching-learning approaches because it has not received the attention it deserves compared to other EU higher education institutions, as most Spanish teachers are accustomed to traditional, lecture-based methods of instruction and feel that this approach is time-consuming to implement [5, 11]. For that purpose, we implement a design thinking exercise with teachers from a public university in Spain, particularly the University of Valencia (UV). The teaching-learning approach was organized into five sessions, lasting 2 hours each, during the second quarter of the academic year 2023/2024. It helped us identify the challenges Spanish universities have overcome to increase the use of active teaching-learning methods. After this introduction, we describe the Spanish higher education regulation for teachers in Section 2; next, we describe the methodology in Section 3; results are reported in Section 4, and conclusions and policy recommendations are shown in Section 5.

2. Spanish higher education regulation for teachers

National laws, university regulations, and specific institutional policies primarily govern the regulation of higher education teachers in Spain. The Spanish Higher Education System comprises 50 public and 34 private universities. In the 1980s, Spain underwent a significant legal reform with the approval of the University Reform Act (*Ley de Reforma Universitaria*, LRU) to democratize the internal structure of universities and move from direct state intervention to institutional autonomy to enhance higher education quality. However, it was not until the Organic Law of Universities (*Ley Orgánica de Universidades*, LOU), initially formulated in 2001 and modified in 2007 and 2021 (the later introducing additional changes to improve the quality of education) (*Ley Orgánica para la Mejora de la Calidad Educativa*, LOMLOU), that the recruitment, roles, and promotion of teaching staff were regulated [14].

There are several professional categories for the academic staff. These positions are distinguished by tenure status, rank, and contractual terms as follows: (i) Full Professors, the highest academic rank tenured position, held by those with extensive teaching and research experience; (ii) Associate Professors, tenured faculty members who conduct research and teach at undergraduate and postgraduate levels. They used to apply for promotion to full professor once they meet the necessary qualifications controlled by the National Agency for Quality Assessment and Accreditation of Spain (*Agencia Nacional de Evaluación de la Calidad y Acreditación*, ANECA); (iii) Permanent Professors, similar to tenured professors, but under slightly different contractual conditions as they also need to pass a national accreditation process; (iv) Assistant Professors, junior academic staff with temporary contracts, often in the early stages of their academic careers; (v) Adjunct Professors, part-time lecturers, often professionals from outside academia, who bring practical experience to the classroom. Therefore, the recruitment process for public university teaching staff is highly regulated and includes accreditation by ANECA, which evaluates primarily research outputs, teaching experience, and recent knowledge transfer activities [15]. After obtaining ANECA accreditation, candidates must participate in a competitive selection process organized by universities and evaluated by a panel of experts. Furthermore, Spanish higher education teachers are subject to periodic evaluations to ensure the quality of their teaching and research. However, research productivity, impact factors of publications, and citations are rather relevant than teaching effectiveness, which influences teaching methods [5, 14].

National labor laws and collective agreements regulate the work conditions of public higher education teachers. For instance, professors who get tenured positions enjoy considerable job security as their positions are protected by law. Tenured faculty members can only be dismissed under specific circumstances, such as serious misconduct or inadequate performance [16]. The national government and regional authorities also standardize salaries for public university professors. Pay scales depend on rank, tenure status, and the region in which the university is located. Faculty can also receive bonuses based on research productivity and service to the institution [14]. However, teaching hours are defined by contract, with most full-time professors expected to teach around 240 hours per year. Research activities are often conducted outside these teaching hours, and the balance between teaching and research varies by position and university [17, 18].

In this framework, teachers in Spanish public universities are subject to a structured accreditation, career development, and evaluation system, with a strong focus on research productivity and, recently, knowledge transfer instead of teaching

efficiency. Although institutions promote academic excellence, research pressures to get accreditation standards, primarily through ANECA, influence that faculty members may be less inclined to engage in innovative teaching practices, undermine teachers' creativity, and diminish teaching productivity. Therefore, analysis of the academic environment and teachers' concerns may enhance the university's capacity to address the quadruple demands of teaching, research, knowledge transfer, and administrative responsibilities. In this study, one way to explore part of teachers' concerns is through the implementation of the design thinking approach, which focuses on understanding teachers' needs and generating creative solutions, as shown below.

3. Methodology

In 2022, the Spanish Higher Education System, primarily composed of universities, includes 84 universities, with 50 being public and 34 private [19]. Nine of these universities were established in the sixteenth century. Unlike many other countries, the nineteenth century and the Industrial Revolution did not see the emergence of new institutions. However, significant expansion began in the 1970s as the system transitioned from serving an elite to providing mass higher education [14]. We focus our study on the University of Valencia (UV—Universitat de València) as it was set up in 1500. It is one of the oldest Spanish public universities offering courses in traditional and technical disciplines, including around 40,000 students, 4700 lecturers, 1600 researchers, and 2200 administrators [20]. UV defines itself as a public service responsible for providing students with the teaching needed for their education, their preparation for professional practice or artistic activities, and their relevant academic qualifications. Moreover, it is concerned with updating the knowledge, skills, and values of its staff, lecturers, and researchers at all levels of education. It encourages both basic and applied research, scientific and technological development, and spreads culture within society [5].

For our analysis, we chose a cross-sectional study and based our approach on [5] study, ensuring both data validity and reliability. The fieldwork involved 47 teachers hired at the UV during the academic year 2023/2024. The sample was composed of 59% women and 41% men. The average age of the teachers who participated in this study was 45. The teaching-learning approach was organized during the second quarter of the academic year 2023/2024. It was organized into five sessions, lasting 2 hours each. We employed the design thinking method to allow the collection of both quantitative and qualitative information [21]. The selection of the sample was not probabilistic. The teachers signed up for the study on their initiative through the UV Permanent Training and Educational Innovation Service. We got a representation of the following teachers' knowledge area: 35.29% associated with Social Sciences (excluding Education), 17.65% associated with Education, 29.41% associated with Health, and 17.65% associated with Natural Sciences. There was no representation of teachers from the humanities and engineering fields.

By implementing design thinking in a teacher training program, we tried to analyze the level of engaging teachers' professional development by focusing on empathy, creativity, and iterative problem-solving. First, we conducted an online survey based on the literature review [5, 10, 21] to identify teachers' background (e.g., gender and professional category) and experiences implementing active teaching-learning methodologies (e.g., flipped classroom, gamification, project-based learning, service-learning, and design thinking, among others) (around 30 minutes). Participants

were informed that data collection was part of the study, and their responses were voluntary and anonymous. Then, we organized a focus group [10, 11] with teachers to better understand their day-to-day experiences and the dynamics of their teaching methods, with the following discussion questions: What is your typical day like a teacher? What are the biggest challenges you face in the classroom? What strategies do you use to keep students engaged? What teaching methods do you find most effective? (around 60 minutes). After that empathize activities, some areas for classroom management were identified as core challenges (around 30 minutes). Among them, the most important was the concern about keeping students engaged during lectures using mobile devices or laptops as a powerful tool for learning rather than a source of distraction. Then, a brainstorming session was organized to explore different ideas and approaches for addressing the identified challenge (around 30 minutes), followed by a short prioritization of ideas, considering novelty, innovation focus, and viability (around 60 minutes). The following session was associated with the LEGO bricks prototyping activity, which allowed us to visualize ideas quickly and explore different solutions tangibly. Teachers were divided into small groups of four, encouraging collaboration and allowing participants to share ideas and resources (around 30 minutes). Each group had the opportunity to present their LEGO prototype to the class. They explained their design process, challenges, and how their prototype addressed the problem. Discussion was facilitated, where participants gave constructive feedback on each other's prototypes (around 120 minutes). Participants could modify, rebuild, or even start over if necessary (around 30 minutes). Prototypes were assessed based on creativity, problem-solving, and how well they addressed the challenge. Self-assessment and peer assessment were part of the process. Later, participants were asked to reflect on what they learned from the prototyping process and how it helped them understand the challenge matter better (around 30 minutes). Moreover, the participants were asked to link the prototyping activity to their lecturers' learning objectives and extend the use of design thinking as a teaching-learning approach (around 30 minutes). Voluntary participants presented their enriched lecturers, shifting from a content-based curriculum to a problem-based one. The discussion was facilitated, highlighting what worked well, what could be improved, barriers and solutions, and how the connection to the curriculum could be further developed (around 120 minutes). Finally, participants were requested to fill out an online survey. A battery of closed questions was drawn up to check the degree of knowledge they gained after the teaching-training approach (around 30 minutes) [5, 10, 21]. Both questionnaires, the former and the latter, were distributed via Google Forms, a platform chosen for this accessibility and ease of use. Once the data collection phase was completed, the dataset was exported into a compatible Excel format and later imported into STATA software. STATA was employed to perform descriptive statistics and accurate analysis to ensure the validity and reliability of the study's findings.

In the following section, we present the most significant results gathered from direct observations, the narratives, and participants' opinions according to the surveys.

4. Results

Participants were asked about their knowledge of the design thinking approach. Only 29% knew the design thinking approach but never implemented it in their lecturers. The rest, 71%, pointed out their unfamiliarity with that approach, although

they used other active methodologies such as collaborative work (31%), gamification (22%), flipped classroom (12%), and project-based learning (6%).

For those who implemented active methodologies in their lecturers, most of them were associate professors (including permanent professors) (29.82%) and adjunct professors (24.85%). However, full p rofessors (8.52%) and assistant professors (7.81%) do not frequently use active teaching methods in the classroom. One possible explanation for this result might be generational differences in teaching approaches [22]. On the one hand, the literature indicates that associate professors adopt more innovative and student-centered teaching methods than their senior counterparts. However, Full Professors, who often have more years of teaching experience, maybe more accustomed to traditional, lecture-based approaches might be predominant at the start of their teaching careers [4]. Another possible explanation could be linked to the criteria for promotion and tenure. In this sense, associate professors seeking promotion to full professor may feel more pressure to demonstrate innovation in their teaching practices. However, full professors who have already secured promotion might focus more on research productivity or administrative duties, reducing their motivation to modernize their teaching methods [5, 23]. On the other hand, adjunct professors often prioritize teaching over research or service duties, as their positions are centered around collaborative projects, interactive discussions, and technology-enhanced learning, less bound by rigid curricular requirements or research commitments compared to tenure-track assistant professors. In contrast, assistant professors are particularly those who have recently completed their doctoral studies, may have less professional experience outside academics, and may initially focus on traditional lecture-based methods they encountered during their education. Moreover, the latter, who are on a tenure track, often prioritize research outputs (e.g., publishing research and citations) over teaching innovation [24–26].

Regarding gender differences in teaching practices, we observe that females implement more active teaching-learning approaches (41.76%) than their male counterparts (29.24%). Some literature provides insights into gender differences in pedagogical strategies, remarking that female teachers are more likely to adopt student-centered approaches, which are closely aligned with active learning, encouraging interaction, discussion, and collaborative learning [6, 27]. However, male teachers might be more hesitant to use active learning methods if they perceive them as time-consuming or less efficient for content-heavy courses. This perception can lead to a preference for more direct instruction or traditional lecture-based teaching [28].

As design thinking is a problem-solving approach that centers on understanding the needs of users and encouraging innovation by combining empathy, ideation, and experimentation, we asked the participants the extent to which they had some competencies related to identifying, addressing, and resolving problems. The aim was to assess the participants' development of these competencies after implementing the design thinking based on the teaching-learning approach. A pre-test and post-test methodology were employed, using a Likert scale ranging from 1 (not at all) to 5 (very much). The competencies assessed included: (i) the ability to genuinely understand and respect others' perspectives and emotions (empathy); (ii) the ability to identify problems (problem identification); (iii) the tendency to generate or recognize ideas, alternatives or possibilities that may be useful in solving problems (creativity); (iv) the process of designing or developing solutions to a problem (prototyping); (v) the willingness to explore different options to find solutions, even when they may not be immediately satisfactory (embracing experimentation/learning from failure); and

(vi) the ability to work with other disciplines toward a shared goal (multidisciplinary collaboration). **Table 1** shows the participants' level of competencies before and after the design thinking approach by gender and field of study.

