VOLUME 1 ISSUE 1 • JANUARY 2025
ISNN 3007-5483

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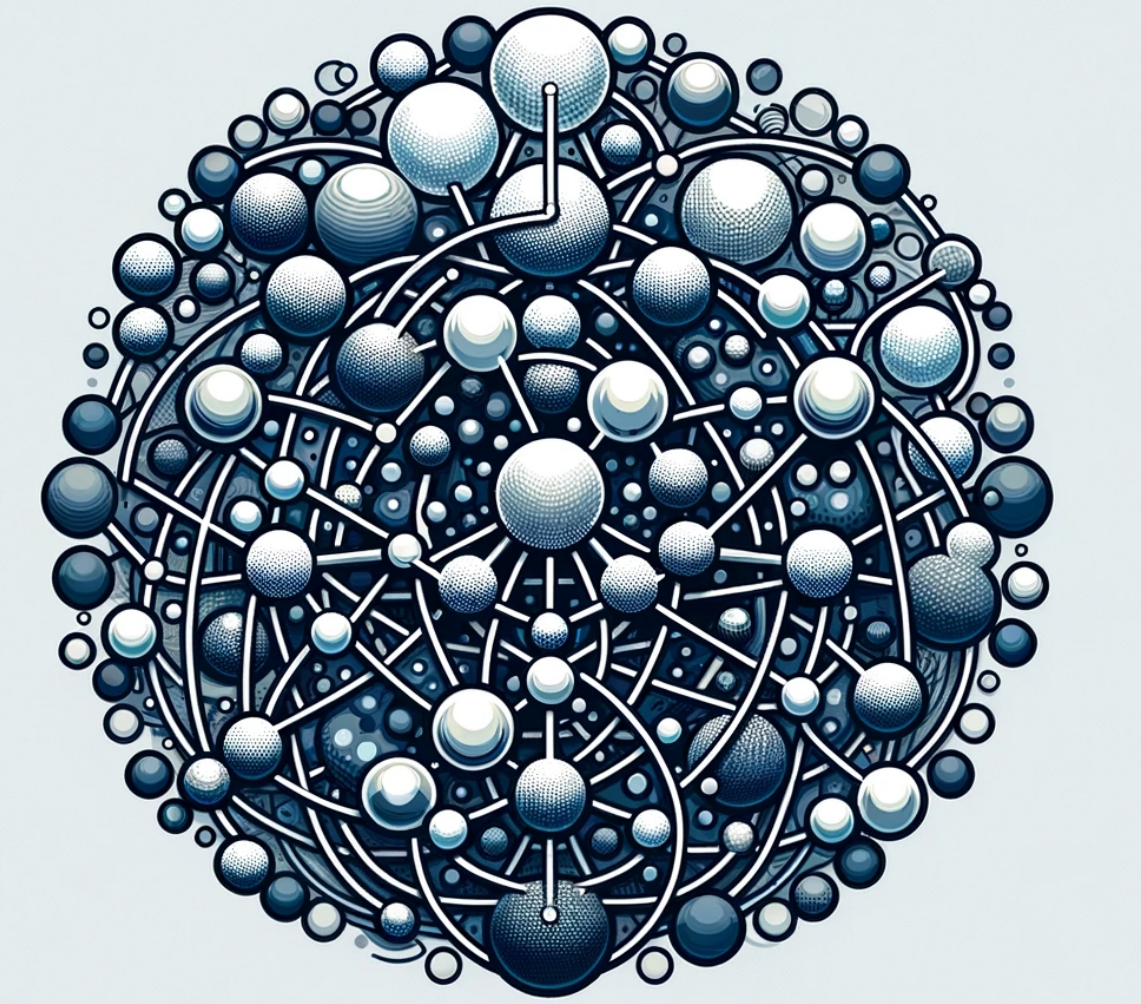

جامعة أبوظبي
Abu Dhabi University

College of Arts, Education and Social Sciences

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College of Arts, Education and Social Sciences
Abu Dhabi, 2025

ISSN 3007-5483

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Editorial

Welcome to the inaugural issue of Crossroads of Social Inquiry, a peer-reviewed academic journal published by the College of Arts, Education, and Social Sciences at Abu Dhabi University. This journal seeks to provide a dynamic platform for exploring the complex and multifaceted intersections of education, society, and innovation. Our mission is to advance interdisciplinary dialogue and disseminate impactful research that addresses the challenges and opportunities of our rapidly evolving world.

The papers featured in this first issue represent a rich fusion of ideas and insights that exemplify the journal's interdisciplinary nature: *Schule als Hybrides System: From Education to Edu'action'* by Mandana Sedighi (Karlsruhe Institute of Technology, Germany) introduces a hybrid architectural-pedagogical framework for reimagining school spaces as integrative environments that bridge education, sustainability, and community engagement. *Design Curriculum Reimagined: Leveraging Design Thinking for Educational Innovation* by Halim Choueiry (American University of Science and Technology, Lebanon) explores the transformative potential of design thinking as a methodology for creating responsive and future-oriented educational curricula. *Water Scarcity Management and Finance: A Research and Education Agenda* by Charilaos Mertzanis (Abu Dhabi University, UAE) highlights the need for innovative financial mechanisms and interdisciplinary educational approaches to address global water scarcity challenges. Finally, *Using Artificial Intelligence (AI) as a Tool for Inclusive Leadership in the Digital Era: Challenges, Opportunities and Implications* by Tasneem Alkhateeb (Zarqa Private University, Jordan) explores the ethical and strategic dimensions of integrating AI in leadership to enhance inclusivity in educational institutions.

Each of these contributions underscores the journal's commitment to addressing critical societal issues through diverse disciplinary lenses and collaborative inquiry. Together, they reflect the breadth and depth of scholarship that will define Crossroads of Social Inquiry in the years to come.

Acknowledgements
The successful launch of this journal would not have been possible without the unwavering support of Abu Dhabi University's leadership. I would like to extend my deepest gratitude to *Dr. Ghassan Aouad,* Chancellor, Abu Dhabi University, for his visionary guidance and steadfast encouragement of academic excellence, *Prof. Montasir Qasymeh,* Associate Provost for Research, Innovation, and Academic Development, for his instrumental role in raising a culture of research and interdisciplinary collaboration, and, *Dr. Sreethi Nair,* Dean, College of Arts, Education, and Social Sciences, for her visionary leadership and continuous commitment to advancing scholarly pursuits within our college.

I would also like to thank the authors, reviewers, and editorial team for their dedication and invaluable contributions to this inaugural issue. Your efforts have laid a strong foundation for a journal that aspires to influence and inspire.

As we embark on this journey, we invite researchers, practitioners, and policymakers to contribute to Crossroads of Social Inquiry and join us in exploring the intersections of knowledge, innovation, and societal impact.

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Schule als Hybrides System: From Education to Edu'action'

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Abstract

Hybrid architectural-pedagogical concepts, in which schools are understood as a kind of 'home base', transform school space into a 'hybrid space' that includes different user groups. By overlapping diverse and varied functions, "Schule als Hybrides System" can accommodate current social developments such as demographic change, diversity and inclusion, migration and technological trends (digitalization, artificial intelligence) and create innovative conditions for dealing with the requirements and effects of such change processes. "Schule als Hybrides System"[1] is created in a participatory process and is a suitable basis for education for sustainable development (ESD). It acts as an architecturally multidisciplinary integrator of structures, systems, processes and internal and external actors in the education sector. "Schule als Hybrides System" promotes integration and inclusion and creates space for new educational experiences and group-dynamic social developments. The results of this project can become the starting point for a new holistic architectural and pedagogical perspective on school and educational buildings. They also offer decisive architectural impulses and supplementary information for school building guidelines and provide innovative ideas for participatory neighborhood planning and urban development at the interface with society.

Keywords

Architecture, pedagogy, hybrid system, learning environment, sustainable development, edu'action'

1 Introduction

In the schools that are being envisioned and built today, the generations of tomorrow will receive their education. It is therefore important that architects and school space planners design the schools of today in such a way that they can successfully meet the challenges of the future regarding developments for a sustainable environment. Education, training and further education are increasingly focusing on holistic education not only for children and young people, but across all generations. The development of technology with digital media and networks is a key factor in this and ensures that learning and working spaces are opening and becoming more flexible. Learning and working are getting mobile, flexible in terms of time and location and individualized.

While numerous different pedagogical forms and didactic methods have been developed for schools, the architectural form of schools has usually still been virtually unchanged for decades. Many schools have reached the limits of their space, room structure and interior design in terms of today's requirements. The design of educational facilities remains a very complex issue in the 21st century, not least as a result of the global Covid-19 pandemic.

[1] School as a Hybrid System

Hybrid buildings can incorporate these trends by superimposing different functions. The terms 'hybrid' and 'hybridity' are understood in the built environment as an innovative, open possibility for design, expansion, development, renewal, overlapping, addition and superimposition (Fenton, 1985; Adam, 2018; Stöckmann, 2017). Buildings with multifunctional uses are often referred to as 'hybrid', even though they are merely an addition of functions, i.e., a mixed form of use.

Bhabha (2016), for example, describes a genuine hybrid space in his 'Third Space Theory': 'But for me the importance of hybridity is not to be able to trace two original moments from which the third emerges, rather hybridity to me is the ‚third space' which enables other positions to emerge.' Bhabha understands hybridity not simply as the combination of two things into a third, new something, as in technology or biology, but for him the consideration of 'cultural difference' and 'cultural translation' leads to the concept of the 'third space', which can open up between cultures and enable cultural negotiations and 'translations'.

In the context of my research, I define 'hybrid space' as a possibility and origin for change by providing free space for improvisation, innovation, experiments and new ideas of different actors. Hybrid space thus becomes 'more than the sum of its parts' (according to Aristotle: 'The whole is more than the sum of its parts.'), something unpredictably new emerges in the encounter and interaction. This distinguishes hybrid spaces significantly from multifunctional spaces and makes them interesting for educational institutions and schools in which creativity, individual activity, learning and community play a decisive role: through overlapping and encounters, hybrid architectural concepts could support integrative and inclusive pedagogical and didactic methods, which currently undergo a paradigm shift against the backdrop of heterogeneous student bodies. With its spatial possibilities, hybridity can open up schools to the outside world and utilize the potential of external actors and stakeholders from society, business, economy, and industry from real everyday life into the school.

2 The concept of "Schule als Hybrides System"

Hybrid architectural-educational concepts, in which schools are understood as a kind of 'home base', transform school space into a 'hybrid space' that includes various user groups. For example, rooms in the building for coworking spaces, a communal canteen, offers for health promotion and leisure activities, adult education, space for exhibitions, libraries or start-ups integrate the school and its educational mission into the socio-cultural, socio-structural and socio-economic environment and open up opportunities as a kind of 'creative SpielRaum' or creative leeway (Sedighi, 2018), as a meeting place and setting for educational networks with non-school stakeholders from society, industry and services in the immediate vicinity (Fig.1).

By superposing diverse and varied functions, 'schools as a hybrid system' can accommodate current social developments such as demographic change, diversity and inclusion, migration and technological trends (digitalization, artificial intelligence) and create innovative conditions for dealing with the requirements and effects of such change processes. It can support the paradigm

shift in social values towards sustainability, sharing ('sharing economy') and participation against the backdrop of the global goals for sustainable development of the UN Agenda 2030 (United Nations, 2015, UNESCO, 2014).

Figure 1: "Schule als Hybrides System" - more than a place of learning (Sedighi, 2022).

"Schule als Hybrides System" acts as an architecturally multidisciplinary integrator of structures, systems, processes and internal and external actors in the education sector. It forms a communal, identity-forming social space for the municipality and the urban quarter by superimposing and integrating a wide variety of institutions and private companies from all sectors (primary, secondary and tertiary sector). In this way, a new, agile center is created in the urban quarter and at the heart of society (Figure 2).

School is thus transformed from a pure place of learning into a 'place of living', where children and young people are no longer educated and taught separately from the rest of society with their teachers and caregivers, but where they experience real everyday life. Older people (e.g. childcare and homework supervision by senior citizens on the one hand and explanation of modern digital media by children on the other) can be integrated into hybrid concepts, as can parts of the family (e.g. coworking spaces) - there are few limits to the design here and schools can open up as much as possible, but boundaries must also be drawn where necessary (e.g. noise, safety).

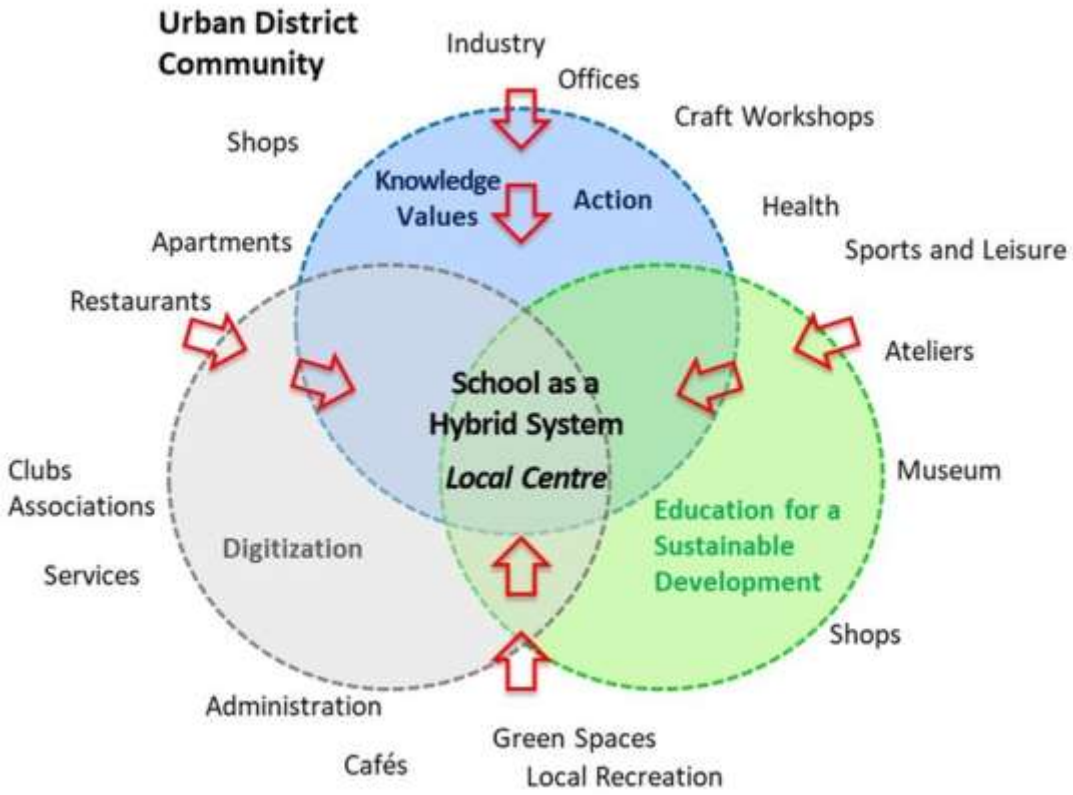

Figure 2: "Schule als Hybrides System" - creation of a multifunctional center in the urban quarter at the interface between education, sustainability and digitalization (Sedighi, 2023).

