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The development of a Montessori-inspired framework to solve dilemmas in higher education during the 5th Industrial Revolution.

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A new framework was developed based on Montessori's pedagogy, Andragogy principles, and Heutagogy principles, to address the challenges of 5IR education. Modern-day Higher Education Institutions must explore innovative approaches to teaching and foster a culture of lifelong learning among students.

A qualitative, thematic structured literature review was conducted to examine Montessori's pedagogy, Andragogy, and Heutagogy. The aim was to create a new framework that can be implemented in higher education institutions (HEIs) to address the educational needs of the 5th Industrial Revolution (5IR). To achieve this, ten articles were selected using pre-defined keywords, and articles older than 10 years and those that didn't answer the research question and sub-question were eliminated. Similarities, concerns, mismatches, and dilemmas were extracted from the selected articles. These were then compared to the 5IR education requirements to create the new framework.

It was found that the combination of Montessori's pedagogy, Andragogy, and Heutagogy has the potential to address the dilemmas found in 5IR education. Montessori strongly emphasises self-directed, self-determined learning and is guided by individualised instruction that fulfils the principles of Andragogy. Andragogy focuses on the learner's autonomy and own experiences. Coupled with this is Heutagogy, which focuses on self-determined learning. This could only contribute to the idea of Montessori's pedagogy in HEI. Montessori's method should provide a strong philosophical foundation and perspective to the combined approach idea. Future work could look at the practical application to fully explore the potential of the combination to address 5IR educational dilemmas.

Keywords

adult pedagogy, higher education, adult education, life-long education, didactic

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Abbreviations

4IR	4th Industrial Revolution
5IR	5th Industrial Revolution
AI	Artificial Intelligence
HEI	Higher Education Institutes
SA	South Africa
TVET	Technical and Vocational Education and Training

1   Introduction and Background

1.1   Introduction

During the COVID-19 pandemic, Higher Education Institutions (HEI) were forced to go online, thus forcing all education into the 4th Industrial Revolution (4IR). Most HEIs were not ready or equipped to deal with the sudden change in teaching methods. The aim would be to develop a new framework inspired by Montessori pedagogy to teach modules at Higher Education Institutions in South Africa. The framework is new and has never been done before, thus making it unique. The significance of developing this new framework is the improve the education system in South Africa and the environment the author works in. The education system in South Africa needs to change to keep up with high demand and ever-changing environments and more importantly to ensure that HEI equips the students with the appropriate skills and abilities that are needed in the future.

The idea is that the teaching methods should aid in pushing HEI into the 5IR and producing students who can cope in the new world. The study uses a qualitative structured literature review to gain insights into how Montessori's method could be incorporated/implemented in the higher education institutions of South Africa. This study will look at pedagogies geared toward adult learning and compare them to one another to see if the combination of those teaching methods and Montessori could create a new environment for learning and teaching that is geared toward 4IR and 5IR.

The study will be a thematic structured literature review that will focus on the last 10 years of literature and will be conducted by identifying keywords and searching against scholarly literature sources for example: Google Scholar, Scopus, etc. The results will be reviewed and all articles older than 10 years that do not fulfil the research questions will be eliminated. The remaining articles will be critiqued to answer the question: Could 5IR education dilemmas be solved by combining the Montessori pedagogy, Andragogy, and Heutagogy?

1.2   Background

Adult learning is vital to reduce the unemployment rate of our country. When searching for "Adult learning in Higher Education Institutions" (HEI) there are very few resources found based in South Africa. HEI in the South African context is tertiary institutions

such as Universities, the University of Technology, and TVET colleges. There are studies done in Zimbabwe, America, and many more. The study was based on Kolb's learning theory and constructivist and adult learning theory. The findings were that most state universities will still be teacher-centred (Simon et al., 2024, p. 358). Simon (2024, p. 358) goes on to say that it is the responsibility of policymakers and HEI to make the right choices when choosing instructional and support strategies for adult learning. The study also mentions that a United Nations Study found a gap between participation, innovative teaching, and learning methods (Simon et al., 2024, p. 358). The recommendation from the study was that South Africa (SA) needs to update and incorporate critical thinking, problem-solving, collaboration, and conflict resolution into the teaching and learning of HEI (Simon et al., 2024, pp. 358-359). They mention that sustainability can be incorporated by sharing good pedagogical and andragogical practices among educators in HEI.

Another point made is that educators have the most influence when with comes to developing sustainable content (Simon et al., 2024, p. 359). This is also evident in an article written by Hendricks & Aploon-Zokufa (2021, p. 1) that argues that the teacher is the one who selects what is taught, how it is taught, and what knowledge is to be passed to the students.