On average, **Table 1** shows that the participants' level of competencies increased for all the items addressed during the implementation of the design thinking approach. All the differences between the pre-test and the post-test are statistically significant. The higher gain was in the ability to collaborate with a multidisciplinary team (from 3.88 to 4.58 points), followed by prototyping (from 4.00 to 4.35 points), embracing experimentation and problem identification (see last column of **Table 1**). Regarding differences between males and females, we observe that before the implementation of the design thinking approach, the level of competencies is similar between females and males; however, after the implementation of the design thinking activities, male participants show higher gains in the level of competencies compared to their female counterparts, overall in terms of empathy and creativity. Focusing on specific socio-emotional competencies used in this study, trends in the literature suggest that women score lower than men on self-reported measures of positive self-concept and higher on measures of empathy and interpersonal relatedness [29].

Items	Males	Females	Social Sciences	Education	Health	Natural Sciences	TOTAL*
Empathy							
Pre-test	3.71	4.10	4.33	4.00	4.00	3.00	3.94
Post-test	4.14	3.90	3.33	3.00	4.80	5.00	4.00
Problem Identification							
Pre-test	3.71	3.80	4.00	4.00	3.59	3.33	3.76
Post-test	4.14	4.00	3.33	3.67	4.59	5.00	4.06
Creativity							
Pre-test	3.71	3.50	3.83	3.67	3.40	3.33	3.58
Post-test	4.14	3.40	2.83	3.00	4.40	5.00	3.71
Prototyping							
Pre-test	3.86	4.09	4.00	4.33	3.80	4.00	4.00
Post-test	4.28	4.40	3.67	4.33	4.90	5.00	4.35
Embracing Experimentation							
Pre-test	3.71	4.00	3.50	4.33	4.00	4.00	3.88
Post-test	4.28	4.09	3.67	3.33	4.80	5.00	4.18
Multidisciplinary Collaboration							
Pre-test	3.86	3.90	3.83	4.00	3.80	4.00	3.88
Post-test	4.57	4.60	4.33	4.66	4.59	5.00	4.58

**All differences between pre-test and post-test are statistically significant at $p \leq 0.10$.*
Source: Authors, based on COMETA data.

Table 1.
Participants' level of competencies related to the design thinking based on the teaching-learning approach.

Here, contrary to expectations, women scored higher in prototyping, and we found gender differences mixed in embracing experimentation [30].

Concerning the field of study, **Table 1** shows that the competency associated with multidisciplinary collaboration significantly improved from pre-test to post-test in all knowledge areas. However, after implementing the design thinking approach, the rest of the competencies show an improvement in the knowledge areas associated with Health and Natural Sciences and a decrease in Social Sciences and Education. These results confirm that the design thinking approach fosters multidisciplinary collaboration by encouraging diverse teams to work together to solve complex problems [31].

Moreover, it was asked to the participants to what extent the implementation of the design thinking approach had increased their interest, on a Likert scale from 1 (not at all) to 5 (very much), in using that approach in their day-to-day lectures. Most participants (70.59%) stated their interest in the design thinking approach had increased. However, only 47.06% would apply during their lectures. Additionally, 82.36% of the participants enjoyed the LEGO bricks as a tool for prototyping the innovative solution; however, only 11.76% would use LEGO during their lectures. During the discussion sessions, the participants argued that they experience levels of stress and job dissatisfaction due to the overwhelming workload, balancing teaching, research demands (e.g., publishing regularly in international journals and looking for external research funds), knowledge transfer (e.g., patenting and arranging quadruple helix partnerships), and administrative duties. Consequently, teachers are less disposed to engage in innovative teaching practices, pursue interdisciplinary collaborations, or even contribute to institutional services initiatives. This result was also found by Isusi-Fagoaga and García-Aracil [5], where teachers explained the difficulties in implementing other active teaching-learning and evaluation methodologies (see also [21]).

5. Conclusion

This chapter examines how to motivate higher education teachers in their teaching practices through the use of active teaching-learning methods, in particular, by implementing an approach such as design thinking. We focused on a public university in Spain, particularly teachers from the University of Valencia (UV). Learning analytics, which involved the collection, analysis, and data reporting of learners and their contexts, were used to understand and optimize learning and the environments in which it occurred. Although most of our participants had experience in the implementation of active teaching methods, few of them knew about the design thinking approach. We choose this active teaching-learning methodology, which follows a twofold part: a mindset and a dynamic non-linear process.

The design thinking approach was organized into five sessions, lasting 2 hours each. As a creative process, design thinking follows a human-centered, action-oriented, prototype-driven, and non-judgmental mindset. Thus, it espouses positivity, eliminates the fear of failure, and maximizes input and participation. Our participants, higher education teachers, experienced all five design thinking stages: Empathize, Define, Ideate, Prototype, and Test. During the process, the teachers were asked about key difficulties they had addressed during their daily lectures. One of the critical difficulties was keeping students engaged during lectures. The design thinking approach was laid out based on this problem. One advantage of the present study was the robust design, which incorporated a clear operational definition of design

thinking and reliable and validated measures to assess its effect on problem-solving, creativity, and participants' motivation in the learning process.

According to the data collected, the design thinking intervention positively impacted teachers' empathy, problem identification, creativity, prototyping, embracing experimentation, and multidisciplinary collaboration. Moreover, using LEGO as a prototyping tool created a dynamic, hands-on learning environment that fostered creativity, collaboration, critical thinking, and communication, improving teachers' motivation in the learning process. However, the scope of this study did not allow us to determine at what specific design thinking stage the strongest development of teachers' motivation in the learning process did occur. Based on the techniques and teachers' discussions (our students) adopted, we might conclude that collaborating with a multidisciplinary team (i.e., members from different fields) brought unique viewpoints, encouraging innovative solutions and more comprehensive approaches to complex problems. By learning from colleagues in other fields, teachers gain fresh perspectives and innovative tools to apply in their classrooms. This revitalizes the teaching experience, making it more dynamic and inspiring both teachers and students. Therefore, the opportunity to experiment with new ideas could enhance teachers' job satisfaction and motivation [32].

Furthermore, the discussions and reflections of our study conclude that from a methodological perspective, the application of design thinking as a course design strategy does not require fundamental changes in the way courses are currently designed but offers additional tools and approaches that have been shown to improve the process significantly [33]. It enhances experiential learning, bridging the gap between academic knowledge and practical impact. Moreover, this approach enables course designers to develop an in-depth understanding of the subject and how the students will interact with the topic. It should be noted that teachers demand training in methodological approaches such as the one they received in their university training service. These training programs can support teacher's personal training to get involved and take charge of their professional practices and can be replicated at other educational levels. By equipping educators with innovative tools, strategies, and mindsets, the programs enhance their ability to engage students effectively and adapt to dynamic classroom environments. Then, teachers can proactively address challenges, design creative solutions, and lead innovations within their classrooms and institutions.

Public policies should support continuous teacher training in innovative pedagogies, including collaborative learning, ensuring educators can effectively implement these methods. This may involve investment in modernizing classrooms with technology that enables interaction (e.g., smartboards, Moodle), flexible learning spaces, and promoting collaborative networks and partnerships with other educational institutions, industries, NGOs, or other government bodies. Moreover, institutions should reconsider promotion and tenure criteria to acknowledge and reward faculty members' contributions to teaching, research, and service equitably. Balancing the emphasis on research productivity with the recognition of teaching excellence is essential for promoting faculty engagement and job satisfaction, fostering teachers' motivation and retention in the profession. Furthermore, public policies should consider integrating active teaching-learning methods into national curricula, which could encourage teachers to move away from traditional, lecture-based instruction toward more engaging participatory approaches.

In conclusion, the findings of this study suggest that active methodologies centered on collaborative learning present a viable alternative to the traditional lecture

format overall when the subject matter is primarily theoretical. However, our study has certain limitations. We especially concentrated on a public university in Spain, and the number of participants in our sample was not randomly representative regarding the knowledge area at the university. Further research could be done by examining additional higher education institutions and analyzing if there are differences between public and private universities and between generalist and specific-knowledge areas of universities.

Acknowledgements

This research has received support from the Emerging Education Innovation Project of the University of Valencia (SFPIE_PIEE: Proyectos de Innovación Educativa Emergente—Universitat de València). The project, titled "COmpetències amb METodologies Actives en la formació del professorat: Design Thinking i Podcast (COMETA)" is supported by grant number UV-SFPIE_PIEE-3328191. It is important to note that the opinions and conclusions presented in this chapter are those of the authors and do not necessarily reflect the views of the funding organization.

Conflict of interest

The authors declare no conflict of interest.

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Chapter 6

Multidimensional Academic Anxiety: Examining Domain-Specific Differences and Motivational Impacts

Qian Li and Rosalie Palaroan

Abstract

Academic anxiety significantly influences students' academic achievement and motivation in learning. As a domain-specific emotional experience, academic anxiety differs significantly across various academic domains due to the specific cognitive challenges and academic expectations imposed by each discipline. The current study adopted a systematic literature review approach to synthesize recent empirical findings focused on students' academic anxiety across various domains and to provide insights into how academic anxiety varies by subject and how it influences motivation. Drawing on control-value theory, the systematic literature review synthesized findings from 71 empirical studies. The analysis revealed that academic anxiety is a multidimensional experience that includes both emotional reactions and cognitive appraisals. Higher levels of academic anxiety were consistently associated with lower levels of motivation across all domains. However, strategies to reduce anxiety and improve motivation should be tailored to the unique characteristics and demands of each academic domain. This review highlights the complex relationship between academic anxiety and motivation, demonstrating how specific motivational factors, such as competence belief, intrinsic value, and utility value, can affect anxiety levels. Practical strategies are proposed for educators to support student motivation and mitigate anxiety in the classroom.

Keywords: academic anxiety, math anxiety, second language anxiety, student motivation, control-value theory

1. Introduction

1.1 Research background

Academic anxiety, characterized by feelings of tension, apprehension, and fear that students experience within learning tasks, plays a crucial role in shaping

students' motivation, engagement, and school-related outcomes [1]. Previous research has revealed a range of negative consequences associated with high levels of academic anxiety, including diminished academic performance, low self-esteem, disengagement from learning tasks, self-handicapping behaviors, and avoidance of certain majors and career paths [2]. Academic anxiety remains a prevalent issue in K-12 education and has been extensively studied across various disciplines with the aim of understanding the antecedent factors and developing effective strategies or interventions to reduce anxiety and support students' learning [3, 4].

Control-value theory, a comprehensive framework for understanding the role of academic emotions, offers a cohesive perspective on the relationship between academic anxiety and student motivation [5]. According to this theory, two key factors shape academic emotions, including academic anxiety: students' perceived control over learning outcomes (i.e., beliefs in their own competence to succeed in learning tasks) and their value beliefs related to academic tasks (i.e., the importance they place on these tasks, including both intrinsic value like enjoyment and extrinsic value like usefulness) [6]. Students with strong competence beliefs and a high perception of control are likely to experience lower levels of anxiety during the learning process. Additionally, students who view learning tasks as significant and valuable tend to exert greater effort, engage more deeply, and thereby influence their emotional experiences in learning. This interplay between anxiety and motivation is crucial for understanding how academic anxiety can either hinder or enhance student performance, depending on the context.