3 "Schule als Hybrides System": definition and objectives

"Schule als Hybrides System" is an intended form of hybridity and is based on differences, diversity, ambiguity and heterogeneity. It is variable, multi-layered and surprising and is only activated, shaped and developed by the different user groups. It includes the surroundings, consciously creates networks and transitions from a pure learning space to a hybrid living space (Fig. 2).

Some of the main objectives of "Schule als Hybrides System":

- expands the range of uses and opens up space for socio-cultural communication, improvisation and innovation,
- stands for an educational network of various stakeholders that goes beyond the school itself counteracts social and ethnic-cultural segregation in an integrative way,
- promotes inclusion and teaching concepts for heterogeneous groups of students,
- supports the transition from school to working life and offers holistic solutions for the training of highly qualified specialists and managers of the future,
- creates a reliable, stable learning and working environment in a kind of 'home base' and is therefore an interesting concept, especially for all-day schools,
- is adaptable and variable in terms of future social and technological challenges.

3.1 School as a hybrid system: education for sustainable development (ESD)

The educational concept for sustainable development (ESD) is based on openness, reflexivity, networked learning, future viability, vision orientation and participation and requires knowledge in the sense of information, understanding, skills, values and attitude (BMBF, 2017; Künzli-David, 2010; de Haan, 2008).

"Schule als Hybrides System" reinterprets learning, living and working in terms of 'quality education'[2] under one roof by transforming the different requirements in an adaptive form. It is a complex system with a multitude of interlinked processes. It creates a holistic cosmos in which, according to the principle of lifelong learning, not only knowledge but above all skills are imparted against the background of current and future social, technological, climatic and economic challenges (cf. BMBF, 2017; Künzli-David, 2010).

Through the interaction and coherence between 'education' and the 'built environment', a so-called 'creative SpielRaum' for social transformation and shaping the future is created in a "Schule als Hybrides System." This 'creative SpielRaum' is a hybrid space in which diverse and variable functions and different views, perceptions and ideas come together (Sedighi, 2018), so that it can provide a basis for the development and unfolding of innovative possible solutions and their implementation and is fundamentally important for the design of the educational environment and environmental education.

The overlapping of user groups, the integration of external actors and hybrid development spaces created for this purpose can promote the achievement of the global, sustainable development goals (United Nations, 2015), namely to motivate and empower students at an early stage to become integrated, critical and responsible members of our society and at the same time to sensitize all actors involved across generations to sustainability in a global context (BMBF, 2017; Künzli-David, 2010; de Haan, 2008; Forghani, 2001; Stiftung Bildung und Entwicklung, 2010).

Hybrid schools are not limited to a specific pedagogical approach but combine and complement the formal teaching mission of the school with non-formal and informal learning approaches, practice- and action-oriented from "education to edu'action'', making school a social place of learning.

3.2 School as a hybrid system: digitalization

Modern digital technology should always be available in every classroom but 'school as a hybrid' system offers variable possibilities for the implementation of diverse digital learning formats and hybrid learning concepts with an expanded range of rooms and an optimized room concept. There can also be tech labs or maker spaces for digitally oriented project work, programming and computational thinking, as well as informal digital learning environments such as a digitally

[2] As part of the "United Nations World Summit on Sustainable Development" in September 2015 (SDG Sustainable Development Goals, Agenda 2030), a total of 17 goals in five areas (People, Planet, Prosperity, Peace, Partnerships (ibid.)) were adopted for global sustainable development in a resolution of the General Assembly (United Nations, 2015). One of the most important goals (Goal No. 4) is "Quality Education" and means ensuring inclusive, equitable and quality education and promoting lifelong learning opportunities for all (ibid.).

equipped learning lounge, digital workplaces in the library or cafeteria, digitally equipped work niches and group rooms.

"Schule als Hybrides System" can also address and communicate digital topics in a way that is relevant to society and across generations by allowing different stakeholders, such as IT companies or IT start-ups, parents who work with digital media in coworking spaces, students and teachers, people from a retirement home and many more, to interact with and benefit from each other. This creates platforms for an interactive exchange between the various user groups with the opportunity to prepare students for their professional world in the digital future (Fig. 3).

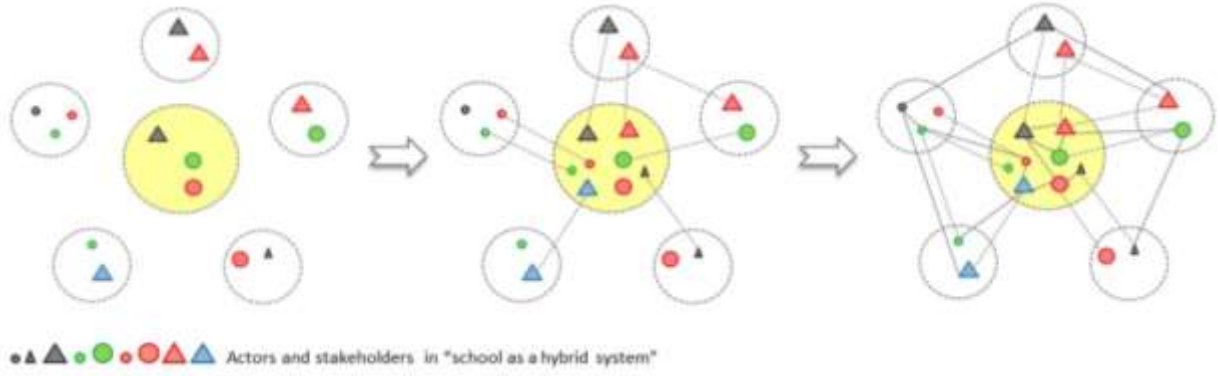

Figure 3: "Schule als Hybrides System" - Schematic representation and development process of an interactive networking platform (Sedighi, 2020).

Thanks to the familiar networks that have been created within the school, the barriers and obstacles from a social, socio-economic, cultural and technological (digital) perspective are better recognized, addressed and, if possible, overcome together through informative transparency. "Schule als Hybrides System" can thus help to decouple academic success from the social and economic background of the students and ensure more equal opportunities, especially for disadvantaged children and young people.

By integrating a large number and variety of stakeholders, it promotes an exchange of experiences and mutual learning effects that accelerate familiarization and the sensible and safe application of new digital developments in the education sector: "Schule als Hybrides System" acts as a catalyst for digital transformation.

4 Holistic architectural hybridization

The architectural development of "Schule als Hybrides System" as a form of school of the future has to do with the aspects of modularity, flexibility, multi-optionality, multifunctionality, optimization of use, temporary or permanent densification, transformation and digitalization. The hybridization of schools will meet with interest in cities, especially in urban centers and conglomerations, where there is a shortage of developable land, the price level is correspondingly

high, and a high building density is accepted. Here, architecture - as a physical supporter of performance, activity and social and cultural community - opens up the space for a new way of teaching and learning and creates a diverse learning and 'creative SpielRaum', a hybrid educational and experiential space.

For the architectural hybridization of a school, the structural, functional and design potential should be considered holistically (Fig. 4). Structural expansion options and space optimization are key aspects for the integration of new functions as well as the creation of different atmospheres through the conscious design of functional areas and the use of sustainable materials.

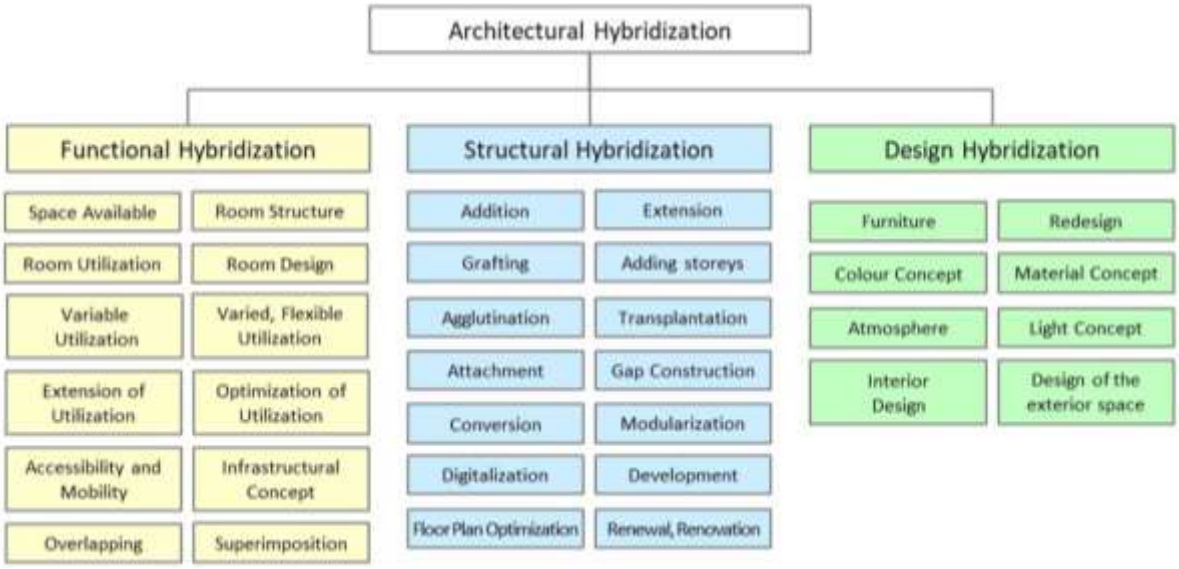

Figure 4: "Schule als Hybrides System": Holistic architectural hybridization (Sedighi, 2023).

Here, common rooms, infrastructure, separating and connecting sections, overlapping areas and places of connection and turning areas are just as important as a varied but safe access and development concept. The view is directed once from the outside in and once from the inside out in order to determine the clear positioning of the spaces in the three areas with the attributes 'private, semi-public and public'. If necessary, rooms are designed for larger groups and the rooms are converted, repurposed or extended.

In this context, the access and circulation areas play a vital role in clearly separating and differentiating the private, semi-public and public areas and ensuring the safety of the players (especially the underage students). At the same time, it is important that, in their role as 'traffic arteries', they connect all areas with each other in such a way that smooth transitions are created, and all players have free access to their areas as well as to the communal zones. Separation and switchability of the areas and sectors should, however, remain an integral part of the planning. The elements are selected and arranged in such a way that synergies can be created through combination and interaction.

Analogous to Reiß's VDAV model (Reiß, 1993; Reiß, 2008), the degree of hybridization can be specifically influenced in four dimensions, namely Variety, Diversity, Ambiguity and Variability,

depending, for example, on how many and how diverse and heterogeneous actors are brought in, how great the differences are, what dynamics and ambiguity are desired. This depends on the needs of the users and the analyzed usage profile of the respective urban district or community and can be adapted to the respective school type and age groups.

The increase in the number of players in the school and an increase in diversity inevitably lead to a functional expansion and the associated structural measures, adaptations and changes, which take on a certain hybrid form and shape using the hybridization principles. These in turn are designed and adjusted using the VDAV parameters. Changing each of these parameters simultaneously leads to a mutual interaction between the three hybridization categories 'functional', 'structural' and 'design' (Fig. 4). For example, by integrating new functions in the school, new spaces are added in a monolithic, agglutinative, modular or chain-like manner according to architectural hybridization principles, and different zones and areas are created that can be realized with design measures in both the interior and exterior spaces with a high aesthetic quality. The number of rooms is increased, the structure and arrangement of the rooms and the utilization concept are adapted with regard to multifunctionality, new key architectural elements are added, the entire access and circulation concept is modified, the number of stairwells is increased, separate sections and hybrid levels are developed and expanded and switching and turning areas are added.

The active hybridization of a school in terms of space, room structure, room use and room design according to the VDAV-principle leads to a transformation and development. An innovative, hybrid system grows out of a classic school building with structures that not only integrate technologies, processes and actors, but which themselves act as a designer and integrator ('3rd pedagogue') and thus form a 'common whole' that promotes and demands the relationship, connection, interaction and interplay of the players. Architectural hybridization can be planned vertically and/or horizontally in a mobile, temporary manner as well as in a permanent form.

4.1 Design hybridization

The design aspect plays a significant role in the interaction between the various hybridization categories. Design hybridization includes spatial planning aspects as well as a harmonious arrangement of rooms and an optimization of areas based on the multi-optionality of functions and uses. The focus is not only on the design of the function(s), but also on the design of the form and its construction and materiality as an interpretation of the implementation of the new, hybrid usage spaces, which can also be integrated into the context of an existing school as a planned development and extension concept. The targeted use of a variety of sustainable and environmentally friendly materials can emphasize the character of the rooms, define zones, create a haptic effect, stimulate concentration with light and play of color and thus successfully support the learning process. The design of the shape and size of a room can also have a considerable influence on the way it is used and its functional effect.

A well-thought-out color scheme in combination with comfort and variable lighting design helps to increase the motivation and performance of the students and further actors. The use of

convertible furniture and equipment also has a strong influence on the design of hybrid spaces and thus the way they are used.

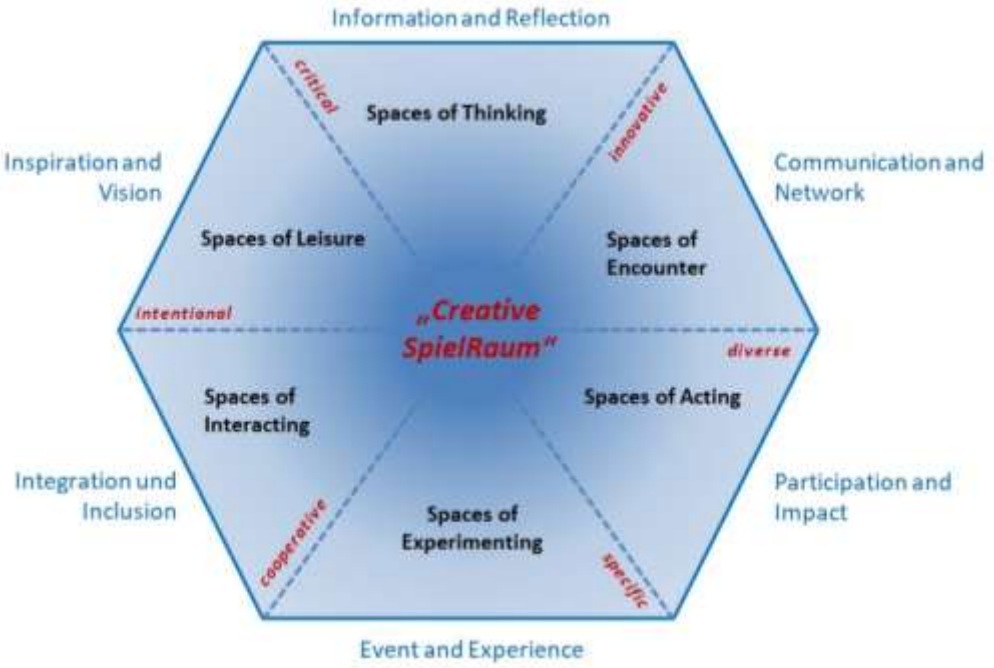

Figure 5: "Schule als Hybrides System" as a 'creative SpielRaum' (Sedighi, 2023).