Because of the influence educators have on the development and presentation of subjects, they must be educated in the different teaching strategies (Simon et al., 2024, p. 359) and should also be qualified to present those subjects (Hendricks & Aploon-Zokufa, 2021, p. 2). As much as educators need to be qualified and educated in methods, students must have the correct skills.

It is mentioned by Simon et al. (2024, p. 359) that graduates should have critical skills and, an innovative mindset and must be self-reliant to develop their knowledge, they also need the basic skills and competencies to be productive in their various working environments.

Simon et al. (2024, p. 359) mention that Zimbabwe has implemented the Education 5.0 principles to ensure lifelong learning. The European study shows that the pedagogical approach is still implemented rather than Andragogy. It also shows that students hardly participate in their goal setting and are not always asked to give inputs to the way classes are presented. Also shows the limitations and the obstacles of adult learning (Simon et al., 2024, p. 371).

The abstract shows what learners as adults need and what makes their learning differ-
ent from children (Collins, 2004, p. 1484). Worth mentioning in the study. Knowledge
makes the statement that pedagogy is teacher-centred- however, this is not the case.
Montessori is child-centred.

2   Literature Review

In the literature review, the existing literature around the study will be highlighted. Please note that the terms teacher, educator, and lecturer are used interchangeably to describe somebody responsible for the education or overseeing of educational functions for learners. The literature review is divided into 5 major sections: Montessori pedagogy, Andragogy, Heutagogy, Lecturer role; and 4IR/5IR. Each aims to investigate the principles, protocols, and importance of each in the study. It aims to show what the current research is saying, and it will be expanded on in the thesis.

2.1   Montessori

2.1.1   Montessori, Vertical grouping, Mentoring/peer groups, and Collaboration

Very little Montessori resources in HEI settings are available. In the table below a summary of peer-to-peer and Montessori's vertical grouping was done in the form of a SWOT analysis. This SWOT analysis was done keeping in mind the implementation or benefit of the HEI in a classroom setting. The SWOT analysis will be the basis and underlying knowledge that is needed to fulfil the data analysis later in the study. The SWOT analysis is therefore done first and then all necessary further information about Montessori and her philosophy is then discussed. The focus of the SWOT analysis is to identify all the relevant information that could be relevant to HEI. The table summarises the pros (Strengths and Opportunities) and cons (Weaknesses and Threats) of using peer-to-peer and vertical grouping as well as the Montessori collaborative capabilities. The view is from both student and lecturer participation in the process.

Table 1. Montessori SWOT Analysis

S	W
Present work to tutors, external guests, and peers, this allows for **simulation of real-life practice.** Peer-to-peer learning in the **absence of tutors** could take place (Pelsmaker et al., 2019, p. 255). **Share knowledge** with novice students (Pelsmaker et al., 2019, p. 255) Gain **multiple perspectives, frequently conflicting, informal dialogues (peers), and formalized learning** (Pelsmaker et al., 2019, p. 255).	Peer-to-peer could lead to **pressure competition** and **long hours** (Pelsmaker et al., 2019, p. 255). This could bring **isolation** from other activities (Pelsmaker et al., 2019, p. 255). **Stress** when exposed to negative "public evaluation" of one's work by others (Pelsmaker et al., 2019, p. 255). Participants have a **hard time engaging and focusing** on more passive learning

Create an environment for **individual and collective learning, reflection, coaching, and articulation of ideas to promote self-discovery** (Pelsmaker et al., 2019, p. 255).

Students get very close allowing for the physical, pedagogical, and cultural space to become very influential (Pelsmaker et al., 2019, p. 256).

Having **different roles allows students to feel safe to comment on each other's work** (Pelsmaker et al., 2019, p. 258).

Pair study and informal presentation help initiate Junior students, building confidence through critical reflection and articulation of position (Pelsmaker et al., 2019, p. 259).

Vertical grouping with leaders **helps facilitate, share knowledge, and integrate deeper learning about sustainability** (Pelsmaker et al., 2019, p. 260).

Create a **sharing and non-competitive atmosphere** (Pelsmaker et al., 2019, p. 260).

Students **gain large amounts of knowledge** thus, gaining insight from the entire group (younger from older and each other) (Pelsmaker et al., 2019, p. 260).

Education is **focused on the student** and actively involves the student (Mavrič, 2020, p. 21)

Self-education is at the heart of learning thus, making students the leaders and authors of development (Capobianco, 2021, p. 78).

Individually driven because of interest in work (Capobianco, 2021, p. 79).