Though there is a general consensus that supporting students' motivation, specifically through enhancing their control and value appraisals, can help mitigate their academic anxiety, it remains unclear whether the strategies or approaches vary across different academic domains. Academic anxiety represents a domain-specific emotional experience that varies significantly across various academic domains due to the specific cognitive challenges and academic expectations imposed by each discipline [7]. For example, mathematics anxiety is frequently associated with abstract reasoning and problem-solving, which can be particularly challenging for students. Science anxiety may stem from the fear of failure in experimental tasks, while language anxiety frequently involves concerns about communication and linguistic competence [8–10]. Understanding these domain-specific anxieties is crucial because they influence how students engage with the material and enable educators to better identify the sources of anxiety and develop targeted strategies and tailored interventions to address them effectively.

1.2 Research objectives

Given the limited direct empirical evidence on the domain specificity of academic anxiety and the variation in its relationship with motivation across different disciplines, the current study adopted a systematic literature review approach to synthesize recent empirical findings from previous research focused on students' academic anxiety across various domains. By doing so, the study aims to provide insights into how academic anxiety differs by subject and how it affects motivation, ultimately informing the development of more effective strategies to support student learning.

Furthermore, this study focuses on four key academic domains: mathematics, first language learning (L1), second language learning (L2), and science, as these domains are considered the foundational disciplines of K-12 education globally. These subjects are prioritized in national curricula across different countries, such as the Common Core Standards in the United States, the National Curriculum in the United Kingdom,

the Finnish National Core Curriculum, Singapore's Primary and Secondary Education Curriculum, and Chinese National Curriculum, due to their fundamental role in developing essential cognitive skills and preparing students for future academic and career success [11–14]. Moreover, the emphasis on STEM (Science, Technology, Engineering, and Mathematics) education, coupled with the growing importance of language proficiency in an increasingly globalized economy, places additional pressure on students to excel in these areas. This heightened emphasis often leads to increased stress and academic anxiety [8–10].

While subjects such as art, music, and physical education contribute significantly to students' holistic development, they are not typically regarded as "core" academic subjects within K-12 curricula in most educational systems and therefore often feature more flexible assessment criteria. Consequently, the pressure to perform in these noncore areas tend to be lower, contributing to different educational experiences for students compared to the more academically intense core subjects.

1.3 Significance and innovation of the current study

The current study addresses a significant gap in the existing literature concerning the domain specificity of academic anxiety and its impact on motivation across various academic disciplines. Previous research has typically focused on academic anxiety within a single domain, leaving the cross-domain variability largely unexplored. Through a comparative analysis of the literature, this study seeks to provide a clearer understanding of whether the conceptualization of academic anxiety differs across different subject areas. This, in turn, enables a deeper analysis of the factors contributing to these variations, such as whether they stem from the nature of the content knowledge, the cognitive demands required, or the distinct skill sets involved in each domain.

In addition, the study examines the core subjects that are not only prioritized in the national curricula of multiple countries but also play a crucial role in students' access to higher education and career advancement. Due to the heightened external stress in excelling in these domains, students tend to experience higher levels of anxiety. Therefore, the study intends to provide educational implications about developing instructional strategies or targeted interventions to reduce academic anxiety, enhance learning motivation, and ultimately improve students' academic performance.

2. Methods

The current study aims to provide a thorough and comparative analysis of the conceptualization of domain-specific academic anxiety and its association with student motivation. Therefore, the study employed a systematic literature review approach, ensuring that the process of searching, screening, and evaluating relevant literature was transparent and replicable, allowing for a comprehensive examination of the existing research [15]. This method enabled a detailed and reliable analysis of existing research findings.

2.1 Literature search and identification

To obtain up-to-date empirical evidence on domain-specific academic anxiety and its relationship with student motivation in K-12 settings, a comprehensive literature

search was conducted using databases encompassing a broad range of academic journals in the field of Education and Psychology. Specifically, the study searched the Education Resources Information Center (ERIC), PsycINFO, and PsycArticles to identify peer-reviewed academic articles published within the past five years (from January 2019 to August 2024). Given that the study primarily focused on two key constructs, the search keywords were carefully selected to reflect these areas: (1) student motivation construct: "motivation" AND (2) academic anxiety construct: "academic anxiety" OR "learning anxiety" OR "math anxiety" OR "language anxiety" OR "reading anxiety" OR "writing anxiety" OR "science anxiety." The initial literature search retrieved a total of 419 articles from the three databases (i.e., 244 articles from ERIC, 168 articles from PsycINFO, and seven articles from PsycArticles). After removing the 41 duplicate studies, 378 articles were screened for eligibility to be included in the literature review. **Figure 1** outlines the process of literature identification and screening.

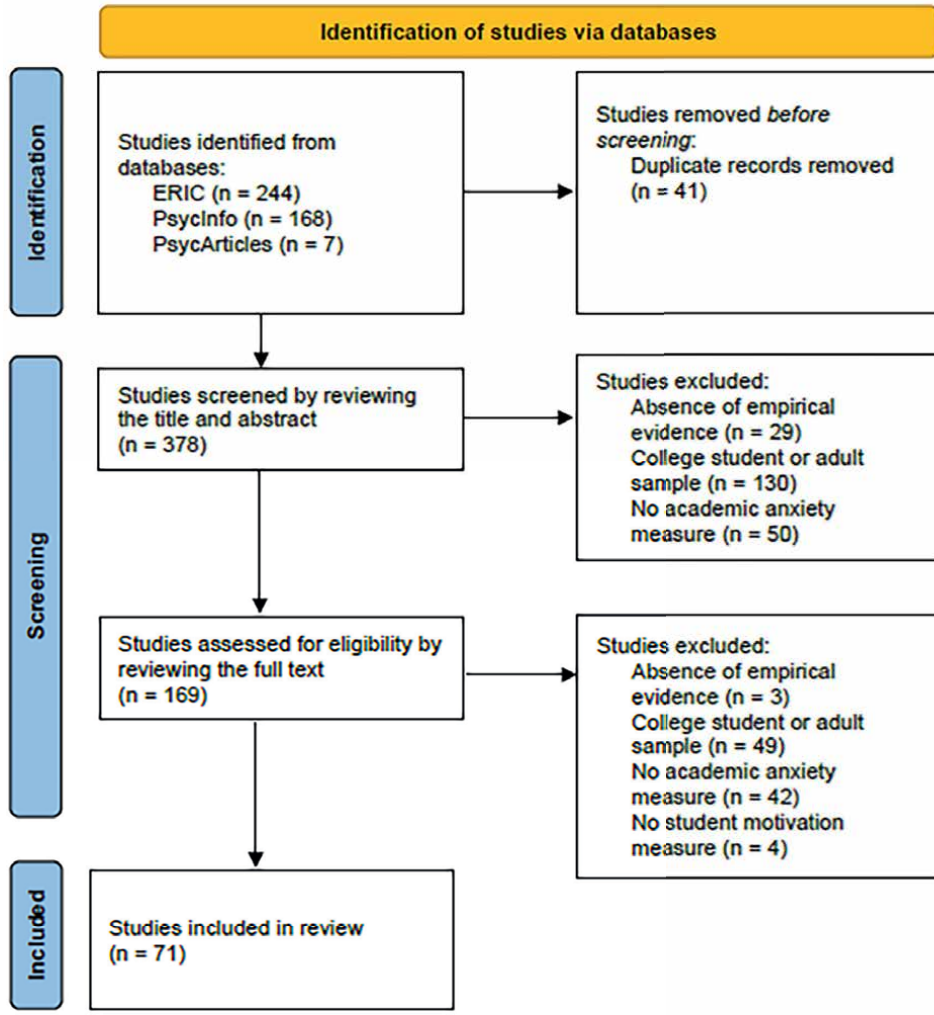

Figure 1.
Literature search and screening process.

2.2 Literature screening and eligibility

The literature screening process was conducted in two rounds. Both rounds of the literature screening followed the inclusion and exclusion criteria indicated in **Table 1**. In the first round of literature screening, the authors screened each article's title and abstract to determine its relevance to the current literature review. As the purpose of the review is to synthesize and analyze the up-to-date empirical evidence on the relationship between domain-specific academic anxiety and motivation in K-12 settings and to draw evidence-based conclusions, studies that do not include any empirical data (e.g., theoretical papers, meta-analysis, literature reviews; n = 29) and do not include K-12 student samples (e.g., college student sample, adult learner sample, n = 130) were excluded. In addition, since the key construct of the study is academic anxiety, it is crucial that all included studies specifically measure academic anxiety. Studies that do not assess academic anxiety (n = 80) are excluded because they do not contribute directly to understanding this key relationship.

In the second round of data screening, the authors conducted a thorough review of the full text of each selected article to assess its suitability for inclusion in the literature review. Four studies were excluded due to the absence of measures of student motivation. In addition, 12 studies were excluded because of the inconsistency between the conceptualization of anxiety constructs in these papers and the major focus of the current review. For instance, some studies assessed participants' state anxiety (i.e., a temporary emotional condition characterized by feelings of nervousness, worry, or tension in response to a specific situation or stimulus), trait anxiety (i.e., a personality characteristic that represents a stable tendency to experience anxiety across various situations), social anxiety (i.e., type of anxiety characterized by an intense fear of being judged, negatively evaluated, or rejected in social or

Criteria no.	Inclusion criteria	Exclusion criteria
1	Published between January, 2019 and August, 2024	Published before January, 2019
2	Full text is available.	Full text is not available after contacting the corresponding author.
3	The study includes empirical evidence.	The study incorporates no empirical research findings, for example, a literature review, a meta-analysis, a policy analysis, or a theoretical or conceptual paper.
4	The study sample includes students from kindergarten through 12th grade.	The study sample does not include students from kindergarten through 12th grade. For example, the study focuses on college students or adult learners.
5	The study includes measures of academic anxiety, and the conceptualization of academic anxiety aligns with the primary focus of the current study.	The study does not include any measures of academic anxiety. Or, its conceptualization of academic anxiety is not consistent with the primary focus of the current study. For example, the study measures participants' state anxiety, trait or dispositional anxiety, or test anxiety.
6	The study includes measures of student motivation.	The study does not include any measures of student motivation.

Table 1.
Inclusion and exclusion criteria.

performance situations) or test anxiety (i.e., a specific form of performance anxiety that occurs in testing or evaluation situations), while the primary focus of this review is to understand anxiety that arises specifically during the learning process—such as anxiety related to engaging with academic material, participating in classroom activities, or mastering domain-specific content. By narrowing the scope to studies that directly address anxiety within the learning process, the review can provide more targeted insights into how this specific type of anxiety interacts with student motivation, ultimately offering more relevant and actionable findings for educational practices and interventions.

2.3 Data extraction and analysis

After two rounds of literature screening, a total of 71 articles were selected for final analysis. To ensure a consistent and comprehensive examination of the included studies, a standardized process was followed to extract relevant information from each study. First, the basic details of each study were documented, including the authors, year of publication, name of the published journal, research design (e.g., correlational study, experimental study), and the characteristics of the sample (e.g., grade level, educational background, country of origin). Next, the authors noted how academic anxiety was conceptualized within each study, focusing on the specific domain of anxiety (i.e., specific domain of anxiety, such as math anxiety, first language anxiety, second language anxiety, and science anxiety) and the methods used to measure it (e.g., self-reported survey, qualitative interview). Following the control-value theory, the authors then extracted details related to the dimensions of motivation measured in each study, particularly focusing on competence belief and value components. In addition, the main findings and conclusions regarding the relationship between domain-specific academic anxiety and student motivation across different educational settings were captured. Finally, the authors documented other contextual and social factors that could potentially influence students' academic anxiety, such as teacher-student relationships and instructional design. These factors were considered essential to comprehensively understand how academic anxiety interacts with the broader learning environment.

The extracted information was then synthesized to identify patterns, trends, and gaps in the research. The current analysis paid particular attention to three key areas: (1) the similarities and differences in the conceptualization and measurement of various domain-specific academic anxiety, (2) the consistency of findings regarding the association between academic anxiety and student motivation, and (3) the influence of educational level and instructional practices on student academic anxiety. The review focused on understanding how domain-specific academic anxiety is associated with student motivation and highlighting areas where further research is necessary.