In summary, variable equipment and furniture, intelligent color concepts, controllable lighting concepts and design of the hygiene concept, room comfort, coziness and atmosphere and their multifaceted interplay are decisive to develop 'space as a 3rd educator.'[3] The combination and interaction of these design elements with functional and structural measures for hybridization creates individualized learning areas, spaces for encounter, spaces for thinking, spaces for action, spaces for communication, spaces for experimentation, 'swarming zones' and 'strolling areas', but also space for resting, pausing, lingering and leisure. In this way, learning space becomes a hybrid living space, namely 'creative SpielRaum' (Fig. 5), which develops continuously and dynamically through the active involvement of the stakeholders: according to the motto 'from education to edu'action''.

5 "Schule als Hybrides System": planning process and implementation

When planning and implementing a "Schule als Hybrides System", a large number of participating institutions has to be included, different organizational forms of cooperation must be integrated, architectural-pedagogical and infrastructural aspects considered as holistically as possible and socio-spatial relationships must be established. School and external, non-school educational

[3] If the 'room as a third pedagogue' (Loris Malaguzzi (Knauf, 2017)) is to take full effect, the form, function, and design of the rooms must first be phased and matched to positively stimulate learning behavior and increase and support learning motivation.

institutions, industrial companies, service providers and public and private institutions should all become part of the "Schule als Hybrides System".

"Schule als Hybrides System" integrates non-school stakeholders and their needs into the school space. This results in synergies, e.g., in the provision and use of restaurants, quiet rooms, shared event and meeting spaces, multifunctional areas and digital equipment. This type of integration poses structural, cultural, and architectural challenges (e.g., digitalization, acoustics, spatial demarcation, code of conduct).

When planning for a 'school as a hybrid system,' it is essential to meet specific conditions, consider prerequisites, and set up agreements. Specifically:

- A variable and flexible usage structure should be created.
- Limited rights of use must be possible.
- No derivation of property rights from the intended rights of use should be possible.
- The ownership structure and the boundaries of the facility (private, semi-public, public areas) must be clarified.
- The surrounding open space of the building(s) in the transition to the public space must be defined.
- The surrounding open space can/may also be used flexibly by the various stakeholders.
- The participatory and active role of the stakeholders in the neighbourhood/community is crucial for the controlled and targeted hybridization of a school. This is why
  - 'school consumers' should become active space and learning 'prosumers',
  - concepts for school space are created experimentally by the actors themselves,
  - the interplay between their own actions and the actions of the other stakeholders involved can be 'felt' and understood,
  - the corresponding actions and procedures can be observed, experienced, and tested.

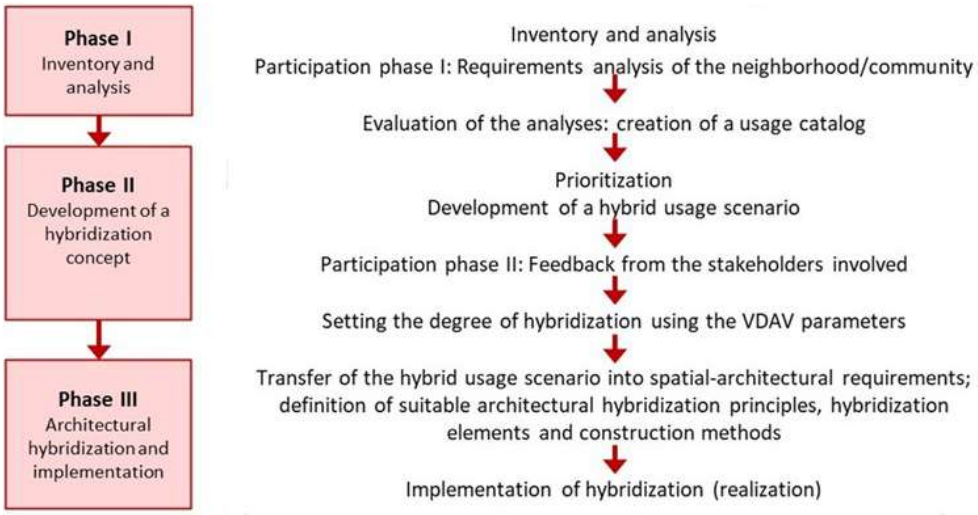

Figure 6: "Schule als Hybrides System": holistic planning and implementation process of the architectural hybridization (Sedighi, 2015; 2023).

In a holistic planning process for "Schule als Hybrides System", structures must be adaptable, experimentally usable, expandable according to the agglutinative principle expandable or reducible and/or divisible, generally convertible and variable. The following steps are essential when preparing, planning and implementing a (model) project "Schule als Hybrides System" (Fig. 6):

- Inventory and analysis of the projected school and the urban quarter/community as the basis for developing a usage profile.
- Participation phase I - Surveys, workshops, interviews to analyze the needs of the neighborhood/community.
- Evaluation of the surveys/feedback - development of a usage catalog.
- Prioritization against the background of pedagogical, architectural, and economic preconditions.
- Creation of a diverse and multifaceted usage scenario.
- Participation phase II - feedback from the stakeholders involved.
- Design of the degree of hybridization based on selected parameters of the usage scenario.
- Transfer of the usage scenarios into spatial-architectural requirements with suitable architectural hybridization elements, tailored to the given district/municipality.
- Implementation of the hybridization process (realization).

The detailed inventory distinguishes between the three categories 'school and architectural space', 'school and pedagogy' and 'school and society' and focuses on a needs analysis (participation phase I), a comprehensive analysis of the location and the architectural school typology. The analysis and target-oriented evaluation of the inventory forms the basis for an initial idea of a desired and necessary range of rooms, room program and room catalog for the school. This is then evaluated and prioritized - also in further interactive feedback loops with the stakeholders - with regard to the implementation possibilities and taking into account the functions and spatial concepts as well as the educational, architectural and economic framework conditions.

In the next step, an interdisciplinary team of architects, urban planners, representatives of the responsible building authority, educators and social pedagogues and other stakeholders 'translates' this prioritized space catalogue into an individual, site-specific hybrid usage concept or usage scenario[4] this prioritized space catalog into an individual, site-specific hybrid usage concept or usage scenario that includes at least the four functional areas of 'learning formats', 'services and community activities', 'skills and competencies' and 'networking and cooperation' (Fig. 7).

What such a hybrid usage scenario looks like in detail can differ significantly depending on the location. "Schule als Hybrides System" always follows an individual, location- and stakeholder-specific usage scenario that is tailored to the current needs of the respective district/community and its stakeholders. For example, health, sports and leisure facilities can be integrated into the school, as can workshops, coworking spaces and start-ups (Fig. 1). The function fields can be expanded and complemented as required.

[4] The composition of the team naturally depends on the respective project and the municipality or city and may include other experts and stakeholders.

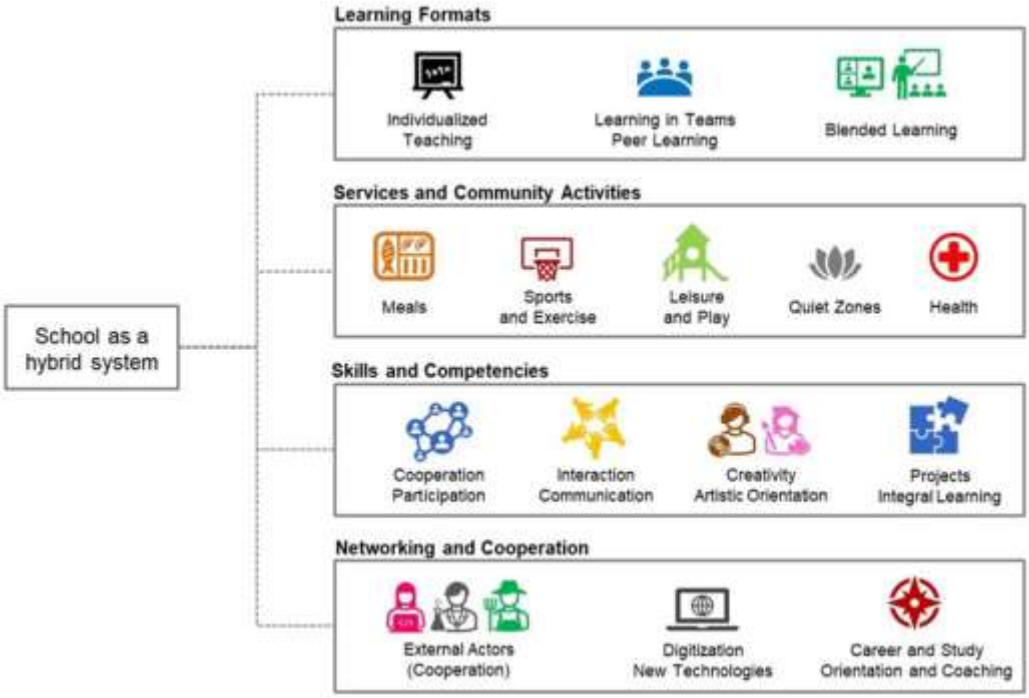

Figure 7: Hybridization process: exemplary categorization of functional fields for the creation of an individual and specific usage scenario for "Schule als Hybrides System" (Sedighi, 2022).

Economic aspects are just as important for implementation in practice as a fundamentally positive attitude and acceptance of the community or neighborhood. In addition to a clear pedagogical concept, the participation of the various stakeholders, e.g., parents/custodians, students, teachers, and extracurricular partners, is particularly important. In this way, "Schule als Hybrides System" can best succeed as an element of sustainable and participatory neighborhood or community development.

Important prerequisites for the successful implementation of a concrete (model) project "Schule als Hybrides System" are:

- Acceptance and openness of the neighborhood/community and the land/building owner towards the "Schule als Hybrides System" concept.
- Active participation of stakeholders in the planning process (participation phase I).
- Pedagogical concept and mission statement.
- Integration into the development plan of the neighborhood/community.
- Financing concept and planning.
- Holistic digitization concept.
- Involvement and cooperation of stakeholders during implementation (participation phase II).

The general and specific framework conditions of schools can be identified as contextual factors. General, for example, is the school legislation of the respective country, specific is the neighborhood surrounding a school and its socio-economic structures.

The process of hybridization also gives rise to numerous architectural, educational, and legal issues. These include the rights and obligations of the actors and stakeholders and the necessary regulations on safety, monitoring, access options and usage behavior. In a corresponding project, the following architectural, educational, legal, and economic framework conditions, and in particular the rights and obligations of the actors and stakeholders, should be given special consideration:

- Compliance with applicable legislation and regulations (e.g., school legislation, building regulations).
- Compliance with the guidelines of the neighborhood/community and the owner/operator.
- A joint body responsible for managing and monitoring the system.
- Regulations on usage behavior.
- Clear regulations regarding assumption of liability.
- Regulations on security and monitoring.
- Adequate access options and (technical) infrastructure.
- Cost-benefit ratio.
- Partly limited rights of use.

Reliable compliance with the agreements about the use by different user groups must be guaranteed, and it should not be possible to automatically derive corresponding ownership or appropriation rights from the intended usage structures. This is particularly important to ensure the safety of students and other actors.

Targeted synergies are created in such a hybrid usage scenario. This turns the school into a place of skill and action and a networked, interactive, and agile place of education and digital participation for all. "Schule als Hybrides System" is not a final product but is constantly evolving in a dynamic process.

The main prerequisite for a pilot project is a municipality or urban district with stakeholders who are in favor of such a project (new school construction or renovation and modernization of an existing school) and agree to actively support it. With a team of experts from the fields of architecture, education, and administration and with the active participation of as many stakeholders as possible (municipality, residents, school, and non-school stakeholders), the various phases of preparation, planning, implementation, and evaluation of "Schule als Hybrides System" could be realized together.

6 Application scenarios

The research results presented provide the basis for a first experimental implementation and testing of "Schule als Hybrides System". A specific monitoring process with a defined and scientifically underpinned parameter matrix and suitable monitoring tools should be developed by an interdisciplinary team for this purpose. "Schule als Hybrides System" can be used universally,

regardless of a school's pedagogical guiding principle, but the concept could demonstrate its advantages particularly well in certain scenarios, especially in a pilot project.

After disasters such as floods, 'schools as a hybrid system' could quickly and easily make essential functions of affected cities and communities available again in the affected areas in a central and possibly temporary building, especially if implemented with cost- and time-efficient modular construction. Building on the parameters of variety, diversity, ambiguity, and variability, "Schule als Hybrides System" can also contribute to the rapid integration of people who come to us from crisis and disaster areas.

The concept also offers innovative and flexible options for the transformation of schools into all-day schools in line with Goal 4 of the UN's 17 global sustainability goals (United Nations, 2015) - Quality Education - for integrating a corresponding all-day offer beyond pure teaching.
In rural areas, 'schools as a hybrid system' can contribute to the revitalization and attractiveness of a village as a new center and represent a crucial factor for the influx of new families.

In densely built-up urban districts, a combined renovation and hybridization of existing schools offers new options for future-oriented and cross-generational participatory densification strategies. The concept of "Schule als Hybrides System" is transferable to other educational buildings such as colleges and universities and to public buildings in general.

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Design Curriculum Reimagined: Leveraging Design Thinking for Educational Innovation

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Abstract

The present paper addresses the possibilities of using Design Thinking as a methodology and a tool to create a new educational curriculum in design at the Bachelor level. The paper is based on the case study of the Arts+Design Department at the American University of Science and Technology [AUST], a Lebanese university adopting the American credit system, and currently undergoing significant changes in its programs. The case illustrates particular opportunities and related challenges and reveals how design thinking has been effective to address intricate social and economic conditions of a challenging environmental context. But despite the circumstances, the Arts+Design Department created a human centred design curriculum that supports students in their learning journey, not only by disseminating knowledge and expertise, but also by empowering them to strategize and to fill gaps in their communities via problem solving, entrepreneurial thinking and design training. The new—currently still under development—curriculum spearheads the way towards a forward-thinking design program, which is both open to international ideas and simultaneously deeply rooted in its socio-cultural surroundings.

Keywords

design thinking, human-centered, curriculum design,process strategies, competency-based education

1 Introduction

The design of university curricula is a multifaceted process that balances educational goals, societal needs, and industry demands. Universities face challenges such as technological advancements—most recently AI (Johnson et al., 2021), balancing general and specialized knowledge (Smith & Anderson, 2020), managing stakeholder interests (Barnett, 2018), meeting accreditation standards (Williams, 2019), ensuring inclusivity (Brown & Caruso, 2021), and overcoming financial constraints (Gonzalez et al., 2022). Additionally, universities must maintain academic rigor while adapting to new paradigms (Knight, 2019), address globalization (Jackson & Miller, 2020), and cater to increasingly diverse student populations (Lee & Perez, 2020). Demands for curriculum innovation require continuous updates to reflect industry trends (Thomas, 2021) and interdisciplinary approaches (Anderson et al., 2019), alongside flexible learning models accommodating different styles (Davis & Kim, 2020).