Everyone has their **own internal and personal development plan** and different potential thus, the development is focussed on student's developmental needs (Capobianco, 2021, p. 79).

In a successful and effective grouping (vertically) class, the teacher **integrates research into the environment through instruction, curriculum, and vertical group-type assessments** (Capobianco, 2021, p. 82).

Teachers can design a curriculum as the students are with her/him for a while thus getting to know their strengths and weaknesses (Capobianco, 2021, p. 87).

situations (Pelsmaker et al., 2019, p. 257).

One-on-one tutoring could lead to the **repetition** of some content (Pelsmaker et al., 2019, p. 258).

Needs ways to help **bridge connections** of each different teaching year (Pelsmaker et al., 2019, p. 260).

Greater emphasis on tutor and student roles is needed in vertical grouping (Pelsmaker et al., 2019, p. 260).

Sessions need a **clear structure.**

The approach needs a **culture change** (Pelsmaker et al., 2019, p. 261).

Not easy to **manage** (Capobianco, 2021, p. 81).

Demands teachers to have a vast **range of strategies** and dedication (Capobianco, 2021, p. 81).

O	T
Reflective practices, integration, and testing of **abstract knowledge** (Pelsmaker et al., 2019, p. 255).	Students don't understand the **concept** and can only **learn independently** (Pelsmaker et al., 2019, p. 256).
Co-experimenting and learning competencies, design processes, and critical reflection from and with one another build student **confidence to try new things** (Pelsmaker et al., 2019, p. 255).	**Trust** in a tutor could lead to **vulnerability and anxiety** (Pelsmaker et al., 2019, p. 256).
Collaborative environment to harness peer interactions, communication, and sharing with peers and instructors (Pelsmaker et al., 2019, p. 255).	Only the **presenter learns** (Pelsmaker et al., 2019, p. 257)
To work with others, **critical reflection**, questioning, articulating, and communicating ideas (Pelsmaker et al., 2019, p. 255).	**Work could not stand alone** and thus learning could be lost and not be able to comment on student feedback (Pelsmaker et al., 2019, p. 258).
Education is not about **control** but rather learning by sharing ideas and giving feedback (Pelsmaker et al., 2019, p. 255).	In vertical grouping, students don't grasp the **benefits** of individual and collective groups (Pelsmaker et al., 2019, p. 260).
Knowledge is acquired by **working with others** (Pelsmaker et al., 2019, p. 256).	Students don't understand the **critical role** they play which is more important than that of the tutor (Pelsmaker et al., 2019, p. 260).
Using a set format for sessions could **enhance engagement** (Pelsmaker et al., 2019, p. 257).	If students are not given **time to practice** what was learned (Pelsmaker et al., 2019, p. 260).
Repetition is reduced with the help of peer-to-peer and group teaching thus enabling deep learning (Pelsmaker et al., 2019, p. 258).	Teachers don't **balance** student input engagement while qualifying and validating group discussion content (Pelsmaker et al., 2019, p. 260).
Peers check for **accuracy** (Pelsmaker et al., 2019, p. 259).	The student **isn't driven** enough to be authors and developers (Capobianco, 2021, p. 78)
Senior students provide a **collective point to depart** from as they check everything and make corrections (Pelsmaker et al., 2019, p. 259).	The **trust** placed by adults in the education of the child (Capobianco, 2021, p. 78)
More experienced students monitor juniors through vertical grouping thus **encouraging project work** outside of the mentor's presence (Pelsmaker et al., 2019, p. 259).	Adults not **preparing the environment** for education and growth to happen (Capobianco, 2021, p. 79).
Students discover through their **exploration** of work (Capobianco, 2021, p. 78).	Students **manage** their own time, material, collaboration, group work, and problem-solving. What if not finished in time as not driven? (Capobianco, 2021, p. 81).
Formative is more set **by the environment** rather than the teacher (Capobianco, 2021, p. 79).	Management by teachers demands commitment and the presenter's involvement (Capobianco, 2021, p. 81)
Education is not only knowledge-based but **holistically** (Capobianco, 2021, p. 80)	Teachers are **not willing** to teach vertical groups (Capobianco, 2021, p. 81)

It is important to clarify some of the Montessori-specific terms used above. Terms such as vertical grouping, simply mean that the class has students of multiple ages and different levels of knowledge (Sibatuara, 2022, p. 34). In a typical classroom setting students will normally be banded together in the age groups 3-6 years, 6-9 years, 9-12

years, 12-15 years, 15-18 years, 18-21 years, 21-24 years as seen in Figure 1 (Lide, 2018, p. 12), further down in section 2.1.4.