3. Results

3.1 Domain-specific academic anxiety constructs

Among the 71 selected studies in the final analysis, the majority of research on academic anxiety (n = 34) focused predominantly on math anxiety, indicating its prominence in academic anxiety literature. This extensive focus reflects the crucial role of math subjects in educational systems across different countries

and the widespread recognition of math anxiety as a significant barrier to student achievement [16]. Students with high levels of math anxiety tended to show avoidance behavior toward math-related learning activities, which not only impacted the short-term learning outcomes but also contributed to a broader disengagement from Science, Technology, Engineering, and Mathematics (STEM) education [17]. As a result, around half of the academic anxiety literature centered on mathematics anxiety, highlighting the prevalence and significance of math anxiety.

In addition to math anxiety, five studies examined students' science anxiety, such as physics anxiety, chemistry anxiety, and physics-chemistry anxiety. Science anxiety is often viewed as closely related to math anxiety. Caymaz and Aydin's study [18] on science anxiety specifically addressed the overlap between math anxiety and science anxiety and included math and problem-solving anxiety as one of the dimensions measured within science anxiety. This overlap outlines the common underlying factors, including student-perceived difficulties in numerical reasoning and problem-solving, which are shared in both academic domains. Therefore, mathematical skills are integral to understanding and succeeding in scientific disciplines, making math-related anxiety a significant factor within the broader context of science anxiety.

Another academic anxiety construct that received considerable attention is L2 anxiety (n = 21). Due to the growing emphasis on bilingualism and multilingualism in global education, L2 proficiency has often been required for access to higher education, job opportunities, and international mobility. The pressure to succeed in acquiring a second language could lead to significant anxiety, involving the challenges and negative emotions associated with learning and using a second language [19]. In contrast, fewer studies have investigated L1 anxiety (n = 6) compared to the number of studies on math anxiety and L2 anxiety. One potential reason might be the assumption that students generally feel more comfortable with their native language, making anxiety in this area less prevalent or recognized. However, L1 anxiety remains a crucial area of study, particularly in contexts where students face high academic expectations or specific challenges in literacy or verbal expression.

In addition to the academic anxiety specific to school subjects, the analysis has identified a new form of academic anxiety, which is related to online learning activities. The shift to online learning during the COVID-19 pandemic brought this issue to the forefront. Five studies examined students' online learning anxiety, characterized by worries about their ability to keep up with online coursework, navigate digital platforms, and remain engaged in an online learning environment [20, 21]. As online learning continues to play a significant role in educational settings, further investigation into this form of anxiety is necessary.

3.2 Similarities in the definitions of academic anxiety across domains

When comparing the definition of academic anxiety across various academic domains, two consistent components emerged: an emotional component and a cognitive appraisal component. The emotional aspect centered on the negative emotional reactions, such as fear and nervousness, that students experienced while engaging in learning tasks in specific domains. For example, multiple studies adopted the definition by the Organization for Economic Co-operation and Development (OECD): math anxiety referred to "students' feelings of helplessness and stress when dealing with mathematics" [22, 23]. Similarly, several other studies defined math anxiety as the negative emotional response students experienced when engaging in mathematics-related activities, such as reading a math book, working with numbers,

solving math problems, or taking math exams [24, 25]. Lee's study [26] also defined L2 writing anxiety as the anxiety, fear, and stress students experienced while performing L2 writing tasks.

In addition to the emotional component, previous research highlighted the cognitive appraisal aspect of academic anxiety, which typically refers to worry or concern about upcoming performance or evaluations. For example, in the study of Pollack et al. [24], the researchers identified the worry dimension of math anxiety, referring to students' concerns about their math performance. Regarding language anxiety, the widely cited definition of L2 anxiety by Horwitz et al. [27] encompassed both emotional and cognitive dimensions by conceptualizing foreign language classroom anxiety with three components: communication apprehension (i.e., fear of nervousness when speaking or listening to a foreign language), test anxiety (i.e., fear of failing or performing poorly on tests), and fear of negative evaluation (i.e., worry and concerns about others' negative evaluation of their foreign language proficiency). The inclusion of both emotional and cognitive components in the definitions of academic anxiety underscores the complex and multifaceted nature of this construct across different domains.

3.3 Differences in the definitions of academic anxiety across domains

While there are notable similarities in how academic anxiety is defined across different disciplines, there are also key differences that reflect the unique characteristics of each academic domain. One of the differences lies in how academic anxiety is measured and categorized based on the specificity of learning activities. Mathematics anxiety is typically defined as a broad, overarching experience in response to any math-related learning task without distinguishing between different types of mathematical activities [25]. A common distinction between math-related activities is the difference between learning-related activities and exams or test-related tasks [28]. Science anxiety follows a similar pattern, distinguishing between learning-related and assessment-related dimensions, but often includes a separate dimension of anxiety associated with experimental tasks. For example, Caymaz and Aydin's study [18] identified specific dimensions of science anxiety, including students' fear of the danger associated with scientific experiments and concerns about the high levels of meticulousness required in performing experiments.

When it comes to language anxiety, including both L1 and L2 anxiety, the definitions tend to be even more specific. Research in this area typically categorized anxiety into distinct categories based on different language skills, such as reading, vocabulary acquisition, writing, and speaking. While previous studies revealed a positive correlation among reading, writing, vocabulary, and speaking anxiety, they also emphasized the significance of examining students' achievement, motivation, and anxiety specific to each skill due to the independent language competence and unique cognitive demand required in different tasks [29]. For instance, writing tasks, particularly in a second language, were found to be more cognitively demanding and are therefore perceived by students as more difficult, leading to higher levels of anxiety [26]. Additionally, the interactive and communicative nature of speaking tasks increased arousal levels in the presence of others, often resulting in heightened anxiety [30].

The current analysis identified a key difference in the cognitive components of math anxiety and L2 anxiety. L2 anxiety often incorporated a sociocultural perspective, where understanding cultural differences was an essential aspect of second language learning. Misunderstandings about these cultural differences could lead

to confusion and poor performance, which in turn contributed to L2 anxiety [31]. Additionally, L2 anxiety, particularly in speaking tasks, requires students to employ not only their language proficiency but also their social and communication skills [30]. High competence in L2 speaking tasks demanded a combination of linguistic ability and social interaction skills. In contrast, the cognitive component of math anxiety was primarily concerned with performance and evaluation related to mathematical tasks. The focus was solely on the fear of underperforming in math-related activities rather than on sociocultural or communicative factors.

3.4 Relationship between academic anxiety and motivation

Drawing on the theoretical framework of control-value theory, the authors analyzed the relationship between academic anxiety and student motivation across academic domains. The analysis first identified a consistent pattern: a negative correlation between anxiety and motivation, regardless of whether the domain was math, science, or language learning. Students with higher levels of academic anxiety tended to exhibit lower levels of learning motivation, engage in avoidance behaviors, and show reduced learning engagement, all of which contributed to poorer academic performance.

Next, the findings were categorized into three groups based on control-value theory: control appraisal, intrinsic value appraisal, and extrinsic value appraisal. These categories were then used to compare the effect of different motivational factors. Students' academic anxiety was found to be influenced by their perceptions of control. Students with stronger competence beliefs in math tended to experience lower levels of math anxiety. Similarly, students who were less confident in their language proficiency were more likely to feel nervous and concerned about language learning [24]. Across different domains, the correlation between academic anxiety and control appraisal was typically of moderate strength.

Regarding intrinsic value or interest, students with a high intrinsic interest in the discipline tended to experience lower levels of anxiety across domains. For example, students who were genuinely interested in mathematics or passionate about learning a new language were likely to feel less anxious about related tasks [20]. In contrast, research showed that the relationship between extrinsic motivation (such as utility value) and academic anxiety was more complex. Some studies found that extrinsic motivation is negatively correlated with anxiety [32]. For instance, students who are motivated by external rewards (e.g., passing an exam, or needing math for a future career) might feel more pressure, which could increase anxiety. Ahmetovic et al. [33] also emphasized the importance of analyzing intrinsic and extrinsic values separately. When these components were aggregated into a single construct, the positive impact of intrinsic value could have been counterbalanced by the negative impact of extrinsic motivation, potentially obscuring the true nature of the relationship with anxiety.

3.5 Supporting student motivation to mitigate academic anxiety

Given the overarching goal of enhancing students' learning motivation to reduce their academic anxiety, the authors summarized and compared the specific strategies proposed and implemented across various domains to achieve this objective. The analysis revealed a key distinction in approaches to reduce anxiety by supporting students' control appraisal and found the common strategies aimed to foster intrinsic motivation.

Across all academic domains, one of the primary strategies for reducing academic anxiety was to increase students' interest in the learning content. This approach typically involved interactive and engaging instructional design. In mathematics, Şanal [34] explored incorporating gamification into lessons to make abstract concepts more approachable and enjoyable. In science education, the use of augmented reality (AR) in laboratory experiments or simulations made complex scientific concepts more tangible and interactive, thereby reducing students' anxiety [35]. In language learning, particularly in second language acquisition, improving contextual and interactive elements in lessons, such as immersive language experiences and interactive technology tools, fostered greater interest, which in turn helped reduce anxiety [36].

Although enhancing student interest is a common approach, domain-specific differences emerged when focusing on competence beliefs, which are critical for reducing anxiety. According to social cognitive theory, there were four main sources for strengthening individuals' competence beliefs: mastery experiences (i.e., successful personal experiences), verbal persuasion (i.e., positive feedback or encouragement from others), vicarious experiences (i.e., observing other models' successful experiences), and physiological and emotional states (i.e., how individuals perceive and interpret their emotional and physical responses to tasks) [37]. While the role of verbal persuasion (e.g., encouragement from teachers or peers) was fairly consistent across domains, the other three strategies varied significantly based on the domain.

In math, researchers primarily focused on supporting students' mastery experiences and vicarious experiences to enhance their competence belief. For example, one study suggested improving students' problem-solving and logical reasoning skills through step-by-step mastery of mathematical concepts [32]. Additionally, some studies emphasized the vicarious experiences of parents as models for students, noting that parents' own experiences with math and their anxiety levels could significantly influence their children's math anxiety [38].

In language learning, the focus was often on physiological and emotional states, particularly in the context of second language use, where the high cognitive demand of processing a new language could elevate anxiety. Multiple studies focused on reducing the cognitive load that comes with learning a new language in real-time communication, including using subtitles in instructional videos or providing scaffolding in the form of language aids that simplify the learning process [39]. By reducing the cognitive load and improving the overall emotional experience, students were less likely to feel anxious and more likely to feel competent in their language abilities.

3.6 Educational level of the samples

Among 71 studies included in the final analysis, only 13 studies focused on samples from kindergarten or elementary school, while the remaining 58 studies examined academic anxiety in middle school or high school students. Research on math anxiety, science anxiety, and L2 anxiety all showed a predominant focus on middle and high school samples.

One possible explanation for the lower number of studies focusing on early grade levels was that anxiety levels in younger children tended to be relatively low. For example, Lu et al. [40] suggested that younger students may not yet experience the same intensity of math anxiety as their older peers due to limited exposure to high-stakes academic assessments and the less complex nature of early learning tasks. Studies of science and L2 anxiety reflected a similar pattern in the developmental trajectory of academic anxiety, indicating that academic anxiety tended to become

more pronounced as students progressed through school and faced increasingly challenging academic demands [41].

Furthermore, the studies focusing on kindergarten or elementary school students predominantly addressed math anxiety (n = 7), L1 anxiety (n = 3), and L2 anxiety (n = 2). This emphasis likely reflected the curriculum at these early stages, where foundational skills in mathematics and language are prioritized, while academic domains like science are typically introduced later. As a result, fewer studies investigated science anxiety in younger students. In contrast, the relative importance of early language development was evident in the higher number of studies on L1 anxiety in early grades compared to studies examining L1 anxiety in middle or high school students. This focus underscored the critical role of early language acquisition and the potential for anxiety to impact this fundamental aspect of early education.