Design Thinking has been effective in technology, stakeholder management, and education (Brown, 2009; Carlgren, Rauth, & Elmquist, 2016). While research has explored its use in teaching (Razzouk & Shute, 2012), its application to curriculum development remains underexplored

(Henriksen et al., 2017). The application of design thinking principles to the process of creating and refining educational curricula offers a promising yet underexplored avenue for innovation in educational design (Laurillard, 2012). Design Thinking's human-centered approach fosters flexible, student-centered, and future-oriented curriculum structures (Koh et al., 2015). Being also a human-centered approach that emphasizes empathy, ideation, and experimentation, therefore facilitating a holistic and creative problem-solving process (Brown, 2009), Design Thinking aligns well with educational goals by ensuring relevance and engagement (d.school, 2021), fostering creativity and innovation (Razzouk & Shute, 2012), and promoting interdisciplinary collaboration (Carroll et al., 2010). It also enhances problem-solving skills through the integration of experiential and project-based learning (Goldman & Kabayadondo, 2017), prioritizes faculty development (Kolb & Kolb, 2005), and establishes industry partnerships (Dym et al., 2005). Additionally, Design Thinking is instrumental in developing suitable assessment methods that reflect real-world challenges (Brown & Katz, 2011), and in supporting the creation of innovative curricula that respond to the needs of diverse student populations (Pohl, 2015). Finally, it emphasizes the importance of continuous iteration and feedback in the curriculum design process, ensuring that educational programs remain dynamic and adaptable (Fixson & Read, 2012; Koh et al., 2015). By incorporating these elements, Design Thinking can help to create curricula that are adaptive, innovative, and closely aligned with real-world needs, ultimately preparing students for the complex challenges of their professional careers.

This research explores the potential of Design Thinking as a tool for developing university design curricula at the Bachelor level, focusing on the Arts+Design Department at the American University of Science and Technology (AUST) in Beirut. AUST provides American-style education with a focus on critical thinking, research, and societal needs, making it an ideal case study for this examination. This paper includes a literature review on curriculum design, a detailed methodology, an empirical case study of AUST, and concludes with recommendations for future research and policy development.

2 Literature Review

2.1 Design Thinking

Design Thinking is a problem-solving framework that emphasizes empathy, ideation, and experimentation through a non-linear process of empathizing, defining, ideating, prototyping, and testing (Brown, 2009). It encourages creativity and innovation via iterative development and focuses on user-centered solutions (d.school, 2021). It fosters collaborative ideation and ensures practical, effective solutions through prototyping and testing (Razzouk & Shute, 2012).

Evolving from its origins in engineering and industrial design in the 1960s (Simon, 1969), Design Thinking became a formalized methodology in the 1980s and 1990s, particularly through IDEO and Stanford's d.school (Brown, 2008). Initially focused on product design, it expanded into business strategy and innovation (Martin, 2009), education, healthcare, and social innovation (Kolko, 2015). Design Thinking integrates human needs with technology and business success, making it applicable across disciplines (Buchanan, 1992). Companies like Apple and Google use it to drive innovation, improve customer experiences, and foster growth (Kelley & Kelley, 2013),

while in healthcare, it enhances patient care delivery (Meinel & Leifer, 2011). In education, Design Thinking fosters student engagement and problem-solving skills (Brown, 2008).

2.2 Design Thinking in Higher Education

Design Thinking has increasingly been adopted in higher education as a transformative tool for teaching and learning (Brown, 2008). This approach is particularly valued for its ability to foster creative problem-solving, critical thinking, and collaborative learning among students (Razzouk & Shute, 2012). Institutions like Stanford University's d.school use it to teach students problem-solving and innovation across disciplines (d.school, 2021). Studies show its use in classroom settings enhances student motivation and deepens learning by making abstract concepts tangible (Henriksen et al., 2017). It equips students with the tools to navigate ambiguity and uncertainty in a rapidly changing world (Carroll, 2015). As a result, Design Thinking aligns well with educational outcomes and 21st-century learning needs.

2.3 Present Difficulties in University Curriculum Design

Designing university curricula is a multifaceted process, balancing educational goals, societal needs, and industry demands (Ornstein & Hunkins, 2018). Challenges include keeping pace with rapid technological advancements, such as AI, which requires investment in infrastructure and faculty training (Johnson et al., 2021; Smith & Anderson, 2020). Balancing general education with specialization (Barnett, 2018) and accommodating diverse student interests and career goals (Williams, 2019) complicates curriculum design further. Faculty members value academic freedom in designing courses, while administrators focus on standardization and accountability (Brown & Caruso, 2021). Additionally, aligning curricula with industry needs without compromising academic integrity (Gonzalez et al., 2022), maintaining accreditation standards (Knight, 2019), and ensuring inclusivity and accessibility for diverse populations (Lee & Perez, 2020) are persistent challenges. Budget constraints often limit resources for faculty and technological updates (Anderson et al., 2019), further complicating efforts to keep curricula relevant.

2.4 Design Thinking as a Methodology in Curriculum Design

Design Thinking aligns well with curriculum design for several reasons. Its human-centered, iterative approach ensures curriculum relevance and adaptability through continuous feedback (Carroll et al., 2010). It fosters creativity and interdisciplinary collaboration, supporting innovation in design education (Razzouk & Shute, 2012). Prototyping allows educators to refine teaching methods and materials before full implementation (d.school, 2021), while integrating real-world problems provides students with practical experience (Goldman & Kabayadondo, 2017).

Design Thinking can be integrated into curriculum design through several key elements, including problem-solving, experiential learning, project-based learning, faculty development, interdisciplinary collaboration, industry partnerships, and innovative assessment methods. Razzouk & Shute (2012) highlight the importance of Design Thinking for developing students' problem-solving skills. Kolb & Kolb's (2005) Experiential Learning Theory suggests that learning occurs through cycles of concrete experience, reflective observation, abstract conceptualization, and active experimentation, all applicable in Design Thinking curricula. Project-based learning (Dym et al., 2005) improves student engagement and prepares them for real-world challenges.

Brown & Katz (2011) emphasize the importance of interdisciplinary collaboration, and Pohl (2015) highlights the role of faculty development in successfully implementing Design Thinking methodologies. Industry partnerships enhance curricula by providing real-world projects and mentorship opportunities (Fixson & Read, 2012). Koh et al. (2015) suggest alternative assessment methods, such as portfolio assessments, peer evaluations, and reflective journals, to align with Design Thinking principles.

3 Methodology

A case study research methodology was adopted for this paper, being a qualitative research approach that provides an in-depth understanding of a specific case within a real-world context and it is often used in social sciences and education to explore complex phenomena and gain insights that are not easily obtained through other research methods (Denzin, 1978).

A case study is a detailed examination of a single subject, such as an individual, group, event, organization, or community (Yin, 2018). The purpose of this methodology is to explore and understand the dynamics, processes, and relationships within a specific, real-life context (Stake, 1995). This methodology is also flexible and adaptable, allowing methods and techniques to be adjusted as the study progresses (Denzin, 1978).

The outcome of a case study research provides rich data through combining multiple sources of evidence and data collection, such as interviews, observations, documents, and archival records (Yin, 2018). Narrative analysis can also be used to construct a detailed description that tells the story of the case (Eisenhardt, 1989). The benefits of case study research include gaining a comprehensive and detailed understanding of complex phenomena, capturing nuances and subtleties that might be missed with other methods (Yin, 2018). It also allows researchers to study singularities in their natural settings, facilitating the exploration of context-specific factors and interactions (Stake, 1995). This methodology also encourages the use of diverse data sources, enhancing the robustness of findings and promoting triangulation, which strengthens the credibility of the research (Denzin, 1978).

At the end, case study research generates findings that are directly applicable to real-world situations, making it useful for practitioners seeking to understand and address specific issues (Merriam, 1998). It also contributes to theory by providing empirical evidence that can support or challenge existing theories and offers insights that can lead to the development of new theoretical frameworks (Eisenhardt, 1989).

4 Case Study AUST

The context of this case study is the American University of Science and Technology, Beirut, Lebanon.

4.1 Lebanon

Lebanon is currently facing a complex macro-environment characterized by significant economic, political, and social challenges. Since 2019, a severe economic crisis has caused the sharp devaluation of the Lebanese Lira, skyrocketing inflation, and widespread poverty. Political instability, coupled with corruption and governmental deadlock, has further eroded public trust (Maksad, 2020). The social fabric has been strained by the Syrian refugee crisis, putting immense pressure on Lebanon's fragile infrastructure and public services (El-Hage & Jabbour, 2021). The COVID-19 pandemic exacerbated these challenges, deepening economic and social inequalities. Environmental concerns such as waste management and limited natural resources also pose significant challenges, affecting public health and quality of life (UNDP, 2021). The education sector, in particular, is vulnerable, as universities struggle to adapt to rapidly changing conditions, highlighting the need for innovative solutions to navigate Lebanon's ongoing crises.

4.2 The American University of Science and Technology

The American University of Science and Technology (AUST) began operations in 1989 as the American Universal College (AUC) and was renamed in 2000 by presidential decree #3585/2000. AUST officially gained university status in 2007. AUST emphasizes excellence in teaching and research, providing affordable American-style education that promotes learning, critical thinking, and applied research. AUST prioritizes student-oriented learning and maintains strong national and international networks for collaboration, part-time and full-time employment opportunities, and research initiatives. The university's programs are modeled after those in the USA, offering high-quality education with a liberal arts foundation. AUST aims to graduate competitive, motivated individuals, fostering problem-solving and entrepreneurship skills. It offers flexible scheduling for working students and encourages applied research to address societal challenges. AUST operates four campuses in Beirut, Zahlé, Sidon, and Bhamdoun, with 32 undergraduate and 16 graduate programs and partnerships with over 60 international universities (AUST, n.d.).

4.3 The Current Challenges

In 2023, AUST's administration recognized the need to overhaul its Art and Design programs—Interior, Graphic, and Fashion Design—due to challenges heightened by the COVID-19 pandemic and Lebanon's economic crises. Issues included the rapid shift to online learning, economic instability affecting resources, brain drain, mental health concerns, student dropouts, and difficulties maintaining international competitiveness (Fawaz & Samaha, 2021; World Bank, 2021; Karam, 2021; UNICEF, 2021). To address these, AUST appointed a new Chairperson for the Arts+Design Department to lead a comprehensive curriculum redesign. Following research from October to November, which included faculty and student iteration, class observation and syllabus evaluations, the investigation highlighted several key issues: an outdated curriculum, delayed introduction of real design courses, over-reliance on manual tools, siloed course content, and a lack of entrepreneurship and innovation. The new Chairperson initiated the Design Thinking process in January 2024, involving student focus groups, faculty retreats, and side meetings. The agendas of those exercises, centered around the redesign of the existing design program and how it be can be evolved using design thinking as a main methodology. The student focus groups, averaging 15 students per session, began by gathering insights on current challenges and desired improvements in the curriculum, emphasizing empathy and understanding students' needs. The

faculty retreat, with 32 faculty presents from all three programs, focused on ideation, where faculty members collaboratively brainstormed and prototyped potential changes to the curriculum, considering the feedback from the student focus groups. The retreat also include sessions on aligning the proposed changes with industry trends and educational best practices. The follow-up side meetings were program dedicated, where faculty from the same program, both part timers and full timers, refined the ideas discussed in the retreat, iterated on proposed solutions, and discussed implementation strategies with key stakeholders.

The culmination of all phases boiled down to three distinct pathways, which can be summarized in the following titles: 1. The inheritance of an outdated curriculum, 2. The students' frustration, and 3. The underperforming student outcomes.

5 Interventions on the three pathways

The Design Thinking process was applied to craft a unique program preparing students for evolving design careers, aligning with the World Economic Forum's top skills for 2025, including analytical thinking, innovation, creativity, problem-solving, and leadership (World Economic Forum, 2024).
Chosen for its problem-solving abilities and as a unifying language across disciplines, Design Thinking fosters shared vocabulary in design, innovation, and human-centeredness, crucial for interdisciplinary collaboration. It enables students, educators, and industry partners to align diverse perspectives, drive creative exploration, and rapidly prototype solutions that meet real-world needs. By enhancing communication and fostering continuous improvement, Design Thinking empowers individuals to transform ideas into practical solutions.

5.1 Pathway 1: The inherited outdated curriculum

The current curriculum fails to foster innovation, leading to student projects lacking originality, creativity, and problem-solving. This stifles critical thinking, resulting in superficial work that relies on unchallenged assumptions. Without an entrepreneurial mindset, students are discouraged from exploring creative solutions or envisioning sustainable outcomes. A lack of research curiosity leads to repetitive, shallow projects. Additionally, the absence of advanced internships prevents students from bridging theory with practice, leaving them disconnected from industry trends and underprepared for the job market.

Design Thinking fosters innovation, analytical thinking, and entrepreneurial skills by integrating empathy, ideation, and prototyping into the curriculum (Carroll et al., 2010). It encourages continuous improvement, creativity, and interdisciplinary collaboration (Razzouk & Shute, 2012). Design Thinking promotes inquiry and reflection, aligning student projects with real-world market applications (Goldman & Kabayadondo, 2017), while fostering an entrepreneurial mindset that prepares students for the challenges of modern industries (Neck & Greene, 2011). The methodology fosters research curiosity through deep understanding, continuous inquiry, and experimentation, resulting in more informed design outcomes (Liedtka, 2015). Additionally,

Design Thinking helps students make informed internship decisions by aligning personal goals, company culture, and industry needs for a fulfilling experience (Stickdorn & Schneider, 2011).

5.2 Pathway 2: Students' Frustration

Lack of student interest leads to projects marked by minimal effort and shallow analysis, often caused by Lebanon's economic and safety challenges, which further diminish academic performance. Students, overwhelmed by external stressors, disengage from coursework, often perceiving their instructors' knowledge as outdated. This disengagement is compounded by over-reliance on easily accessible online information, resulting in projects that lack depth and originality.

Design Thinking enhances project engagement by fostering a student-centered approach that aligns with learners' interests (Brown, 2009). It empowers faculty to create engaging project briefs and emphasize the value of in-depth classroom learning, helping students move beyond superficial online research. This approach ensures well-integrated, original, and analytically rigorous projects, counteracting reliance on shallow internet searches (Liedtka, 2015).

5.3 Pathway 3: Underperforming students' outcomes

Students' work often lacks originality and depth when they resort to copying content with minimal adjustments. This leads to disjointed projects that misinterpret cultural references, show weak connections between ideas, and fail to deliver clear arguments. The improper use of AI further exacerbates these issues, producing impersonal work that raises concerns about academic integrity.

Design Thinking helps eliminate structural gaps that undermine the persuasiveness of projects. It assists students in refining their semiotic contextualization, producing work aligned with deeper meanings and resonating with the intended audience. It also aids students with short attention spans by fostering consistent, connected ideas, resulting in coherent thought processes and thorough topic exploration. Furthermore, foreign cultural elements in locally oriented projects will undergo proper analysis, ensuring relevance to the local context and avoiding mixed messages.

With the rise of AI platforms, students face challenges in effectively using AI-generated content. Design Thinking guides students in critically analysing this content and integrating personal insights, leading to more consistent and personalized projects. Moreover, it addresses concerns about academic integrity by minimizing reliance on AI for original thinking, preparing students for professional environments where problem-solving skills are essential.