2.1.2 Montessori Philosophy

According to (Montessori Northwest., n.d.) website and Bhat (2021, p. 14), students learn through hands-on learning. They also learn through self-directed activities and collaborative play. Self-driven indicates that the learner chooses what they want to learn, guided by the teacher. Collaborative learning refers to the learner choosing to work with a group or individually. The aim is that each learner discovers and explores the material to develop the maximum potential. It is worth mentioning that hands-on exploration is a necessity. The learner will create knowledge from the activity if the whole self is engaged, meaning the use of the mind, body, and senses. There must be a variety of appropriate objects and activities available for meaningful engagement to aid the process. As mentioned earlier learners are learning through self-driven exploration. This will allow learners to discover the answers for themselves. This, in turn, will lead to a deep learning experience, which will foster a desire for lifelong learning. Problem-solving and discovery become more self-driven by learning (Montessori Northwest., n.d.; Bhat, 2021, p. 17).

Teachers must give learners the opportunities to allow for self-driven learning, this stands at the heart of Montessori's philosophy (Bhat, 2021, p. 16). Thus, the teacher takes on a guidance role. The role of the teacher is thus to observe; and prepare the learning environment; give learners free options; create special interests for the learner; and ensure that the environment is conducive to concentration on that which interests them (Bhat, 2021, p. 16). The materials produced must be of such a nature that it sparks the interest of the student that speaks to that interest that the learner has and not that of the teacher. This will create a learning-rich and self-driven working environment for learners (Atli et al., 2016, p. 132).

2.1.3 Classroom structure (design)

One only must look at a Montessori classroom layout to appreciate and notice how the environment aids the learning process.

Figure 1. Typical Montessori Classroom (Source: https://m.made-in-china.com/prod-uct/Montessori-Kindergarten-Nursery-Preschool-Classroom-Furniture-and-Layout-De-sign-801527175.html).

By reading through the Montessori Northwest website (n.d.) the following information was clearly articulated. The typical Montessori classroom has many different places where learners can go to learn and interact with the materials. Learners can use these "places" to either work by themselves, in small groups, or even larger groups. Areas may include tables, and floors, can be indoors or even outdoors. The classroom usu-ally does not have an area that has a focus point. The reasoning behind this is so that the teacher doesn't carry the focus but rather that the area is part of a larger commu-nity. Learners become aware of the fact that they are part of the larger community.

It is important to note that in the Montessori environment, dubbed the "favourable envi-ronment", learners must decide on and adjust the amount of interaction with others and whether it will be for work or social interaction. Learners move freely in the classroom and are simply guided by the teacher (One Community, n.d.). Learners are allowed to engage in the activities and use other fields in the school that are needed. Thus, the environment must be created for the learning activity to take place (Atli et al., 2016, p. 131). The teacher models how the environment should be and what the appropriate in-teractions in class will be. This gives the learner the confidence to resolve issues

themselves thus creating a harmonious working environment. This teaches the learner to respect themselves, others, and the environment (One Community, undated).

Another eight ideas that define the favourable environment by Curious Neuron (2021) is that the classroom is set up with the correct tools and environment that will provide the learner with the potential to become a productive member of the community. Secondly, the teacher sees the learner as an individual and customizes learning to what the learners need; learning is normally done individually or in small groups. Thirdly, the classroom encourages collaborative work and not competition. Fourthly, "Independence, self-control, confidence, and repetition are not only encouraged but built into all lessons and materials. Once a child is introduced to new material, they are encouraged to work through a series of tasks individually (or with a classmate)" (Curious Neuron, 2021). Fifthly, materials that are designed correctly will allow learners to move easily from concrete to abstraction as learners use their hands. Idea 6 mentions that learners are grouped with younger and older learners (meaning that 3 grades/ years are grouped). With the class being learner-centred, the learner can work anywhere they want.

The next idea is that the teacher has respect for the learner's developmental stages and understands how to reach the learner at their level, aiding in learning and concentration. The last idea is that each lesson has a purpose. The lesson should scaffold on previous knowledge and should preferably have some form of control over error.