4. Discussion

4.1 Key finding and theoretical implications

The findings from this systematic literature review provide valuable insights into the conceptualization of domain-specific academic anxiety across various academic domains and its relationship with multiple motivation factors, including students' competence beliefs, intrinsic motivation, and extrinsic value in K-12 settings. First, the review suggested that math anxiety was the most extensively studied form of academic anxiety, followed by L2 anxiety, with less research focusing on science and L1 anxiety. This finding aligns with previous research that highlights the crucial role math success plays in students' academic and career development, as math exams are often associated with high-stakes and significant pressure [8]. Similarly, the prevalence of L2 anxiety was emphasized in the previous studies, due to the high cognitive and communicative demands involved [9]. In addition, since L2 proficiency is considered a crucial skill in the competitive and globalized job market, it is often associated with heightened negative emotions, such as anxiety [42]. In contrast, L1 anxiety and science anxiety have received less attention, possibly because these subjects tend to involve a lower cognitive load. Additionally, science subjects often incorporated more hands-on activities or experiments in K-12 education, which were associated with higher levels of student interest and engagement [10]. In addition, in the analysis, a new form of academic anxiety emerged in online education research: online learning anxiety, which refers to students' worry or apprehension about online learning activities, such as technical difficulties, feelings of isolation, and challenges in learning engagement and self-regulation. Unlike domain-specific academic anxiety, online learning anxiety is primarily related to the challenges and uncertainties of navigating digital learning platforms, rather than the content knowledge itself. As online learning becomes an integral part of higher education, further research is needed to better understand this anxiety and its impact on students' academic performance.

Second, by examining the patterns of anxiety across distinct academic domains, including math, science, and language learning, the review highlights the multidimensional nature of academic anxiety. Academic anxiety in different domains generally encompassed two key dimensions, including negative emotional reactions (i.e., fear or nervousness) and cognitive appraisal (i.e., students' worries or concerns about their performance and evaluation). These findings outlined the similarities between definitions of math anxiety and L2 anxiety and aligned with control-value

theory, which highlights the importance of student's cognitive and emotional experiences in educational settings [43, 44]. The findings revealed the key differences between the cognitive component of math anxiety and L2 anxiety. Based on previous research, these differences could be attributed to the distinct nature of content knowledge in each academic domain and the types of potential evaluations typically involved. Regarding math anxiety, Meece et al. [45] found students with math anxiety tended to focus on concerns related to assessments and performance, largely because mathematical content often involved complex abstract reasoning, which students perceived as particularly challenging. Additionally, in many countries, mathematics is a key subject in high-stakes standardized testing, further intensifying the pressure on students [46]. The combination of abstract content and the high-risk nature of math evaluations significantly contributes to heightened math anxiety. In contrast, the cognitive component of L2 anxiety included sociocultural factors. Previous studies of L2 anxiety indicated that students with L2 anxiety were concerned not only with language performance but also with cultural misunderstandings and the fear of being judged during communication [27, 47]. The cognitive load in L2 learning, therefore, involved both mastering the language content and navigating cultural understanding, making performance evaluation particularly stressful in social and communicative contexts.

Third, the review confirmed a negative correlation between academic anxiety and student motivation across all academic domains. This finding was consistent with previous meta-analyses that focused on math anxiety and established a similar negative relationship between math anxiety with competence beliefs and intrinsic motivation [48–50]. Students with higher levels of anxiety tended to demonstrate lower motivation, decreased engagement, and poorer academic performance, aligning with the control-value theory [5, 6]. Interestingly, while anxiety generally reduced intrinsic motivation, the association between anxiety and extrinsic or utility value was more complicated. Several studies in the review found that students who placed high utility value on subjects, such as math or L2 (e.g., recognizing their importance for career development), experienced higher anxiety. This pattern echoed findings in an earlier meta-analysis on the relationship between utility value and math anxiety [48], suggesting that external pressures to succeed could contribute to heightened anxiety.

4.2 Practical implications for educators

The analysis identified various strategies to enhance students' motivation and reduce academic anxiety, offering significant implications for educators and policymakers. First, the analysis identified a range of instructional strategies to reduce students' academic anxiety in the classroom, including incorporating gamified elements into lessons, adding examples and content that are relevant to students' real-life experiences, designing interactive scenarios to increase students' engagement, and using innovative educational technologies, such as Plickers and augmented reality. All these instructional strategies focused on creating an interactive and supportive learning environment to make learning more enjoyable, relatable, and engaging, which was consistent with previous studies [51, 52].

Second, the domain-specific strategies identified in this review underscored the need for tailoring the interventions based on the distinct nature of content knowledge and cognitive demand involved in each academic domain. For example, students often perceived mathematics as particularly challenging, which highlights the need to support students' competence beliefs. Usher and Pajares's study [37] also suggested

that allowing students to experience success in math by providing tasks of moderate difficulty and structured guidance helped build confidence and reduce anxiety. In contrast, second language learning presented distinct challenges due to its high cognitive demands and the need for social and cultural competence. In this context, reducing cognitive load and offering emotional support during tasks such as speaking in a second language were crucial. Strategies such as scaffolding, the use of visual aids, and gradual exposure to complex linguistic tasks were found, in both the current review and previous studies, to be effective in reducing the cognitive burden [9]. By addressing these specific needs within each domain area, educators can more effectively reduce academic anxiety and enhance student motivation, leading to improved learning outcomes.

5. Limitation and future study

There are a few limitations of the study. On one hand, although the study addressed the domain specificity of academic anxiety, it lacked a direct comparison of effect sizes across the included studies to reveal differences in the strength of the correlation between academic anxiety and student motivation across distinct domains. A meta-analysis would be necessary to provide a more accurate understanding of how, and to what extent, the relationship between academic anxiety and student motivation varies across domains. On the other hand, the current literature review only included published peer-reviewed journal articles to ensure the quality of the included studies. However, the approach might have introduced publication bias. Future studies could incorporate unpublished studies to reduce potential publication bias, and future meta-analyses could conduct quantitative publication bias analysis to assess whether the results are skewed by the reliance on published studies. In addition, the study did not fully address the influence of other individual differences, such as gender, personality characteristics, and learning abilities. Future studies could investigate how these personal factors might affect students' academic anxiety.

6. Conclusion

In conclusion, this systematic literature review highlights the dynamic relationship between domain-specific academic anxiety and student motivation. While common strategies for reducing anxiety and enhancing motivation are applicable across academic domains, the unique characteristics and demands of each academic domain necessitate tailored approaches. By continuing to explore these relationships and develop targeted interventions, educators will be better equipped to support students in overcoming academic anxiety and achieving their full potential.

Acknowledgements

This project was financially supported by the Summer Student Partnering with Faculty Research Program (SSpF) from the Office of Research and Sponsored Programs (Project No. WKUSSPF202407) at Wenzhou-Kean University. We extend our gratitude for their support in making this research possible.

Conflict of interest

The authors declare no conflict of interest.

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Chapter 7

Educational Playground Structure for Elementary School Courtyards: Hybrid Spaces, Methods, and Processes for Creative Learning, Knowledge, and Experience through Play

Patti Kalou

Abstract

The scope of this paper is the design of prototype structures for schoolyards where children's energy field changes frequency. The research question concerns the approach and strategy for developing a special educational space where knowledge, learning, and play positively affect the overall and multifaceted development of children's personality as a high-speed mindset change. Also, the research question concerns the way an architect place changes kids' mind records and beliefs inappropriate for a happy life. To change peoples' life, first change the way they feel and think. Change mentality, habits, and actions. The specific purpose is for students to find themselves, release creative mind, and understand differences between conscious and unconscious mind. This way, they will be great individuals with a strong and mature way of thinking. The schoolyards are chosen because of the contact with the physical environment and the intention for these structures to be multidimensional. Additionally, theatrical play and dramatization are important tools as they push individuals to understand the feelings and the way of thinking of another person, and this is great way to realize oneself. The lesson ends with meditation and speaking positive statements with alpha waves frequency between 8 and 12 Hz in play. This paper describes the three prototype structures that were analyzed with 56 teachers in three primary schools on Lefkada Island, Greece, from 2020 till 2022. The method is descriptive and aimed to meet the intention of Greek society through a specific sample of teachers and schools to accept the proposal in a real environment in the future.

Keywords: prototype structures, education, multidimensional laboratories, interactive playing, educational games, creativity, schoolyards, primary school

> *"If you want to change the world you should firstly change yourself cause the whole world is in your mind, body and soul."—Patti Kalou*

1. Introduction

1.1 Purpose of design

A child's beliefs about the world are transformed directly into the subconscious during the first 6 years of life without the filters of the analytical conscious mind, which is not fully functional at that time. Accordingly, our fundamental understandings of life and our role in it are learned when we do not yet have the ability to choose or reject these understandings. Since the subconscious mind controls 95% of our behavior, external factors such as other people essentially program our lives. The purpose of designing these playground structures is the transformation of limiting beliefs into supportive beliefs at the subconscious level.

This research focuses on the philosophy and approach of designing a special educational space where knowledge, learning, and play are served at the same time, contributing qualitatively and substantially to the overall and multifaceted development of children's personality. The goal is to uproot perceptions and beliefs rooted in the children's subconscious mind and to cultivate positive thoughts and beliefs beneficial for their adult life. These negative beliefs were recorded in the children's minds from the time they were born until they were 7 years old [1]. These beliefs arose from events, opinions of teachers, and behaviors of adults that were uncritically adopted by children and accepted by the subconscious mind as unique truths. The programs acquired from the subconscious mind shape 95% or more of our life experiences, as M. Szegedy-Maszak said in 2005 [2]. Energy psychology, meditation, psychotherapy, and experienced emotion therapy are ways to reprogram the subconscious part of our brain. Our behavior toward an event if we think about the subconscious is one of reflexive behavior that is recorded in our subconscious. No thought or logic intervenes. It is an automatic reaction to a stimulus. The big challenge is how children's thinking and higher sensory perception are activated in multidimensional laboratories for modern primary schools' exterior. This is especially true in countries like Greece where financial problems affect children's personality and affects the way they think or recognize their feelings. Additionally, this helps to improve social skills and enhance teamwork; moreover, there is greater commitment and participation in learning, and above all, happy smiles prevail. A happy smile is a revolution in our days. The final aim is to set guidelines for architectural design research with a focus on the educational environment by developing full-scale physical prototype structures that host interactive game-based activities for educational purposes.

The research is descriptive. It examines at a theoretical level the causes, the perceptions, and the feelings of those involved. It is qualitative while at the same time using interview as a tool to capture new information and insights for this type of design.

1.2 Philosophical motivations behind design

In these educational playground structures, we research if learning through play heals traumatic experiences. We research also if beliefs entrenched in the subconscious child mind can change in a multidimensional laboratory. The purpose of learning is self-knowledge. Change and reattunement through knowledge, learning, and play heals children's hearts and minds and connects them with their life purpose and their truth. It breaks social stereotypes such as "I'm poor," "I cannot," or "I don't deserve to be

loved"—stereotypes so common in contemporary Greek society. The goal is to design a very sophisticated scientific laboratory where be new perceptions and beliefs can be replaced and planted in children's minds. In this laboratory children will play, learn, and know themselves. We are interested in anything that excites a child, and a child always wants to play. In the scientific laboratory art, technology, and science are connected, generating questions which will be answered through virtual reality. First, to be excited and then to learn through intense artistic expression, the child constructs the answers by themself. This is important because the aim is to offer society adults in an elevated state of consciousness connected to the core of their being. Everything lives in a sea of energy. We expand the state of consciousness through fluid and interacting fields of vital energy that surround and permeate all things. In order to understand the child's reactions and the way they learn, we first understand their psychosomatic identity.