6 Discussion of the Results

To tackle the above-mentioned existing challenges and address the long-standing student frustrations, the new curriculum is being developed with a focus on bridging the gap between academic instruction and industry expectations, ensuring that students are better prepared for real-world design challenges. Previously, the curriculum lacked integration between creative

theory and practical application, which often left students feeling underprepared for professional environments. In response, the redesigned curriculum emphasizes hands-on projects, interdisciplinary collaboration, and opportunities for real-world application. This shift aims to foster a more holistic and practical understanding of design, equipping students with both the creative and technical skills needed to thrive in their careers.

Moreover, the department engaged a diverse group of stakeholders, including faculty, students, industry professionals, and university administrators, to ensure that the redesign was comprehensive and responsive to the needs of all parties involved. Through multiple iterations, the curriculum was refined based on feedback from these stakeholders. This iterative approach allowed for continuous improvement and ensured that the curriculum was both innovative and grounded in the realities of design education.

Throughout the process, the proposed changes were carefully reviewed and discussed with the university administration. The administration's involvement was crucial for securing the necessary support and resources for implementation. After thorough feedback and eventual approval, the redesigned curriculum approved and currently set into motion, marking a significant departure from the previous structure. For instance, where the old curriculum primarily focused on theoretical knowledge, the new one integrates more experiential learning opportunities, such as design labs, industry partnerships, and collaborative projects with other departments. These changes are expected to have a profound impact on students, enhancing their ability to apply design thinking in real-world scenarios and improving their overall preparedness for professional roles.

The following table provides a concise comparison between the old and new programs, highlighting changes in the curricula specifically for the common courses in the foundation year across all three programs.

Furthermore, the department has committed to a continuous process of assurance in learning, recognizing that curriculum development is not a one-time task but an ongoing journey. Since this is still a work in progress, the Arts+Design Department will be undertaking regular assessments, student feedback, and industry input to make continual adjustments to the curriculum, ensuring it remains relevant and effective. This approach embodies a cultural shift towards continuous improvement and problem-solving within the department, fostering a mindset of innovation and adaptability among both faculty and students. By embracing this dynamic and iterative process, the department is ensuring that the curriculum will not only address current challenges but also evolve to meet future needs, making it an efficient and forward-thinking approach to design education.

Before	After
Theories of Art course.	Design Culture course.
History of Arts course. Taught in a classic format with written exams.	History of Arts and Design course. Completely redesigned with project-based learning.
Drawing I course. Traditional drawing techniques.	Sketching for Designers course. Emphasis on visual perception.
Descriptive Geometry course. Geared towards Interior Design students.	Math for Designers. Redesigned to encompass all three design majors.
Computer software I course. Was a second-year level course.	Became a foundation year level course.
Design Studio I course. 2D skills, totally manual and by hand projects with a focus on technical skills.	Became a hybrid class with a combination of both hands-on and digital skills, with a focus on analytical skills.
Design Studio II course. 3D skills, totally manual and by hand projects with a focus on technical skills.	Became a hybrid class with a combination of both hands-on and 3D digital skills, including 3D printing, with a focus on analytical thinking skills.
Painting I course.	Removed.
Did not exist before.	Design Thinking course.
Did not exist before.	Design Entrepreneurship course.
Did not exist before.	Initiation of a new innovation hub, to support students in their entrepreneurship endeavor and assist them in both their curricula projects as well as personal innovations.

Table: Comparison between the old and new programs.

7 Conclusion

In conclusion, this paper explored the use of design thinking as a framework for restructuring a university's Arts+Design curriculum. Unlike traditional applications of design thinking, it was employed to guide the entire curriculum redesign process, addressing existing challenges and aligning with industry needs. Design thinking resulted in several organizational advantages, including improved decision-making, greater stakeholder buy-in, and the creation of a curriculum that is both innovative and responsive to the evolving design field. However, limitations remain as the research is based on a single case study, limiting its generalizability to other contexts. The findings offer insights into bridging the gap between theory and practice in design education, emphasizing hands-on, experiential learning over theory-driven programs. Another limitation is that the redesigned curriculum has not been fully tested in practice, with real-world results still pending. Additionally, further research is needed to integrate theoretical frameworks like Experiential Learning and Constructivist Learning, which could enhance these efforts.

In the upcoming semester, efforts will focus on applying design thinking strategies while integrating educational theories into the curriculum design process. This next phase of research will test how these theories, in conjunction with design thinking, can create more effective, student-centered curricula. Embedding these perspectives aims to enrich practical outcomes and provide a comprehensive understanding of design thinking in curriculum development. By

bridging theory and practice, this approach will contribute to the development of adaptable, student-focused programs that meet the needs of the industry and society.

8 Recommendations

For further research, it is recommended that the application of design thinking be explored in the context of other curricula beyond the Arts+Design Department. Investigating its impact across different disciplines and educational programs could provide valuable insights into its broader applicability and effectiveness. Future studies should aim to test the redesigned curricula in diverse contexts to gather real results, enabling a deeper understanding of how design thinking influences student outcomes and organizational efficiency. Additionally, the potential of design thinking as a tool for decision-making and change management within educational institutions permits further exploration. This could involve examining its role in facilitating organizational change, fostering stakeholder engagement, and enhancing the adaptability of curricula to meet evolving industry demands. By expanding the scope of research to include these areas, a more comprehensive understanding of design thinking's utility in educational settings can be developed, offering a robust foundation for its implementation across a variety of contexts.

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Water Scarcity Management and Finance: A Research and Education Agenda

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Abstract

Water scarcity is a pressing global issue with significant impacts on public health, agriculture, industry, and ecosystems. This paper identifies key challenges, including fragmented governance, insufficient financing, inadequate technical solutions, and social inequities. Governance issues, such as lack of stakeholder coordination, exacerbate inefficiencies, while a $2 trillion annual financing gap highlights the urgent need for innovative funding mechanisms like blended finance, green bonds, and debt-for-nature swaps. Technical barriers, including data gaps and limited scalable solutions, impede decision-making, while social challenges, such as affordability and displacement from large-scale projects, further complicate water management. To address these challenges, the paper outlines a comprehensive policy framework emphasizing institutional reforms, financial innovation, and advanced technological solutions. It advocates for participatory approaches to ensure inclusivity, targeted subsidies for equitable access, and public awareness campaigns to support water conservation. Additionally, it highlights the importance of a robust research and education agenda focusing on interdisciplinary approaches, dynamic policy frameworks, and resilience metrics. This analysis provides a strategic foundation for addressing water scarcity management and finance. It offers actionable solutions to mobilize resources, enhance governance, and ensure sustainable and equitable water use, helping to build resilience against escalating global water challenges.

Keywords

water scarcity, water management, water finance, human rights, policies, research and education

1 Introduction

Global water resources face significant challenges driven by population growth, economic development, climate change, constrained government budgets, and rising nationalism. Currently, approximately 97% of Earth's water is saline, leaving only 2.5% as freshwater, with nearly 70% of this freshwater locked in glaciers and ice caps, and the remainder found in groundwater, lakes, rivers, and the atmosphere (Wikipedia, n.d.). Agriculture dominates freshwater use, accounting for about 72% of global withdrawals, followed by industry at 16% and domestic use at 12% (Statista, 2022). As of 2022, around 2.4 billion people lived in areas experiencing extreme water stress, a figure projected to double by 2050, potentially affecting up to 5 billion individuals (Statista, 2022; Carbon Brief, n.d.). Over the next 30 years, global water demand is expected to increase by 20% to 25%, driven by factors such as population growth, urbanization, and industrialization (World Resources Institute, n.d.). Climate change will further exacerbate water scarcity by altering

precipitation patterns, increasing drought frequency, and reducing the reliability of water supplies (Carbon Brief, n.d.). Economically, by 2050, 31% of global GDP, equivalent to $70 trillion, will be exposed to high water stress, up from 24% in 2020 (World Resources Institute, n.d.). Regions like the Middle East, North Africa, and parts of Asia will likely face the most severe water scarcity due to their arid climates, high population densities, and limited renewable water resources (World Resources Institute, n.d.).

Water scarcity impacts multiple sectors of water management, reflecting its interconnected and systemic nature. Key areas include drinking water supply, wastewater management, agricultural irrigation, flood control, and industrial water use. Globally, agriculture accounts for about 70% of water withdrawals, with this figure rising to 90% in arid regions, underscoring the sector's heavy dependency on water resources and the urgent need for efficiency improvements (Our World in Data, 2023). Urban and industrial wastewater treatment systems represent another critical sub-sector, often requiring significant investments in infrastructure to ensure environmental sustainability (UNESCO, 2021). Additionally, flood protection and drainage systems are essential for mitigating water-related disasters, which disproportionately affect low-income regions (UNESCO, 2021). Groundwater management, vital for sustaining urban and rural water needs, faces overexploitation risks in many areas due to inadequate regulatory oversight (UNESCO, 2021). Finally, the increasing pressure on aquatic ecosystems from industrial pollution highlights the necessity of integrated water management policies to balance environmental protection with resource use (UNESCO, 2021). Addressing water scarcity requires a holistic approach, ensuring coordination across these diverse sectors to achieve sustainable and equitable water use.

Despite global recognition of water as a fundamental resource, addressing water needs has faced significant obstacles due to multifaceted challenges spanning governance, financing, technical capacity, and climate impacts. Firstly, governance systems are often fragmented, with limited institutional capacity to design and implement effective water management policies, particularly in developing countries (Alaerts, 2019). Secondly, financing gaps are stark, with the required global water investment estimated at $2 trillion annually, far exceeding the current allocation (Asian Development Bank, 2016). Much of this is due to the high risks and low returns perceived by private investors, compounded by a lack of bankable projects and weak creditworthiness of water utilities (McKinsey, 2017). Additionally, data and monitoring deficits hinder informed decision-making, while tailored technical solutions are often prohibitively expensive for low-income regions. Finally, climate change has intensified water scarcity, with 40% of the global population expected to live in severely water-stressed regions by 2050, amplifying the urgency of comprehensive and well-financed water strategies (OECD, 2016; UN-Water, 2020). These interconnected challenges highlight the need for integrated, scalable, and well-funded water management solutions.

Water scarcity is an urgent global issue that demands immediate attention, as its impacts extend across critical areas such as public health, agriculture, industrial productivity, and environmental sustainability. According to the United Nations, global water demand is expected to exceed supply by 40% by 2030 if current management and financial inadequacies persist (UNESCO, 2021). This gap is exacerbated by factors such as population growth, climate change, and aging water

infrastructure, which collectively hinder equitable and sustainable access to water resources. Without effective management and financing solutions, water scarcity threatens to undermine economic stability, food security, and the well-being of billions of people worldwide (World Bank, 2023).

At COP28, the critical issue of water scarcity was prominently addressed, with significant commitments made to tackle its global impacts. During the conference's Food, Agriculture, and Water Day, 152 countries endorsed the COP28 UAE Declaration on Agriculture, Food Systems, and Climate Action, emphasizing a unified effort to combat water scarcity and enhance food security (COP28, 2023). Building on this momentum, COP29 has continued to prioritize water scarcity, focusing on innovative solutions and sustainable management practices to address this pressing challenge.

The paper underscores the need for urgent reforms in water scarcity management and financing by providing a comprehensive overview of the main challenges and reform imperatives. It identifies fragmented governance structures, insufficient financing mechanisms, and a lack of scalable technical solutions as significant barriers to addressing water scarcity effectively. Additionally, it highlights the critical role of integrating equity considerations, particularly in low-income regions where affordability and access remain pressing concerns (Springer, 2013). Addressing these barriers is crucial, as over 2 billion people currently lack access to safely managed drinking water services, emphasizing the dire need for systemic reforms (UN-Water, 2020).

By outlining an agenda for research and education, the paper serves as a foundational resource for addressing these complex challenges. It emphasizes the importance of interdisciplinary approaches in water management, blending technical, financial, and governance perspectives to develop innovative solutions. Moreover, the paper calls for enhanced focus on financial instruments such as public-private partnerships, blended finance, and green bonds to mobilize the resources necessary for sustainable water management (World Bank, 2023). It also advocates for the integration of educational initiatives that equip future professionals with the skills and knowledge needed to tackle water scarcity (UNESCO, 2021).

This document not only provides a basic understanding of the challenges associated with water scarcity but also offers a strategic framework for reforms. It bridges gaps in current management practices and financing strategies, laying the groundwork for robust research and educational initiatives that aim to ensure water security for future generations. By addressing these pressing issues holistically, the paper contributes to a global agenda for sustainable water use and equitable resource distribution (Springer, 2013; UN-Water, 2020).

The reminder of the paper is structured into eight sections. Section 2 contrasts water as a human right versus an economic resource, while Section 3 examines climate mitigation and adaptation policies. Section 4 analyzes the financial sector's role in addressing water scarcity. Section 5 discusses challenges in water management policies. Section 6 outlines a research agenda, and

Section 7 focuses on education initiatives. Section 8 concludes with actionable strategies for sustainable water management.

2 Water as a human right or water as an economic management objective

Regulatory approaches to water access typically align with one of two paradigms: water as a human right or water as an economic management objective, each carrying distinct policy implications. Treating water as a human right emphasizes equity, universal access, and non-discrimination, requiring governments to ensure affordable and sufficient water for all, often through subsidies or public provision.

In contrast, viewing water as an economic resource focuses on efficiency, cost recovery, and incentivizing conservation, often through market-based mechanisms like tiered pricing or water trading. While the human rights approach prioritizes social justice and basic needs, the economic management perspective aims to optimize resource allocation and infrastructure sustainability. These differing priorities can lead to tensions in balancing equity with efficiency, especially in regions with limited resources. The integration of these approaches in policymaking remains a critical challenge (Dinar & Schwabe, 2015; Rogers, de Silva, & Bhatia, 2002).
Access to water as a human right is founded on the principle that water is a necessity for life and should be universally available to all individuals without discrimination. This view emphasizes the intrinsic value of water, recognizing it as essential for health, dignity, and life itself. Central to this principle is the commitment to equity and non-discrimination, which prioritizes universal access, especially for marginalized populations who are often most affected by water scarcity. Governments have a clear obligation to ensure that water services are sufficient, safe, and affordable for all citizens, even when these services are not economically profitable. This commitment was globally acknowledged by the United Nations in 2010, when it formally recognized the human right to safe and clean drinking water and sanitation (OHCHR, 2021). The approach to implementing this principle often involves treating water services as public goods. This means that water provision may be subsidized or offered free of charge to ensure affordability, particularly for low-income populations. Policies focus on meeting minimum standards for accessibility, quality, and availability to ensure that all individuals, regardless of their economic circumstances, have reliable access to water (Cambridge University Press, n.d.).

This approach brings several advantages, particularly in promoting fairness and social justice. By ensuring that access to water is not determined by economic status, this perspective addresses basic survival and dignity, especially in underserved or low-income areas. It helps reduce inequalities and supports the well-being of vulnerable populations, contributing to overall social equity and sustainability (OHCHR, 2021). However, there are significant challenges to implementing water as a human right. Funding and infrastructure constraints often limit the ability of governments to provide universal access to safe and sufficient water. Additionally, the approach requires substantial government intervention and regulation to uphold standards and prevent inequities in water distribution. These challenges can be particularly acute in regions with limited

resources or weak governance structures, where ensuring equitable access may prove difficult (Cambridge University Press, n.d.).

On the other hand, the perspective of water access as an economic management objective views water as a valuable economic resource that must be allocated and managed efficiently to maximize its utility. This approach emphasizes the scarcity and efficiency of water, recognizing it as a finite resource that requires prudent use and management (Young, 2005). A market-oriented approach is often adopted, where water is priced to reflect its true costs, —including extraction, treatment, and delivery—to incentivize conservation and efficient usage (Dinar & Schwabe, 2015). Access to water may also be influenced by economic considerations, such as the ability to pay or the value of water for industrial, agricultural, or municipal use (Grafton & Horne, 2014). Furthermore, this perspective focuses on infrastructure and investment, advocating for sustainable financing, infrastructure development, and cost recovery through user fees or tariffs (Grigg, 2011).

In practice, water services may be privatized or managed through public-private partnerships, which can help improve efficiency and attract investment (Marin, 2009). Pricing mechanisms like tiered tariffs or water trading are commonly used to regulate demand and allocate resources effectively (Rogers, de Silva, & Bhatia, 2002). This approach also encourages technological innovation and investments aimed at improving supply efficiency and reducing waste (Perry, Rock, & Seckler, 1997).

The advantages of this perspective include promoting sustainable and efficient water use, generating funding for the maintenance and expansion of infrastructure, and aligning water allocation with economic growth priorities (Young, 2005). However, challenges exist, such as the risk of excluding low-income groups if affordability is not adequately addressed, the potential prioritization of economic activities over social needs, and the possibility of over-commercialization undermining equity (Rogers et al., 2002).

Balancing the two perspectives on water access, treating it as a human right and as an economic resource, requires a nuanced, hybrid approach that incorporates the strengths of both paradigms while mitigating their weaknesses. Such an approach recognizes that water is essential for human survival and dignity, prioritizing universal access to clean and safe water for basic needs, such as drinking, cooking, and sanitation, as a fundamental human right. This ensures that marginalized and low-income populations are not excluded due to financial constraints. To achieve this, governments can provide subsidies, establish minimum access guarantees, and maintain public control over critical water services to uphold equity and social justice.

At the same time, water is also a valuable and finite economic resource that requires efficient allocation to maximize its utility. For industrial, agricultural, and other high-consumption uses, water can be managed through market-based mechanisms such as pricing, tiered tariffs, and water trading. This encourages conservation, incentivizes technological innovation, and ensures that the cost of extraction, treatment, and delivery is recovered sustainably. In this context, private sector participation through public-private partnerships can also play a vital role in developing infrastructure and improving supply efficiency.

The hybrid approach allows policymakers to address both the ethical imperative of ensuring access to water for all and the practical need for resource efficiency and economic sustainability. However, implementing such a model requires robust regulatory frameworks to prevent over-commercialization and safeguard the rights of vulnerable populations. A well-designed hybrid approach can strike a balance between equity and efficiency, ensuring that water resources are managed sustainably while meeting both social and economic objectives.

3 Climate mitigation versus climate adaptation policies

There is a gradual shift in environmental research and policy focus from climate mitigation to climate adaptation, which reflects the growing acknowledgment that many impacts of climate change are now unavoidable. While mitigation efforts to reduce greenhouse gas emissions remain essential, the delayed progress in emissions reductions and the long-lasting effects of existing emissions in the atmosphere have made adaptation an urgent priority (Adger, Arnell, & Tompkins, 2005). Policymakers and researchers are increasingly addressing the immediate and anticipated consequences of climate change, such as rising sea levels, extreme weather events, and ecosystem disruptions, by focusing on resilience-building strategies. This shift also recognizes the pressing need to protect vulnerable communities and ecosystems, ensuring sustainable development in the face of a changing climate (Folke et al., 2010). Adaptation thus complements mitigation by addressing the current realities of climate impacts while still working towards long-term solutions.

Climate mitigation policies aim to reduce or prevent greenhouse gas (GHG) emissions, thereby limiting future climate change. These policies focus on addressing the root causes of climate change by reducing GHG emissions (Intergovernmental Panel on Climate Change [IPCC], 2018) and enhancing carbon sinks, such as forests and wetlands, to absorb more carbon dioxide (Griscom et al., 2017). Examples of mitigation strategies include transitioning to renewable energy sources like solar, wind, and hydropower (Jacobson et al., 2017); improving energy efficiency in buildings, industries, and transportation (Ürge-Vorsatz et al., 2012); and implementing carbon pricing mechanisms such as carbon taxes or emissions trading systems (Stavins, 2008). Additionally, reforestation and afforestation projects are promoted to increase carbon sequestration (Bonan, 2008). Another significant strategy involves phasing out fossil fuels or setting net-zero emissions targets to decarbonize economies effectively (Rockström et al., 2017). The overarching goal of these policies is to slow down or halt the progression of global warming and mitigate its long-term consequences.

Climate adaptation policies aim to manage and minimize the impacts of climate change that are already occurring or anticipated. These policies focus on preparing for and adjusting to climate impacts to reduce vulnerability and enhance resilience (Adger, Arnell, & Tompkins, 2005), ensuring that ecosystems and economies can function despite changing climate conditions (Folke et al., 2010). Examples of adaptation strategies include building flood defenses and improving water management systems (Kundzewicz & Döll, 2009); designing climate-resilient infrastructure such as roads and buildings to withstand extreme conditions (Hallegatte, Green, Nicholls, & Corfee-

Morlot, 2013); and modifying agricultural practices, such as adopting drought-resistant crops and efficient irrigation systems (Lobell & Burke, 2010). Furthermore, developing early warning systems for extreme weather events is a critical measure to safeguard communities (Basher, 2006). In some cases, relocating vulnerable communities from high-risk areas may become necessary to ensure their safety (Hino, Field, & Mach, 2017). The overarching goal of these policies is to protect lives, livelihoods, and ecosystems from the adverse effects of climate change.

4 Response of the financial sector

The financial sector is increasingly recognizing the critical need to address water scarcity through innovative financing mechanisms and strategic investments. One significant response has been the development of strategic frameworks by leading institutions. For example, the World Bank's "Scaling Up Finance for Water" framework outlines comprehensive strategies and customizable roadmaps for mobilizing water-related financing. These frameworks aim to catalyze greater collaboration between public and private sectors, driving innovation and investment in water infrastructure and sustainability projects (World Bank, 2023).

In addition, financial institutions are integrating water-related risks into their decision-making processes. The Network for Greening the Financial System (NGFS), which includes 108 central banks, has emphasized the necessity of incorporating water risks into financial and economic stability assessments. This initiative highlights the importance of recognizing water scarcity as a material risk that could impact global markets and investment portfolios (World Economic Forum, 2022).

The private sector is also playing a crucial role in addressing water scarcity. The United Nations Environment Programme Finance Initiative (UNEP FI) underscores the importance of private sector engagement in mitigating water-related risks. Financial institutions are being encouraged to invest in water sustainability projects and participate in stakeholder dialogues to promote systemic change. Such involvement not only helps address water challenges but also aligns with broader environmental, social, and governance (ESG) goals (UNEP FI, 2023).

Innovative financial instruments like debt-for-nature swaps have emerged as effective tools for addressing water scarcity. For instance, El Salvador recently completed a $1 billion debt buyback deal, dedicating $350 million to conserving the Lempa River watershed. This transaction represents the largest commitment of its kind and shows the potential of linking debt relief with environmental conservation (Reuters, 2024).

Another emerging avenue is the integration of voluntary carbon markets with water security initiatives. By tying carbon credits to water-related projects, financial mechanisms can provide sustainable funding while incentivizing the provision of safe water services globally. This approach offers a dual benefit: addressing both water scarcity and climate change in a synergistic manner (Deloitte, 2023).

Furthermore, regulatory frameworks are enhancing transparency in water-related financial risks. The U.S. Securities and Exchange Commission's (SEC) recent climate disclosure rule mandates that public companies disclose material risks associated with water scarcity. This initiative aims to promote greater accountability and transparency, ensuring that water risks are adequately considered in corporate strategies and reporting (Reuters, 2024).

These responses collectively reflect the financial sector's growing recognition of the imperative to address water scarcity through targeted investments, risk management, and innovative financing solutions. They underscore the need for collaborative efforts across public and private sectors to ensure sustainable and equitable water use in the face of escalating global challenges.

Addressing water scarcity requires substantial financial investments, prompting the development and implementation of various financial approaches and instruments. One significant strategy is public-private partnerships (PPPs), which leverage private capital and expertise to develop, operate, and maintain water facilities, reducing the financial burden on public budgets. For example, the Disi-Amman Water Conveyance Project in Jordan, valued at approximately $1 billion, was executed through a PPP, significantly enhancing water supply to Amman (Wikipedia, n.d.).

Another approach is blended finance, which combines public and private funds to mitigate investment risks and attract private capital into water projects. By using public funds to absorb initial risks, blended finance makes water projects more appealing to private investors. The World Bank's "Scaling Up Finance for Water" framework underscores the importance of blended finance in mobilizing resources for the water sector (World Bank, 2023).

Green and blue bonds are also gaining traction as debt instruments designed to raise capital specifically for environmental and water-related projects. While green bonds are used to fund sustainable water management initiatives, blue bonds focus on ocean and freshwater conservation. Notably, Seychelles issued a $15 million blue bond in 2018 to support sustainable marine and fisheries projects (UNESCO, 2021).

Debt-for-nature swaps represent another innovative financial mechanism, where countries restructure their debt in exchange for commitments to invest in environmental conservation. In October 2024, El Salvador completed a $1 billion debt buyback deal, dedicating $350 million to conserving the Lempa River watershed, marking the largest commitment of its kind (Reuters, 2024).

Microfinance for water and sanitation is another effective tool, offering small loans to households and small enterprises to invest in water supply and sanitation facilities. Organizations like Water.org have implemented WaterCredit programs, facilitating over 51,000 loans to improve water access in developing countries (Wikipedia, n.d.). Voluntary carbon markets are being explored to finance water initiatives through the sale of carbon offsets. By integrating water security projects into carbon credit schemes, this approach addresses water scarcity while contributing to climate change mitigation. A 2024 report by Deloitte highlights the potential of voluntary carbon markets to fund global water security projects (Deloitte, 2024).

Finally, economic instruments such as water tariffs, taxes, and tradable permits promote efficient water use and generate revenue for water management. For instance, Jordan has implemented increasing-block tariffs for residential water use, where higher consumption leads to higher rates, encouraging conservation and generating funds for the water sector (Wikipedia, n.d.). These financial approaches and instruments are critical for mobilizing the resources needed to tackle water scarcity, ensuring sustainable water management, and building resilience against water-related challenges.

5 Challenges in developing water management policies

The key challenges for effective water scarcity management policies span five critical areas: institutional, involving fragmented governance and weak capacity; financial, including high adaptation costs and limited access to climate funds; technical, such as data gaps and complex project designs; political, encompassing competing priorities and resistance to reforms; and socioeconomic, which address affordability concerns, displacement impacts, and public awareness. Addressing these interconnected challenges is essential to developing sustainable water management strategies.

5.1 Institutional challenges

Institutional challenges significantly impact the effectiveness of water management and climate adaptation efforts. Fragmented governance is a key issue, as water management often involves multiple stakeholders across local, national, and international levels, leading to coordination challenges. This fragmentation can result in overlapping responsibilities and inefficiencies. For example, research on Ontario's water governance demonstrates how legal institutions contribute to fragmentation, complicating effective management (Mitchell, 2011).

Another major challenge is the lack of integrated water planning, where many countries fail to incorporate water financing into broader climate adaptation strategies. This leads to inefficiencies and funding gaps, undermining resilience-building efforts. A World Bank report highlights the critical need for integrated planning in transboundary basins to ensure effective resource allocation and climate adaptation (World Bank, 2018).

Additionally, weak institutional capacity hinders the ability to design, implement, and monitor adaptation projects, making it difficult to attract and manage financing effectively. Strengthening institutional capacity is essential, as research emphasizes the importance of robust governance frameworks in achieving improved water management outcomes (Rogers et al., 2020).

5.2 Financial challenges

Financial challenges pose significant obstacles to effective water adaptation strategies, particularly in developing countries. The excessive costs of adaptation projects, such as building dams, desalination plants, and flood defenses, require substantial upfront investment that is often beyond the financial capacity of many nations. Research highlights that the infrastructure

demands for climate resilience could cost trillions globally, with developing countries facing disproportionate challenges (Hallegatte et al., 2013).

Another barrier is the uncertainty about climate impacts, which makes it difficult to estimate funding needs and prioritize investments. As future climate scenarios remain unpredictable, governments and financiers often struggle to allocate resources efficiently. A study by Ranger et al. (2010) underlines the complexities of planning under uncertainty and the need for flexible, iterative approaches to financing adaptation.

Accessing climate finance is also a significant hurdle for developing countries. International mechanisms like the Green Climate Fund are critical, but bureaucratic requirements, a lack of technical expertise, and insufficient project proposals often prevent these countries from fully utilizing available funds. Betzold and Weiler (2018) note that institutional barriers and capacity constraints undermine the effectiveness of climate finance in addressing adaptation needs.

Low revenue generation from water services exacerbates financial constraints. In many low-income regions, water is heavily subsidized or provided free of charge, limiting opportunities for cost recovery. Studies show that while subsidies ensure affordability, they often leave water utilities financially unsustainable (Whittington et al., 2009).

Finally, private sector hesitancy limits investment in adaptation projects. Private investors frequently perceive water projects as high-risk with limited financial returns due to the public good nature of water services. A report by the World Bank (2016) highlights the need for innovative financial models to attract private sector involvement in water infrastructure projects.

5.3 Technical challenges

Technical challenges significantly impede the effectiveness of water adaptation strategies, limiting their impact and scalability. Data and monitoring gaps are a major hurdle, as the limited availability of reliable hydrological and climate data hampers effective planning and resource allocation. This issue is particularly acute in regions with underdeveloped observation networks. For example, Africa has the world's least developed weather and climate observation infrastructure, with only two out of 53 African WMO member countries meeting basic observation standards (Reuters, 2024).

Another challenge is the complexity of project design. Adaptation projects often require multidisciplinary expertise, integrating scientific, engineering, and socio-economic disciplines to address the multifaceted nature of climate adaptation. This complexity increases the costs and timelines for implementation. Research highlights the importance of interdisciplinary approaches to overcome these challenges and ensure effective project execution (Smith et al., 2021).

Finally, the lack of scalable solutions poses significant difficulties. Many adaptation measures need to be tailored to local conditions, which complicates the development of standardized financing models that can be applied broadly. While localized interventions are critical for addressing specific challenges, they hinder the creation of scalable frameworks necessary for widespread

adaptation. Reports emphasize the challenge of scaling adaptation solutions due to their inherently context-specific nature (UNFCCC, 2022).

5.4 Political challenges

Political challenges significantly impact the effectiveness of water adaptation strategies and the ability to implement sustainable solutions. Competing priorities are a key issue, as governments often focus on immediate economic needs over long-term investments in water adaptation. This short-termism can result in underfunding critical water infrastructure projects, increasing vulnerability to climate impacts. Research shows that short-term economic goals frequently overshadow necessary investments in climate resilience, delaying essential water adaptation measures (Sustainable Earth Reviews, 2023).