2. School in our days

2.1 Modern school and self-knowledge

The modern school supports self-knowledge through freedom of expression, improvement of children's social skills, and teamwork. Modern educational models and newer teaching methods emphasize the equality in the relationship and cooperation between students and teachers as well as between students themselves [3]. Play is increasingly being integrated into educational processes since the importance of play is inextricably linked to children's mental, social, and physical development. The research question that arises concerns the approach and strategy for developing a special educational space where knowledge, learning, and play are served simultaneously, contributing qualitatively and substantially to the overall and multifaceted development of children's personality [4]. What is the role of architecture, and how are the qualitative characteristics of the space linked to concepts such as knowledge, play, and technology? The purpose of learning and how it is enhanced by interactive play in specially designed educational environments is also the main research challenge. The synergy between the relevant concepts will result in revised models of knowledge development in response to the spirit and challenges of the current era. These models will then form the theoretical and methodological foundation for development of novel constructions that promote a more interactive relationship with the subject matter, knowledge through play, and experiential learning.

2.2 Modern games in learning processes

The relationship between creative play and learning is a field of research by experts, and many forms of play are often used by teachers as high-quality learning tools. Modern games, TV programs, computer games, films, and virtual reality interfaces have added significance in this direction. Play contributes to the formation of children's personality, especially their cognitive and emotional structure assisting creative acts. During play, the child explores and evaluates personal experiences as well as data and characteristics identified in their physical and social environment. This process of exploring the limits, possibilities, knowledge, and needs of the child and their environment is critical to the development of students' creativity [5]. Play is a very important function that contains meanings, creates and constitutes order, and, independently of the player's demonstration of their abilities, is at the same time

a demonstration of the honesty of their character despite the attraction of winning. Play is understood as a free activity in which the child voluntarily and enjoyably seeks to participate. According to Froebel, play is the highest form of expression of the child, of their thoughts and feelings. Through play the child can express their soul. Through play they gain experience and learn to understand the world around them [6]. The goals of learning and play seem to be common, so they are explored in parallel in this paper.

2.3 Why play is still important

The study and use of play in learning processes contributes to the cognitive, psychomotor, and emotional development of the child, as well as to the acquisition of knowledge, socialization, and the formation of opinions and values as key components to creative thinking. Play means exploring and evaluating experiences, characteristics, and data found in children's physical and social environment. This process of exploring the limits, possibilities, preferences, knowledge, and needs of the child and their environment contributes to the formation of the child's personality.

Play is what a kid is. When a child wants to eat, to read, to sleep, to express feelings, or to explore something, they will play. Play is as important as a person's mind and their skills [7]. Professor H. Jenkins extends Montessori's "game play cycle of learning" theory by arguing that learning is likened to a cycle in which participants—students—express interest and curiosity in a topic, act to satisfy this curiosity (a phase in which skills are developed), and conclude the process with critical thinking and reflection on the issue of interest. Essentially, the learner can regurgitate what they are supposed to know, but only by really engaging with the issue at hand will they understand it and change as a person [8]. At the same time, however, it is subject to rules, purposes, modes of play, cooperation, and concessions that have direct consequences for the child's overall development. As modern forms of learning dominate the educational process, the presence and value of play as an educational tool are increasingly recognized. Play invites you to discover yourself and your existence through successive challenges.

According to Jenkins, there are educational environments that support the natural tendency and desire of students to explore and learn about the world. Learning involves play and fun, companionship, and often humor and banter. We need learning environments where children communicate with each other and seek out learning experiences on their own. We need spaces where children meet to play, hang out, and have fun. Most of the time when we talk about introducing play into the classroom, we have only one type of play in mind. It is important to remember that there are different types of games for teaching different subjects and many categories of players who prefer different types of games. Furthermore, the same game can be played in different ways. Every child has different experiences of different types of games, and knowledge of each type is in itself of great interest. Most of the time, teachers know only one way of using an object. Children playfully experiment with the idea that the world is full of data that makes an excellent "game board" [9]. We can in the learning process build game experiences by giving students interesting choices based on the data systems and then investigate what they do. Today digital games, through interactivity, relate users to each other and users to computers. With video games in school we can understand how students think, act, and learn in virtual worlds. However, research is still theorizing about how video games work and their importance in learning, schooling, and society. The interactivity of video games in schools

enables students to participate in the evolution of events by changing symbols and representations they see on the screen. Without the player, there is no game. In terms of narrative structure, video games are reminiscent of travel texts. In a video game, you move through fascinating landscapes, and many times the player wishes to stay in the game with the curiosity to see the next landscapes that appear in front of them while the characters play a secondary role. The storytelling of many games is based on the use of space. To implement these ideas in schools requires radical changes in the educational system and approach to learning.

2.3.1 Theatrical play in school

One of the most representative examples of a participatory process with a playful character is theater. It is a game; it serves the purposes of learning and contributes to the multifaceted development of children and their self-expression. The relationship between interactivity, theatrical play, and drama during the lesson is explored. Art in general has an important role in the healing of a traumatic experience. Art and especially theatrical play are proposed this paper to be used as a systemic psychotherapy. The specific purpose is for students to find themselves, release creative mind, and understand differences between the conscious and unconscious mind. Additionally, having a personal traumatic experience as a baby affected my whole life till today theater, music, and architecture helped me bend over the wound and free it. Through theatrical play the child projects their own view on human relationships and problems, having already projected characteristics of the world and the environment around them. It follows that conducting a performance is not the only purpose of the dramatization lesson.

Theatrical play and dramatization are types of stage play that contribute to the development of emotional empathy, that is, children putting themselves in the shoes of a third party and understanding their emotions in real scenarios or imaginary situations. Through this process, children's personal life experiences are enriched, their thinking is broadened, they learn to channel possible psychological tensions, and they learn to coexist, socialize, and cultivate a sense of justice. Dramatization involves theatrical play but does not follow strictly predetermined roles or constraints and relies on creativity and improvization.

The connection of this process with the learning process can support the orientation of the work toward the cultivation of "multiple intelligences" [10]. Through theatrical play and meditation children are offered entertainment, ways of activating and releasing their imagination, awareness and cultivation of their psychomotor expression, joy, socialization, and self-expression. It is a method with pedagogical, cognitive, esthetic, and artistic value since through it children create, express themselves, speak freely about their feelings, activate their imagination, and develop and cultivate their sociality [11]. The purpose is not necessarily the performance of a children's theater, but through sensory-motor activities the child reaches a point of self-expression and learns to project characteristics of the world based on their own view and to present their feelings and thoughts on human relationships and their problems. Most of the time, the child needs to experiment with their body and motor skills. The dramatic text draws on material from the curriculum of most school subjects, for example language, mathematics, geography, physics, chemistry, and mythology. Transferring these elements into cyberspace and linking them to J. Murray's research on the interactive transfer of stories, familiar texts, and myths to digital media offers a contemporary look at dramatization in today's school [12]. It

is in essence the presentation—perhaps the renegotiation—of a story in which the student acts directly, activating psychomotor expressions and eliciting a reaction. Thus, the student puts themself in the position of the protagonist of the story and acts according to their own character. In this way, the story develops according to the decisions of each student. The process is a time-based, living process since you do not know the end of the story, which is left to the actions and reactions of the child. To paraphrase one of J. Murray's examples, the user-student intervenes in the story of a refugee peer who walks miles away after being forced to leave his country. This is where imagination and empathy are activated. The child steps into the role of someone else in a fictional world that draws inspiration from real stories using educational technology, cyberspace, and holograms.

One of the most representative examples of a participatory process with a playful character is theater. It is a game; it serves the purposes of learning and contributes to the multifaceted development of children and their self-expression. The relationship between interactivity and theater play and drama during the lesson is explored. Role-playing and drama are methods with pedagogical, cognitive, esthetic, and artistic value. Through theatrical play and dramatization, children express themselves, talk freely about their feelings, and mature their social skills [13]. Through dramatization the child expresses themself in their own way, effortlessly and subjectively, without having to memorize a text and recite it as in a theatrical performance. The aim is for the child to project characteristics of the world based on their own view and to present original thoughts and feelings concerning human relationships and their complexities. Dramatization helps children to develop their own personal perception of situations that concern them. In this way they learn to cope with problems in a critical manner. This process helps the teacher to get more information about the child and, accordingly, to be able to help directly and efficiently as necessary. The texts are not presented to an audience as in a classical theater performance. The texts chosen for dramatization often allow children to come into contact with characters who have similar problems and experiences. Through the assignment of roles, the child faces new problems and then is encouraged to find innovative solutions and take initiative and action. This fosters boldness, a sense of confidence, and the belief that one can overcome one's insecurities since infancy.

2.3.2 Dramatization, fables, and personality

Dramatization helps people reach the core of self-expression. It supports surface beliefs of the subconscious mind and the consolidation of new beliefs. It looks like systemic psychotherapy for children—a modern attempt to synthesize the various aspects of reality, adopting a holistic approach. Peoples' beliefs create peoples' lives. Traumatic experiences that a child carries in their soul can be expressed through dramatization. It activates the students' bodies, their expressive potential, and elements of their character and personality such as spontaneity, imagination, and creativity. It is based on improvization and can draw on material from most school subjects, such as language, mathematics, geography, physics, chemistry, literature, and mythology but also simple concepts, phrases, and images that children can choose themselves and bring to life. To dramatize a text, students work on two levels. First, they process the dramatized text, and then they re-enact it. The drama is based on dialog, action, and the mixing of the characters in the play. The narrative is developed in person and contributes to the action and fills any gaps due to the absence of scenography, while dialog exists and is used according to the needs of the text and the decisions of the

participants. Dialog adds to the development of the action, which is characterized by the element of surprise and unexpectedness, in order to manifest the dramatic situations on which the course of the text is based. It is through these that the views of the characters in the play emerge [14].

Children show great interest in and are inspired by the heroes and situations in a fable. Fables are short fiction stories and could be used in contemporary systemic psychotherapy. Aesop (620–654 BCE) was a famous Greek fabulist and storyteller who created a number of fables. Often children identify with heroes who are strong and clever, and they like to find and draw parallels with themselves and their lives. This is because of their need to feel strong as if they were already grown-ups. Within the fables, the child follows the heroes' actions, adventures, and sufferings and recognizes the characters and the qualities of their behaviors while watching the struggle between good and evil, also negative and positive forces. Children aged 9 to 10 years old tend to prefer fables that are closer to reality and more realistic. Fables with references to travel, exploration, and adventure fall into this category. Older elementary school children, 10–12 years old, show interest in fables that identify their personal interests and preferences. They are characterized by the ability to organize a role and retain information and texts much more easily. By improvizing, they put their personal stamp on how they perceive a role or the play itself. Dramatizing the story can improve the child's language and expressive skills. Through this process, imagination is cultivated and optimistic perspectives for the future are developed. Fables are moral texts that do justice to the good, promote constructive dialogs, and help children to draw useful conclusions for their lives. Additionally, the use of the present tense helps children to approach the content of the story more fully and to experience it directly, vividly, and intensely. The approach of dramatizing the fable through physical movement is fundamental and is a key element of transmitting meanings, messages, moods, and emotions. Also, rhythm followed by movements and hand clapping, and the use of percussion instruments and singing, contributes to the release of body expression.

3. Educational playground structure for elementary school courtyards

This chapter presents three educational game physical structures. These structures combine architecture, knowledge, play, drama, and meditation in specially designed environments. The inspiration of the design was three modern lessons that have been taught in primary schools in Lefkada in 2015. More specifically, it combines the Greek lessons of language, history, music, dramatization, visual arts, mathematics, and physics. It is a modern view of the culture in ancient Greece cities, like Epidaurus, where learning, socialization, play and sports, theater, and meditation took place. These new lessons offer a lot in the comprehensive development and cultivation of children like modern holistic healing centers. The problem came when teachers realized that there was not any appropriate space in a school or in a courtyard for these specific lessons. Following the theoretical framing set discussed previously, this chapter presents three examples of educational game physical structures. Every structure was designed for the lesson examples above. Of course, there are many ways to use these structures, and this is a field that can be researched in the future.