Equity issues also arise, as balancing funding allocation between urban and rural areas, or between large-scale projects and community-based initiatives, can lead to political tensions. Disparities in resource distribution often exacerbate social inequalities, leaving marginalized communities with inadequate access to water services. Studies emphasize the need for inclusive policies that address the diverse needs of rural and underserved populations to ensure equitable water access (OUP, 2023).

Another challenge is resistance to tariff increases, where political opposition or public reluctance to higher water prices hampers cost recovery and deters private investment. Although water tariff reforms are essential for maintaining and improving infrastructure, they often face significant pushbacks due to affordability concerns. Research highlights the complexities of balancing financial viability with public acceptability, making tariff adjustments a politically sensitive issue (OUP, 2023).

Finally, corruption and mismanagement further undermine water adaptation efforts. Misallocation of funds and a lack of transparency erode public trust and reduce the effectiveness of financing mechanisms. Analyses of water governance systems indicate that corruption often diverts resources away from intended projects, calling for stronger accountability measures to ensure successful implementation (OUP, 2023).

5.5 Socioeconomic challenges

Socioeconomic challenges significantly impact the implementation of water adaptation strategies, often hindering equitable and effective solutions. Affordability concerns are a key issue, particularly in low-income communities where balancing equitable access with cost-recovery mechanisms proves challenging. Implementing water tariffs to fund infrastructure can disproportionately burden these populations. A study highlights that in nearly half of OECD countries, water affordability is already a pressing or emerging issue, emphasizing the need for policies that ensure access without imposing undue financial strain on vulnerable groups (IWA, 2023).

Displacement and social impacts pose another challenge, as large-scale adaptation projects, such as dam construction, can uproot communities, leading to social conflicts and political resistance.

Research shows that population displacement caused by such projects often results in loss of livelihoods, cultural disintegration, and increased social tensions, undermining the perceived benefits of these initiatives (Springer, 2022).

Limited awareness of the importance of climate-resilient water systems further reduces public and political support for necessary investments. Without widespread understanding of the risks posed by water scarcity and climate change, stakeholders are less likely to prioritize funding for sustainable water management. A study notes that raising awareness about these issues is essential to building momentum for effective policy implementation and long-term resilience (PLOS ONE, 2021).

6 Developing a water scarcity management research agenda

A comprehensive research agenda for water scarcity management should address critical challenges across institutional, financial, technical, political, and socioeconomic dimensions. Institutional reforms and governance are vital to overcoming fragmented governance structures and promoting integrated water management. Research should focus on creating frameworks for coordination among local, national, and international stakeholders. Strengthening institutional capacity to design, implement, and monitor water adaptation projects, especially in developing regions, is equally critical. Additionally, studies should investigate mechanisms to balance resource allocation between urban and rural needs, ensuring equity and fairness in water distribution (Springer, 2013).

Innovative financial mechanisms are essential for sustainable water management. Research should explore the viability of blended financing approaches that combine public funds, private investment, and international climate finance. Addressing barriers to accessing climate funds, such as bureaucratic hurdles and technical expertise gaps, is also crucial. Furthermore, strategies to balance cost-recovery mechanisms with equitable access, particularly for low-income communities, must be developed to ensure affordability without compromising financial sustainability (Springer, 2022).

Advancing technical solutions is another priority area. Filling gaps in hydrological and climate data through technology, such as remote sensing and artificial intelligence, is vital for informed decision-making. Research should also focus on standardizing scalable adaptation measures that remain flexible for local conditions. Interdisciplinary approaches that integrate engineering, environmental science, and social sciences are essential to design comprehensive and effective water adaptation projects (MDPI, 2023).

Addressing political barriers is equally important. Research should investigate strategies to align long-term water adaptation goals with immediate economic priorities, ensuring that short-term needs do not undermine resilience-building efforts. Overcoming public resistance to water tariff reforms requires studies on effective communication and policy design to improve social

acceptance. Additionally, governance frameworks that enhance transparency and accountability are critical for reducing corruption and ensuring efficient allocation of resources (Springer, 2013).

Socioeconomic considerations must also be central to water scarcity management research. Participatory approaches that engage communities in planning processes can reduce displacement and social conflicts caused by large-scale projects. Public and political awareness campaigns and educational initiatives are needed to enhance understanding of water scarcity and the importance of climate-resilient systems. Moreover, research should focus on addressing the intersection of water scarcity, poverty, and inequality to ensure inclusiveness and fairness in water management policies (Springer, 2022).

Exploring hybrid approaches that integrate water as a human right with market-based models is essential for balancing equity and efficiency. Studies should analyze successful public-private partnerships that combine public oversight with private sector innovation to develop sustainable and inclusive water management systems. Similarly, research on climate change adaptation and resilience should emphasize dynamic, iterative planning frameworks that can accommodate uncertainties in climate impacts. Developing metrics to measure resilience outcomes will help track the effectiveness of adaptation measures under varying scenarios (MDPI, 2023). This research agenda aims to provide a comprehensive, interdisciplinary, and equitable approach to managing water scarcity, addressing both immediate needs and long-term sustainability in the face of global challenges.

7 Developing a water scarcity management education agenda

A higher education agenda for water scarcity management should equip students and professionals with the interdisciplinary knowledge and skills needed to tackle the complex challenges associated with sustainable water resource management. Interdisciplinary curriculum development is essential to address these challenges. Programs should integrate hydrology, environmental science, economics, engineering, and social sciences to provide a comprehensive understanding of water management. Modules on the intersection of water scarcity and climate change, resilience planning, and policy frameworks prepare students to address long-term impacts effectively. Additionally, courses on advanced data analytics, remote sensing, and geographic information systems (GIS) are crucial for developing technical expertise in water resource monitoring and decision-making (Oxford Research Encyclopedia, 2017).

A focus on governance and policy is crucial for addressing institutional and political challenges. Students should learn about water governance frameworks, strategies for resolving fragmented management, and enhancing institutional capacity. Courses on policy development should emphasize designing equitable and effective water policies, including public-private partnerships and tariff reforms. Exploring the legal and ethical dimensions of water management, such as balancing the human right to water with its economic value, provides a nuanced perspective on equity and sustainability (MDPI, 2020).

Financial management and innovation should also form a core part of the agenda. Training in accessing international climate funds, preparing project proposals, and navigating bureaucratic processes is vital. Case studies on blended finance, cost recovery mechanisms, and subsidy design can offer insights into sustainable financing models that ensure affordability. Furthermore, courses should address strategies for engaging the private sector in water projects while safeguarding public interest and promoting equity (World Bank, 2022).

Developing technological skills is essential for addressing technical challenges in water management. Training in technologies such as artificial intelligence, Internet of Things (IoT), and satellite-based monitoring systems can help bridge data gaps in hydrology and climate forecasting. Practical skills for designing and managing complex water adaptation projects that integrate technical, social, and environmental considerations are equally important. Encouraging research and innovation in scalable adaptation technologies tailored to local conditions is also vital (World Water Council, 2023).

Community and stakeholder engagement is another critical area of focus. Emphasizing participatory approaches equips students with the skills to involve communities in planning processes and address displacement and social impacts of water projects. Courses on communication strategies can help raise public and political awareness about water scarcity and climate resilience. A strong focus on equity and inclusion ensures that policies prioritize marginalized communities and promote social justice (Springer, 2022).

Leadership and decision-making training are necessary for future policymakers and water managers. Strategic planning courses enable individuals to navigate competing priorities and resource constraints. Emphasizing ethical leadership, accountability, and transparency is essential to combat corruption and mismanagement in water governance. Additionally, fostering adaptive leadership skills prepares individuals to manage water-related crises and uncertainties effectively (Springer, 2018).

Finally, the agenda should prioritize research and innovation. Research on hybrid models that integrate human rights and economic approaches to water management can balance equity and efficiency. Developing flexible, iterative policy frameworks that accommodate uncertainties in climate impacts and changing socioeconomic conditions is essential for effective water management. Moreover, creating resilience metrics to measure and evaluate outcomes in water systems ensures that adaptation efforts are both sustainable and impactful (MDPI, 2018).

8 Conclusion

Water scarcity presents a multifaceted challenge, impacting public health, agriculture, industry, and environmental sustainability. Key problems include fragmented governance, insufficient financing mechanisms, inadequate technical solutions, and social inequities. Institutional barriers, such as the lack of coordination among local, national, and international stakeholders, exacerbate inefficiencies in resource allocation and policy implementation. Financially, the gap between the resources required—estimated at $2 trillion annually—and available investments highlights the

urgent need for innovative funding mechanisms. Moreover, inadequate technical capacity and data gaps hinder informed decision-making, while social challenges, such as affordability concerns and displacement from large-scale projects, create additional complexities.

Addressing these challenges requires an integrated and interdisciplinary approach. Suggested policies include strengthening governance structures through institutional reforms that promote equity and efficiency. Innovative financial instruments such as blended finance, green and blue bonds, and debt-for-nature swaps can mobilize resources while incentivizing sustainable water management practices. Enhancing technical solutions through investments in advanced technologies, such as artificial intelligence and remote sensing, can bridge critical data gaps and improve planning.

Additionally, socioeconomic policies must prioritize community engagement and inclusivity. Participatory approaches can address social conflicts, while targeted subsidies and tiered water pricing can ensure affordability for marginalized populations. Public awareness campaigns and educational initiatives are essential for fostering understanding and support for water conservation and adaptation strategies.

Finally, a robust research and education agenda is vital to develop the knowledge and skills needed to tackle water scarcity effectively. Research should focus on integrating human rights and economic perspectives, dynamic policy frameworks, and resilience metrics. Education programs must emphasize interdisciplinary learning, equipping future professionals with technical and governance expertise to address this pressing global issue. By implementing these policies, the global community can move toward sustainable and equitable water resource management, ensuring resilience against future challenges.

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Using Artificial Intelligence as a Tool for Inclusive Leadership in the Digital Era: Challenges, Opportunities and Implications

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Abstract

This paper explores the use of Artificial Intelligence (AI) in higher education institutions to enhance inclusive leadership. Inclusive leadership must support the ethical integration of AI to ensure it serves all students. Artificial intelligence has the ability to solve problems in education, improve teaching and learning methodologies, and accelerate progress towards long-term improvement. However, leaders face five top challenges in the age of artificial intelligence. These include: adapting to technological disruption, ethical issues, improving collaboration between humans and AI, leading workforce change, sustaining human leadership and fostering a moral culture. Leaders must understand the technical aspects, practical applications, and strategic implications of AI, prioritize continuous education, and create an adaptive culture. They must navigate ethical concerns like privacy, bias, fairness, and accountability, establish ethical leadership strategies, and ensure transparency in AI decisions. The study recommends strategies, including creating explicit criteria for the use of artificial intelligence, promoting digital literacy and ensuring that the impact of its technologies on learning is continuously evaluated.

Keywords

artificial intelligence, leadership, inclusive leadership, diversity, equity

1 Introduction

AI has the potential to address several challenges in education today; improving teaching and learning strategies and accelerating progress towards sustainable improvements. On the other hand, these rapid changes inevitably bring various challenges that require the adoption of new policies and regulations in administrative systems. UNESCO is one of the organizations committed to supporting the monitoring of the potential of AI tools to achieve the Education 2030 goals, while ensuring that their application in the educational environment adheres to essential standards of inclusion and value (Fengchun & Holmes, 2023).

In today's world, all institutions and communities strive to involve all skills and knowledge in the process of development and improvement, which has made inclusive leadership the preferred leadership style (Schiltmans & Davies, 2023). AI tools can help leaders make the institution more welcoming for all. For example, AI-driven recruitment platforms can help reduce hidden biases in candidate selection by focusing only on their qualifications and skills. Artificial intelligence can analyze how employees feel and help managers understand and solve any problems. This can promote a friendlier and more welcoming environment (Lakhanpal, 2024).

Inclusive leadership plays a key role in ensuring that new technologies enhance every student's learning. This study looks at how artificial intelligence can help make education more inclusive for everyone, in addition to the barriers that come with it, opportunities and implications. The advent of artificial intelligence (AI) tools has spread fear across the education sector in recent months. Institutions share one primary concern that adopting AI would undermine the existence of valuable academic paradigms: assessment, course design, activities, and more. Along with the increase in popularity, attitudes towards AI in higher education have gradually improved. Instead of neglecting AI, educators should spend time practicing and evaluating this new technology and helping students do the same. Most importantly, the smooth adoption of AI requires tremendous support and accountability from higher education leaders (Nguyen, 2023).

2 Literature review

2.1 Artificial intelligence

Recently, all organizations and societies are witnessing sustainable technological advancements in various sectors (eg industrial, economic, social and educational), which requires keeping up with the ongoing developments. One of the newest and most revolutionary in the world is artificial intelligence (AI).

Crompton and Burke (2023) mentioned in their article "Artificial Intelligence in Higher Education: The State of the Field" that the term artificial intelligence is not new. It was conceptualized in 1956 by McCarthy (Cristianini, 2016), who followed Turing's research (e.g. Turing, 1937, 1950). Turing explored the idea of intelligent reasoning, thinking and applications that can be used by intelligent machines. The definition of artificial intelligence has since improved and changed since 1956 as major improvements have been made in the capabilities of artificial intelligence. A recent definition of artificial intelligence is "computer systems that are able to engage in human-like processes such as learning, adapting, synthesizing, self-correcting, and using data for complex processing tasks" (Popenici et al., 2017) (Crompton & Burke, 2023).

Lozano & Blanco Fontao (2023) stated that although AI has its origins in the mid-20th century, the first AI to be published was in 1957 by American scientists from Dartmouth University (Ganascia, 2018). He then contributed in all other areas in the development era of the 21st century (Susnjak, 2022). In recent years, artificial intelligence technology has spread to various fields and sectors, such as healthcare (Xu et al., 2021) and sustainable industrial development (Peksen & Spliethoff, 2023). And education, especially higher education, is the most affected (Lozano & Blanco Fontao, 2023).

2.2 Artificial Intelligence in Higher Education

Crompton and Burke (2023) reported that the use of artificial intelligence (AI) in higher education (HE) has increased since 2015 (Chu et al., 2022) with continued improvements in its tools and technologies. Researchers (Chen et al., 2020; Crompton et al., 2020, 2021) evaluated the application of AI in higher education. One advantage is to consider individual differences and

multiple intelligences (Verdu et al., 2017), when providing specialized feedback (Dever et al., 2020), when evaluating results (Baykasoglu et al., 2018) and predicting educational attainment (Cagataylı & Celebi, 2022).

Efthymiou (2024) clarified the use of artificial intelligence supports higher education as one that:

- It improves student learning through sustainable transformations in higher education.
- Creates an educational environment tailored to the needs of students and recruitment.
- Facilitates interactive learning, combining student, teacher and curriculum for academic goals.d
- Provides assistance to students through AI chatbots such as BonBon.
- Provides mental health support through natural language processing skills.
- Enables a global classroom experience by making learning a universal conversation.
- Improves administrative skills by automating tasks such as record keeping, curriculum preparation and records management.
- Addresses learning gaps by providing real-time feedback and improving the quality of instruction.

AI is expected to revolutionize higher education and will require inclusive leadership to design balanced strategic policies to manage its impact. Ethical and rational use of artificial intelligence can create inclusive, accessible and high-quality educational opportunities (Efthymiou, 2024). Artificial intelligence is rapidly advancing into higher education, offering personalized tutors, student retention analytics, and numerous implementations. With financial projections reaching into the billions and an impressive increase in the number of students, the role of artificial intelligence in education is not only a topic of discussion, but a game changer with tangible results (Lindner, 2024).

2.3 Main differences between countries in the adaptation of AI in education

The use of AI in education varies widely between countries, depending on existing differences in technology infrastructure, funding, policy support and levels of digital experience. Developed and rich countries can rely on a more robust technological infrastructure as well as an ecosystem for innovation that includes the private sector. This ecosystem supports schools and universities in leading experiments with artificial intelligence in education. However, this is not the case in the Global South and developing countries in general, which face fundamental challenges, mostly related to the basic prerequisites for the functioning of technology, to quality education, from financing and infrastructure to electricity (Unesco, 2024).

San Global Research (2024) estimates that the global market for artificial intelligence in education will reach USD 2.4 billion by 2022, with an estimated CAGR of 27.2% between 2023 and 2032. The market is segmented by component, deployment, application, technology, end user and region/country.

In their study, Crompton and Burke (2023) conducted a systematic review that provides unique insights into current research on artificial intelligence (AI) in higher education (HE) between 2016 and 2022. The 138 studies they used covered 31 countries in six countries, seven continents of the

world. However, this distribution was not equal between the continents. Asia had the largest number (AIEd) of AI studies in higher education at 41%. Of the seven countries represented in Asia, 42 of the 58 studies were conducted in Taiwan and China. Europe, with 30%, was the second largest continent and had 15 countries with between one and eight studies each. North America was the third largest continent with 21% of studies, with the US producing 21 of the continent's 29 studies. 21 studies from the USA rank it second only to China. Only 1% of studies were conducted in South America and 2% in Africa. Figure 2 illustrates a visual representation of the distribution of studies across countries. Continents with a high number of studies are from high-income countries, and those with a low number lack publications in low-income countries. These results are shown in the following figure (Crompton and Burke, 2023).

2.4 Applying inclusive leadership in 2024 and why it is important

The terms inclusive leadership, diversity, equity and inclusion are increasingly used in all institutions and communities. All are incredibly important for personal and organizational development. But in recent years they have often been confused and even used interchangeably, leading to confusion that needs to be clarified to make it clear that people work in organizations when hiring and retaining the right people is increasingly important. (Stiebing, 2024).

Artificial Intelligence is evolving in education and inclusive leadership is critical to achieving equality in diversity and inclusion. Inclusive leadership includes addressing team composition based on gender, age, ethnicity, race and orientation and promotes a more inclusive and equitable environment. Leaders play a particularly important role: they account for up to 70 percentage points of the difference in employee experiences of belonging and psychological safety, and inclusive leaders saw a 17% increase in team performance, a 20% increase in decision-making quality, and a 29% increase in team collaboration. Inclusive leaders also reduced the risk of employee turnover by 76%" (Zheng, Kim, Kark, & Mascolo, 2023).

Birring (2024) stated in his guide that the impact of inclusive leadership includes:

- It supports the sustainable behavior of the organization.
- Increases job satisfaction and job retention.
- Builds reputation avnd trust.
- Promotes equity and social responsibility.
- Increases organizational success. (Birring, 2024).

Unbiased and inclusive leadership is critical to organizational success. Traditional leadership development programs often fail to address bias and equip leaders with the necessary tools. Artificial intelligence tools enable leaders to gain unbiased leadership intelligence and lead their teams to success (Nguyen, 2023). Wit (2023) stated in his study that the higher education leadership literature increasingly focuses on inclusive leadership to promote equity, diversity and inclusion in higher education and its corresponding societies (Burkhardt, 2022; Lewis, 2016; Stefani & Blessinger, 2017). The global demand for equality, diversity and inclusion is evident, but these values are not fully realized in all higher education institutions (HEIs) or in society as a whole. Acknowledging these values and committing to them is not enough for sustainable change (Burkhardt, 2022; Stefani & Blessinger, 2017).

The role of higher education is to create knowledge and train society's human capital, which is reflected in their attitudes and achievements. Openness, inclusiveness, diversity of accessibility and equality are characteristics of inclusive leadership (Ashikali et al., 2021; Qi et al., 2019). Recognizing the contributions and talents of team members regardless of their gender, race, ethnicity, background, or disability enhances member performance in higher education, including learning, teaching, research, and creativity (Leon & Olmedo-Cifuentes, 2022).

Efthymiou (2024) stated that by reducing access barriers and enhancing educational opportunities, artificial intelligence has great potential to democratize higher education. Accessibility issues arising from factors such as cost and location often prevent access to traditional higher education. However, AI platforms can eliminate geographic and financial barriers by offering flexible and affordable learning opportunities. Artificial intelligence can provide personalized learning experiences designed around each student's needs, opening up high-quality education that was previously unattainable for students from diverse backgrounds (Efthymiou, 2024).

2.5 Challenges of inclusive leadership when using Artificial Intelligence

Although automation and artificial intelligence have huge potential to improve education, there are concerns about:

2.5.1 Security, privacy and cost

Educational institutions must prioritize strict data security measures to protect sensitive data and preserve the human aspect of the teaching and learning process. In order to guarantee sustainable and fair educational practices, it is also necessary to carefully assess the financial and ethical implications of the use of artificial intelligence. In his study, Tambuskar (2022) stated that the adoption of ride-sharing technology poses significant challenges, including privacy violations and uncertainty arising from the potential negative effects of AI (Cheng et al., 2022). Data management includes various aspects such as organization, collection, review, storage, use, archiving and destruction. It includes specialized programs, policies and communications from leadership and management. Regulations must provide tools to meet standards such as auditability, security, accessibility, availability, completeness, accuracy, integrity and consistency (Owoc et al., 2019). The effective use of big data analytics and artificial intelligence depends on the knowledge and analytical skills of individuals, as they have the skills necessary to perform complex data analysis for decision-making (Tong-n et al., 2022).

One of the challenges of inclusive leadership in using AI in higher education is the accuracy and bias of AI-based content, which needs to be addressed through ethical inclusive leadership (Dwivedi et al., 2023). Also, the way data and knowledge are generated using artificial intelligence increases the risks of plagiarism and requires inclusive management to use a strict set of academic policies that guarantee the application of academic ethics (Kasneci et al., 2023).

2.5.2 Top challenges for leaders

Spair (2023), as stated in his article "Five Top Challenges for Leaders in the Age of Artificial Intelligence," identified five top challenges that organizations involving leaders may face:

Challenge 1: Adapting to technological disruption. Leaders need to understand the technical aspects, practical applications and strategic implications of artificial intelligence in order to effectively adapt to technological change.

They should prioritize continuous education for themselves and their teams through regular training, workshops, seminars, online courses and collaboration platforms. Encouraging employees to update their skills ensures that the organization remains at the forefront of AI innovation. Strategic collaborations with AI experts, research institutions and technology companies can provide valuable insights and access to cutting-edge AI resources, helping leaders understand the implications of AI in their industry, access new technologies and co-create innovative solutions for them held in front of others. Cultivating an adaptive culture that supports change and innovation is critical to adapting to AI-driven disruption. This includes creating flexible organizational structures, fostering agile thinking and embracing failure.

Challenge 2: Ethical issues Moral values. The integration of artificial intelligence into business and society raises ethical concerns about privacy, bias, fairness and accountability. Leaders must navigate these issues with a clear ethical compass and ensure that AI applications respect human rights, promote justice, and align with societal values and organizational ethics. Establishing ethical guidelines is not just a regulatory requirement; it is a fundamental aspect of responsible leadership that involves proactively understanding and mitigating risk. Ethical guidelines are key factors to the responsible use of AI, governing the entire AI lifecycle from design to deployment, ensuring fairness, accountability, transparency and privacy. Transparency is critical to trust and understanding in AI systems. Leaders should make AI decisions understandable, including technical aspects, data usage, and priorities. They should also reveal limitations and potential pitfalls for informed interactions with users and stakeholders.

Challenge 3: Improving collaboration between humans and AI Synergizing strength. The successful integration of human and artificial intelligence represents a paradigm shift in the workforce and heralds a new era of collaborative intelligence. The unique combination of human intuition, creativity and emotional intelligence with AI analytics, data processing and predictive capabilities can lead to unprecedented levels of productivity, innovation and growth. Achieving this synergy, however, requires a deliberate effort by leaders to establish them in an environment where humans and AI are not seen as competitors, but as collaborators, each amplifying their strengths. Training projects for an AI-enhanced future should focus on strengthening digital literacy, fostering adaptability and continuous learning. This will provide employees with the knowledge and skills to collaborate with AI, facilitate the transition to AI-integrated workflows, and reduce resistance. Establishing responsibility: Shifting AI to repetitive tasks requires leaders to redefine human roles and focus on tasks that require creativity and emotional intelligence. This is consistent with an AI-enhanced environment and ensures harmonious cooperation between humans and AI. Building a culture of trust: Integrating AI into the workforce requires fostering trust and understanding in a culture that transparently communicates its use, decisions and ethical practices, and encourages open discussion of feedback and concerns to alleviate fear and foster collaboration.

Challenge 4: Leading workforce change, changing leader. Artificial intelligence is transforming the workforce, requiring changes in skills, job roles and organizational structures. While it may cause job displacement, it also presents opportunities for innovation and growth. Leaders must navigate this transition with strategic foresight, identifying high-demand skills, potential automation and emerging job categories. This understanding helps develop targeted strategies for a resilient workforce. Investing in workforce development is critical to the AI transformation. Up skilling programs should enhance AI-related skills, such as data literacy and technical proficiency, while promoting soft skills such as creativity and emotional intelligence, and foster a culture of continuous growth. The growing demand for AI-related skills requires leaders to adapt their recruiting strategies to focus on technical expertise, adaptive skills, and diverse talent pools. This includes partnerships with educational institutions, competitive advantages and creating an inclusive workforce. Leaders should offer comprehensive support to AI-enabled employees as they transition into new roles or career paths. This may include career guidance, job matching services or retraining programs. Leaders should provide empathy and support and foster a resilient workforce. A focus on up skilling, talent acquisition and transition support can help organizations thrive in the AI era, driving innovation, productivity and growth.

Challenge 5: Sustaining human leadership. Artificial intelligence is revolutionizing industry, which is why a human-centric approach is crucial as an executive. Leaders must focus on qualities such as empathy, ethical judgment, compassion and interpersonal skills. Artificial intelligence should be used to enhance human potential, not replace it. Leaders must hone skills, acquire talent and support transitions to ensure organizations survive and thrive in the AI era. This creates a mutually beneficial ecosystem for innovation, productivity and growth. Emotional intelligence is essential for people-centered leadership, enabling leaders to understand and manage emotions, foster empathy, and connect with teams. It includes active listening, empathy and effective communication. Improving emotional intelligence helps navigate human dynamics and ensures that the implementation of artificial intelligence improves the work environment. A values-based culture is necessary for the integration of artificial intelligence to align with basic human values. Leaders should set ethical standards, promote inclusivity, and use technology for the greater good. This creates a respectful and motivated environment that ensures the human soul of the organization thrives alongside the technology. In an AI-integrated workplace, leaders must prioritize employee mental health, job satisfaction and personal development. They should offer support, career growth opportunities and maintain a positive work environment. Leaders should solicit feedback on AI implementations and adapt as needed. Maintaining human-centered leadership, a focus on emotional intelligence, a values-based culture, and employee well-being will help organizations succeed in the age of artificial intelligence while fostering a culture where people feel valued and empowered (Spair, 2023).

3 Conclusions and recommendations

Leadership and inclusive leadership are interchangeable. Inclusive leadership improves traditional leadership practices by integrating the principles of equity, diversity and inclusion. Inclusive leaders create a positive environment where everyone participates in creating and realizing the institution's vision. In today's digital and connected world, inclusive leadership skills are essential

for leading educational institutions. Inclusive leadership fosters an environment where everyone feels comfortable contributing their unique perspectives—resulting in a richer pool of ideas and a better understanding of the institution we belong to, providing an inclusive way to lead any group regardless of differences.

Inclusive leadership is not only a moral obligation but also a strategic need in higher education. It is essential for the development of equitable, innovative and responsive institutions capable of meeting the challenges of the 21st century. By adopting inclusive leadership, universities can maximize the potential of their diverse populations, improve learning and research, and contribute to a fairer and more just society.

As higher education evolves, putting inclusion at the forefront of institutional goals results in stronger and more resilient higher education providers, as well as building a future where everyone can flourish and thrive. The way automation and artificial intelligence are coming together is radically changing the landscape of higher education. These technologies are creating a new era in which technology enables effective and personalized learning experiences, not only by changing teaching methods, but also by streamlining administrative processes and leadership styles.

Despite some institutional resistance, AI has enormous potential to improve the quality of education, develop tailored learning experiences, provide rapid support for students, and simplify administrative duties. AI-driven technologies have the potential to revolutionize higher education by facilitating inclusive, accessible and effective learning through personalized learning, interactive environments and student support services.

Educational institutions must emphasize ethical implementation and preserve the human aspect in the teaching and learning process while embracing the revolutionary power of AI. Achieving a progressive future in higher education will require a combination of strategic integration of AI with a balanced approach to realizing its full potential. AI is more than just a technological advance; it is a transformational era that is reshaping the basic structure of business, society and human interactions. As a result, leaders are expected to be stewards of this new frontier, embracing the power of artificial intelligence to drive innovation, efficiency and growth while protecting ethical ideals and ensuring that progress benefits all of humanity. Embracing adaptability is the first crucial step on this journey. Because AI technologies are evolving so quickly, what's cutting edge now may be obsolete tomorrow.

Leaders must foster an environment of continuous learning and flexibility where agility is not just a tactic but a core organizational characteristic. Ethical foresight is equally important. As the capabilities of artificial intelligence grow, so will its ethical implications. Leaders must navigate these murky waters with a clear moral compass, setting standards and policies that ensure AI is deployed responsibly, transparently, and fairly. It must promote ethical artificial intelligence that enhances human capabilities while respecting rights and dignity.

Creating a collaborative environment is another critical factor in realizing the full potential of AI.

This means building synergy between people and technology, leveraging each other's capabilities to achieve previously impossible goals. It's about creating teams where artificial intelligence and human intelligence complement each other, leading to greater creativity, better decision-making and more innovative solutions. Moreover, the demand for transformational strategies has never been greater.

Leaders must rethink leadership in light of AI. This requires a strong vision and confidence to explore and develop, turning setbacks into stepping stones to greater success. In addition, it is important to maintain a human-centered approach for enlightened leadership in the age of artificial intelligence. The journey through the era of artificial intelligence is one of transformation, difficulty and enormous opportunity. Leaders who embrace these responsibilities, adapt and innovate while remaining true to ethical and human-centered ideals will not only guide their businesses through the challenges of AI, but also lead them into a future where technology and humanity coexist. It is a future that promises not only survival but also innovation, ethical growth and a legacy of enlightened leadership. This is the potential and struggle of becoming a leader in the age of AI Enlightened leadership in the age of artificial intelligence.

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