This chapter also presents comments from discussions held with teachers of primary schools in Lefkada (Eptanisa, Greece) during the period September 2020–February 2022. The communication with these schools was easy as Lefkada is my

birth place and the place I have lived the last 11 years. So, it was easy to make the appointments with teachers, be in the schoolyards for many hours, be in contact with children, and have the parents feel safe.

The island of Lefkada is an interesting example as the economy is based in tourism and many people are rich. At the same time, children raised in rich families feel poor emotionally, find it difficult to express their true self, or hide behind social or family rules that do not contribute to the development of a healthy personality. The rates of depression and use of antidepressants in Lefkada are very high. Expectant behaviors of children who constantly seek attention are everyday occurrences. There is emotional abandonment. Mindsets like "I do not exist," "My parents do not love me," and "I am not good enough like my parents" are usual. The aim is a high-speed mindset change through the playground structures.

3.1 Examples of teaching a lesson using technology and theatrical play

The following examples of teaching a lesson using technology and theatrical play were created by Greek teacher Vasiliki Kitsaki with the support of her colleagues. They are based on scenarios and exercises that were first implemented in primary schools in Lefkada in 2015. Through this program, children practice, research, and observe as they explore works of art surfing in the internet and in a virtual gallery. The children take the initiative and work on their own. The main subjects of focus are language, history, music, visual arts, mathematics, and physics.

Based on these examples, we adapted them to our constructions and then enriched them with gymnastics, meditation, and speaking positive statements.

3.1.1 First example

As the lesson begins, the children gather around the interactive screen where they choose to learn one of the three or four mythology lessons and fables. They follow the topic on the screen, which is linked to the history lesson. At the same time one group of students reenacts what they watched while another group observes and evaluates the fidelity of the replication. The children paraphrase the story they watched based on new questions adapted to the particular environment in which the school is located, and dramatization is now linked to the environmental studies lesson. Then, by using the interactive screen again, the children listen to words, correct spelling, conjugate verbs, and etymologize lemmas, and this is linked the language lesson.

3.1.2 Second example

The children start with the visual arts lesson and gather around the interactive screen, which projects famous paintings. They discuss and compare what is displayed on the screen with reference to the environment they are in, for example trees, cars, pedestrians, and bicycles, and this is linked with the environmental studies lesson. They can draw on the screen what they see in their environment. An example of this exercise is to record the color around them by showing elements with same color on the screen, a link to the physics and painting lesson. Also, by using their bodies, the children are free to represent the color discussed earlier and what they have observed in their structured or unstructured environment through dramatization.

3.1.3 Third example

The teacher sets the central question and explains the lesson's topic to the children. Then the interactive screen presents paintings, which are linked to the history lesson. At this point the pupils can choose to represent the postures they see in the paintings. Some other students check the fidelity of the replication through dramatization. Also, the children can reenact the entire scene they watched as they imagine it. Also, by reenacting the topic in a different light, they try a different approach, linking to the e lesson. An exercise is to record the color of the paintings—light and shadow, which is linked to the physics lesson.

3.2 Design of educational playground structure

Next, the paper describes the scenarios of use and the mode of operation of three designed play structures. These structures have been designed for children from 6 to 11 years old. They will be placed in primary school courtyards. These playgrounds serve learning and theatrical play by also using an interactive screen. The lesson starts and ends with meditation and positive statements while alpha waves of 8–12 Hz play. Most children and younger teenagers have a dominant alpha rhythm. Positive statements are the following: "I am good enough," "I love myself," "I can do it," "I am smart," "I am kind," and "I am brave."

The design of the three structures is inspired from physical natural forms like shells, circles, and spirals. These forms are close to human chakras that are important energy centers in our body, since they are located in key points and regulate the vital function of our most important organs and therefore our basic qualities. After all, the goal of this design is inner balance, emotional maturity, and peace. So, it offers to the world mature, happy citizens. There is also a linear design, simple and clear, that relaxes individuals' brains. This line ends up to a sphere. Curves and circles are used as they are meeting points because of their shape. You can speak to your partner face to face.

3.2.1 Project 1

The play structure contains an entrance ramp and monorails, which are used for body movement—gymnastics. Round seats have been designed for both the students who act there and for the spectators of the dramatization. A small bridge connects the two circular areas. Children may divide into groups as follows: action group, observation group, visual speech group, and discussion and recording group. The 17 cm pitched step makes it easier to access the second circle of the game structure, which is also used as seat (**Figure 1**).

When the students enter the play structure, they are given the option of warm up their bodies on the whole structure and on the rings. Also, they can choose to gather around the interactive screen. Some students stand, some squat, while others one sit on cushions as they watch the lesson on the screen. They can also move on to the reenactment part—the theater scene—where they perform the topic they discuss. Some students may watch the acts by sitting on the stools in the structure. The drama group can give way to the seated group so that they too can proceed with the reenactment of the topic. The teacher requests that the students discuss the topics further (**Figures 2** and **3**).

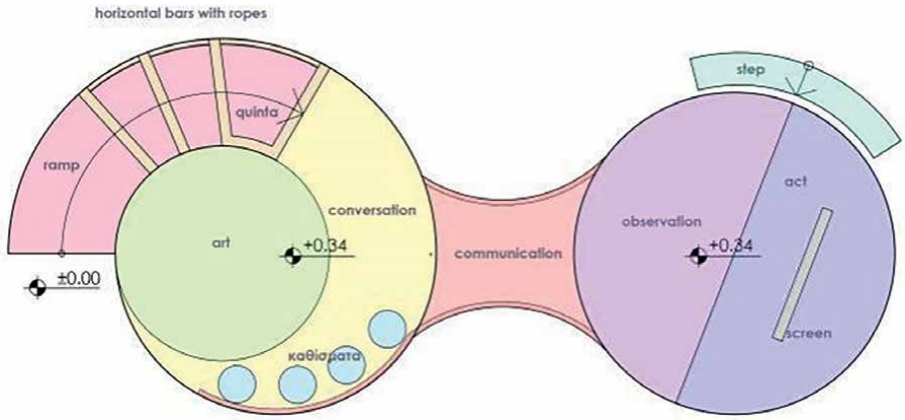

Figure 1.
Top view.

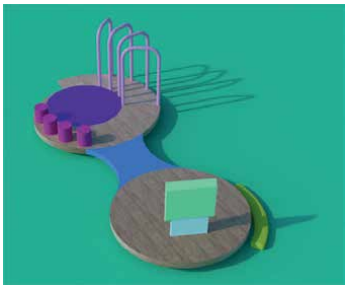

Figure 2.
Photorealistic illustration of project 1.

Figure 3.
Children just finished their lesson.

When the lesson begins and also at the end of the lesson, meditation and positive statements take place in the whole area while children are lying down or sitting.

3.2.2 Project 2

The lesson is ready to begin; children take deep breathes and speak positive statements. Students sit in a row next to each other. Some of them can visit the

sphere and shout the positive statements. In this project, children can decide to work in groups or alone. Students may choose to stand in the area where the interactive screen is located. Also, children can go up to the "podium" to represent the given topic. Another choice is to stand in the sphere and discuss the given topic. They can simultaneously play and climb the ropes of the sphere. Also, the students can discuss while wandering in the maze (**Figure 4**). The central movement corridor has a height of 15 cm. At the beginning of the corridor there are monorails for play and gymnastics. The corridor is 1.70 m wide. The height of the drama area is 95 cm. Around the sphere there is a 1-m-wide corridor, and low walls used for play and dramatization (**Figure 5**). Through dramatization, children are offered entertainment, ways of activating and releasing their imagination, awareness and cultivation of their psychomotor expression, joy, socialization, and self-expression. Lesson and play are free activities in which the child voluntarily and enjoyably seeks to participate.

3.2.3 Project 3

The students enter the structure. They use the rails, do gymnastics, and then go to sit and relax. It is time for meditation, for positive statements, lying down or sitting. Then in small groups of seven or alone, they walk down the driveway discussing the topic given. They then gather around the interactive screen. Some students sit on stools, some remain standing, and some squat. They watch the lesson on the screen. Then in the same place in front of the screen, they are free to recreate what they saw.

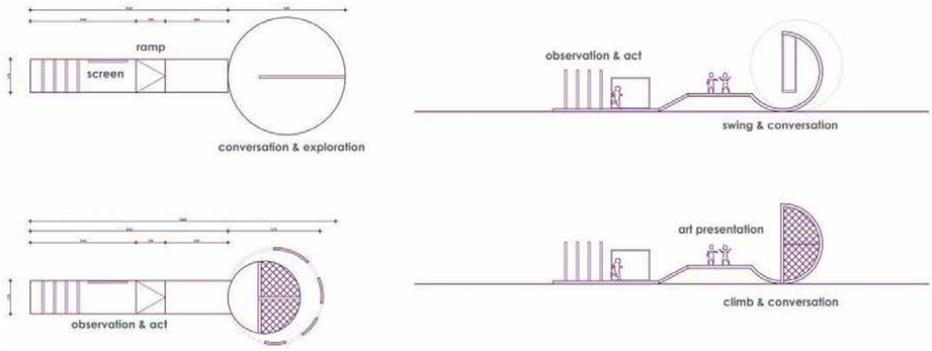

Figure 4.
Top view.

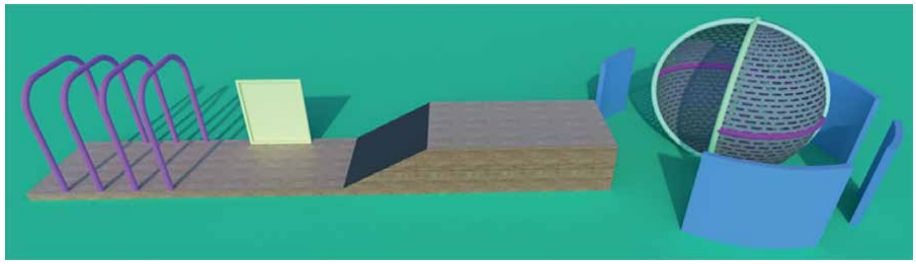

Figure 5.
Photorealistic illustration of project 2.

The other students watch them from the stools. They can change positions as they decide. They solve exercises together from the same spot. At the entrance is the conferring and recording stage, where large rings are designed for play. Further along the route, which is 1.30 m wide, is the stage of visual discourse. Then comes the observation stage. In the area where the observation takes place there are seats that have a direct visual connection with all the stages of the toy construction. The spaces of action and observation are intertwined in this concept. Only the circular area where the big screen is placed is delimited, which is mainly used by the students engaged in the action stage. The purpose of dramatization is not necessarily the performance of a children's theater, but through sensory-motor activities the child reaches a point of self-expression and learns to project characteristics of the world based on their own view and to present their feelings and thoughts on human relationships and their problems (**Figures 6** and 7).

3.3 Evaluation of proposals from elementary school teachers

The meetings with teachers were held in three primary schools of Lefkada with focus groups of teachers of all subjects and specializations (general core, gymnastics, arts, theater education). In the 2nd Primary School of Lefkada, a meeting with 12 teachers was held in the classroom with a computer and a projector. At the 4th Primary School two meetings were held with 12 and 15 teachers in the management offices, and

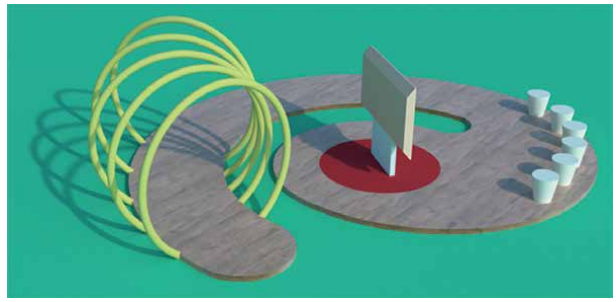

Figure 6.
Large rings designed gymnastic lesson and play.

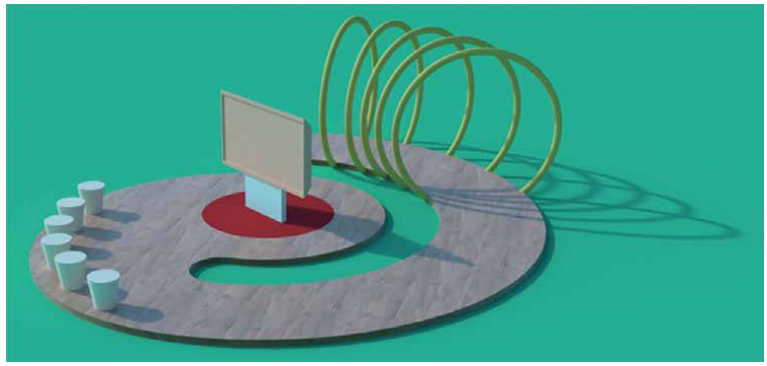

Figure 7.
Screen area.

at the Primary School of Lygia two meetings were held with 7 teachers and 10 teachers respectively in the computer room. The average age of teachers is 40 years old. The duration of the teachers' training experience was different. Most teachers had more than 25 years of experience, some had 10 years, while many teachers had about 4 to 5 years of prior teaching work. The total duration of the visit to all four schools was 6 hours. There the three proposals of educational game structures were presented, followed by a discussion on the idea of the project, as well as on how some of the game structures could be integrated into the teaching process. The play structures are linked with the lesson and are an important part of school. These structures may be used during the lesson. No special permission is required from parents or students. Constructions must meet certain European Union ISO specifications. All the materials (aluminum, HDPE, HPL, steel and wood) have to be certified from European Union.

3.3.1 Interview analysis

The meeting with the teachers in the primary schools of Lefkada was an occasion to draw important conclusions, and at the same time it gave rise to various concerns about the research. The main subjects that discussed were (1) spaciousness, (2) how important circular arrangement is in the largest part, (3) visual user contact, (4) separate drama section, (5) group separation service, (6) space of silence, (7) sufficient space for alternating children's body positions during the course, and (8) position of the surveillance equipment from each point. **Table 1** presents the subjects that were discussed and the rating from 1 to 5 that teachers gave to each project.

3.3.2 Feedback

As a general remark, the feedback received on this study was very encouraging, and the discussions with the teachers were characterized of acceptance by all parts involved. Teachers insisted and focused on five fields. The subjects that were discussed and the rating from 0 to100% that teachers gave to the concept were as follows:

1. Acceptance of children and teachers, 90%

2. Suitability of courtyards in Greece, 65%

Teachers' remarks	**Project 1**	**Project 2**	**Project 3**
Spaciousness	5	2	3
Circular arrangement in the largest part	5	1	3
Visual user contact	5	3	3
Separate drama section	5	5	1
Group separation service	5	5	2
Space of silence	3	5	2
Sufficient space for alternating children's body positions during the course	5	2	1
Position of the surveillance equipment from each point	5	1	1

Table 1.
Teachers remarks.

3. Teaching outdoor, 80%

4. Theatrical play, 100%

5. Meditation, 100%

Concerns were expressed regarding the suitability of the courtyards of public schools compared to private schools, and the issue of the coexistence of the gymnastics lesson with the project was raised, since the gymnastics lesson is mainly held in the courtyards of primary schools. The teachers mentioned during the interviews the positive aspects of teaching outside the classroom. They unanimously stated that teaching in outdoor environments is always more attractive for the children as well as for themselves. They mentioned several times that they are always looking for reasons to go outside the classroom as the students feel free there to improvize and try out new things. To date, this is mainly the case in environmental studies, drama, the core of the flexible zone, less frequently in language and, of course, mostly in gymnastics. It was strongly emphasized that the theatrical game is an excellent tool—a means of strengthening many other subjects such as language, history, mathematics, environmental studies, physical education, and physics. The history lesson was mentioned with great enthusiasm in all three schools. On all occasions, it was said that the project lends itself to more lessons and not just drama.

The lesson outside can be conducted in the same way as in the classroom, but the installation in the courtyard combined with the freedom of movement of the students and the choice of posture exalt the children's interest in the discussed topics. By allowing the children to sit in a variety of ways during the lesson (either in the positions indicated by the teacher or as they decide themselves, e.g., on stools, down, squatting, on cushions, lying down, standing up) provides the necessary sense of freedom, a critical quality to engage the students in many lessons. In such an environment the role of the teacher becomes also clear. They are a co-researcher who co-constructs knowledge with the children. The teacher poses the central question and can participate, collaborate with the children as they discuss with each other, help them to present what they have prepared, and give directions for fruitful reflection and enquiry.

3.3.3 Remarks

Whether the lessons take place in one group or in several, it is important to have very good eye contact both for the safety of the children and for the success of the lesson. This relies on communication between students, a better view of the visual aid, and supervision by the teacher. Five teachers noted that it is interesting to have a special section as a quiet space (corner) where children can feel privacy and autonomy, which is also particularly important for children with distraction problems. Based on the objectives of the courses, it is ideal to have large open spaces in total, rather than confined spaces (e.g., corridors). In the larger spaces students can sit, relax, and lie down during the lesson. According to teachers, in large spaces a larger number of students can be gathered, which is a prerequisite even in collaborative group teaching. At that point, the importance of forming groups during the lesson was stressed by all the teachers. Also, the teachers praised the circular or Π-shaped

arrangement in terms of realizing the educational objectives. They mentioned that they often try to rearrange desks and chairs in a classroom when and where possible. According to the teachers, the displays always keep the students' attention. They themselves make a great effort to ensure that their lessons take place in the computer rooms. They also try to integrate the use of a projector in most lessons, which is not always easy. When asked about the teacher's reaction in case a child gets bored, the teachers argued that it is difficult for children to get bored in these environments and if that happens it is easier to reestablish and reactivate the student's interest. It is a requirement of teachers in today's schools that children feel freedom of action-movement, and their role is to help draw on resources and drive them to new knowledge from a wider environment. Today's school pays high attention toward the development of students' creative and critical thinking through experiential approaches and with a parallel effort to enhance their emotional intelligence. A very important observation is the requirement for large and spacious spaces that offer freedom of movement and body comfort, so that it is possible for children to follow the lesson not only from the static position offered by a seat but by taking the position they want with their body (as mentioned in the description of the discussion with the teachers). The requirement for very good eye contact between pupils and teacher is crucial to the choice of the final product of the task. The linear spread of a construction in space lags behind a circular arrangement that allows for unobstructed eye contact between students, teacher, and supervisory means; enhances a sense of equality and courage; highlights the role of the parties involved; and fosters discussion. Student communication becomes more efficient, and socialization and emotional development are enhanced by the face-to-face view of a classmate or teacher. Very important is the spaciousness of the drama section, which must not contain other elements (supervisory tools, etc.) in order to achieve its objective. The play structure should offer large spaces almost all over its surface in order to allow children to work in groups.

Discussions with teachers raised concerns about protecting the structure during break times and during periods when schools are not in session. This leads to the option of removing the screen from the structure and adding it whenever the lesson is being conducted. Also, for unobstructed conduct of the lesson in case of drizzle or strong sunshine, a canopy-type design in the esthetics and style of the structure is a proposed solution to this issue. **Table 2** shows the highlights in order of priority.

1. Teachers' remarks
2. Spaciousness
3. Users' contact
4. Group separation service
5. Space of silence
6. Sufficient space for alternating children's body positions during the course
7. Position of the surveillance equipment from each point
8. Protection in bad weather

Table 2.
Teachers remarks in order of priority.

4. Conclusions

This paper describes the three prototype structures that were analyzed with 56 teachers in three primary schools of Lefkada Island, Greece, from 2020 till 2022. The method is descriptive. At the moment there is a strong core of the research that started 3 years ago for the Department of Architecture, University of Ioannina city, Greece. The research is at its beginning and theoretical base. There is no application with children or quantitative analysis. There is a theoretical frame with vision and inspiration. The next stage is the construction through funding support of the municipality of Lefkada and the Greek government being applied in primary schools in 1:1 scale.

According to the teachers, the educational objectives set by the modern school in the context of collaborative teaching and creative learning through discovery are met by the design of the projects. The teachers at the Primary School of Lygia named it "a different and very interesting educational tool," while those at the 2nd Primary School said that "it is extremely interesting" and "breaks the monotony of the teacher-centred teaching." Educational playground structures for elementary school courtyards are in the initial research stage. The next stage is the communication with children and the cooperation between teachers and children at the same time. The three ideas that are presented in this paper are in the beginning. A new construction may be created by the combination of these three first ideas. New places, like specialized parks or multidimensional laboratories where learning, art and play meet, may function as spaces of transformation and upgrading of personality. And this is participating actively in the cosmic symphony.

Concerns were heard regarding the protection of the structure during recess and during periods when the schools are not operating. There were concerns about whether the courtyards meet all the standards these installations require. In fact, private schools were suggested as more suitable environments. In addition, it was felt that such structures could also be placed in public spaces to reinforce afternoon activities and extended use by children in their free time. In all schools there were concerns that the structures were exposed to weather conditions (such as heavy rainfall, cold, wind), and at that point two teachers were quick to respond that this structure could be placed in a semi-outdoor or covered area.

The meeting with 56 teachers gave first basic conclusions for the research that is continued. First of all, we have a conservative society such as Greek society, almost ready to accept the change. The island of Lefkas is an example in this research. Every society can use modern educational structures in their schoolyards. This research focuses on emotionally poor and unhappy countries because the change is in children's hands. Countries like Greece emphasized the need to rely on the young children. Young people are the future. The vision of this design is helping young people change their perception of the world. When you change your perception, the world changes around you. This research started up with the vision of a society where happy people live and make their dreams come true—people who live in balance and harmony. The structures are designed to help children become architects of their own reality. In these educational playgrounds children may achieve an holistic integration of mind, heart and soul through learning, play, and art. Greek lessons in school such as language, history, music, dramatization, visual arts, mathematics, and physics combine in a holistic lesson with meditation and speaking positive statements that teaches student they can make a choice of emotions' quality and their thoughts. It teaches students to recognize intentions behind our actions, make conscious selections of their thoughts; recognize triggers, choose responses, and remain centered amid external fluctuations; and to learn the art of conscious creation.

DOI: http://dx.doi.org/10.5772/intechopen.1007848

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Edited by Jian-Hong Ye, Liying Nong, Li Wang, and Weiguaju Nong

Learning is always a core activity in forming cognitive abilities and personality traits in people's growth process, and motivation is the key psychological mechanism that drives learning behaviour. Therefore, motivation in learning is an important area of research in educational psychology. It not only determines the initiation and continuation of learning but also affects the effectiveness and depth of learning. The complexity of motivation in learning lies in its multidimensional composition and dynamic changes, making its in-depth study an important area of research in psychology, education and other disciplines. Under the title *Motivation in Learning*, this book systematically analyses the nature of motivation and its formation mechanism and manifestations in different learning (educational) contexts. The book attempts to provide a comprehensive and dynamic introduction to the application and interpretation of the theory of motivation in learning and to provide a solid theoretical foundation for subsequent research.

Katherine Meltzoff, Education and Human Development Series Editor

ISSN 2755-9513
ISBN 978-1-83634-150-5
9 781836 341505

Published in London, UK

IntechOpen