2.1.4   Montessori in the Worldview

In the works of Lide (2018, p. 12), the view was that students are divided into bands of 6 years. The diagram below shows the planes of development (6-year cycles) and showing how learning increases and decreases in those planes. In the same diagram, it is shown the traditional learning experiences of traditional schools.
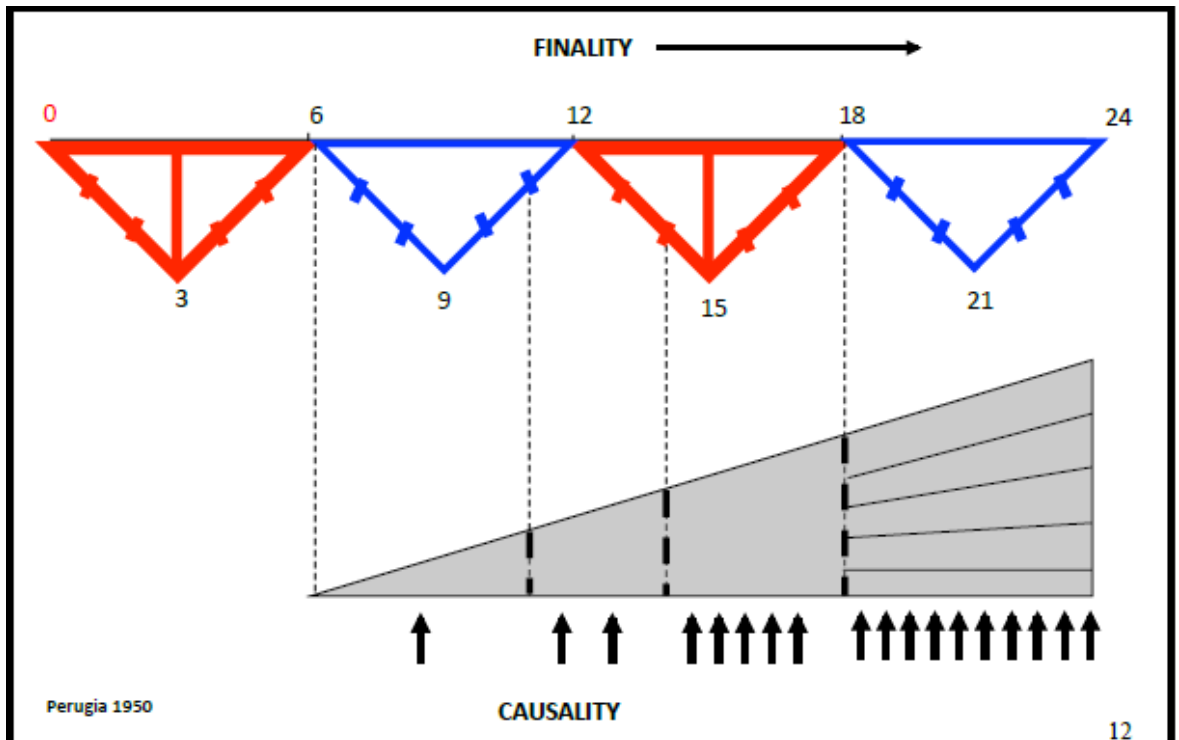
Figure 2. Montessori's non-linear development inside the child

According to the study done by Lide (2018, p. 14), the different planes can be related to the worldview employing the pedagogy. This is done using: 1. movement and cognition; the thought is that the two are closely related as movement enhances thinking and learning; 2. Choice: by children choosing the work they have a sense of control, allowing for a sense of learning and well-being; 3. Interest: interest sparks learning as you learn better if you are interested in what you are learning; 4. Extrinsic rewards are avoided: no reward systems in place, the child is motivated with the mastering of the work; 5. Learning with and from peers: children find benefit of being able to collaborate with others; 6. Learning in context: the learning experience carries more value as it is done in a real-world context and not in an abstract; 7. Teacher and child way: the interaction between teacher and child is to add value, allowing the child to choose their work and be aided by the teacher; and 8. Order in the environment and mind: the child benefits from an environment that fosters order and in turn teaches the child to find order in him/herself.

2.2   Andragogy

According to Amiruddin et al. (2022, p. 81), learning independence can be increased by applying Andragogy. They also mention that a student's autonomy will increase by using Andragogy because students choose what they want to learn. This implies that they will develop according to their potential. Amiruddin et al. (2022, p. 84) want to claim that Andragogy has taken over pedagogy, which means lecturing takes place over a longer period. It is mentioned that Andragogy applies to any adult learning environment (Knowles et al., 2015, p. 4). Another point mentioned by Purwanti (2017, p. 33) is that one should remember that no two people learn the same way and that the theories will help guide the learning process.

2.2.1   Six Principles of Learning

Knowles (2015, p. 4) goes on to say that Andragogy has six (6) principles: "1. Learner's need to know; 2. Self-concept of the learner; 3. Prior experience of the learner; 4. Readiness to learn; 5. Orientation to learning; and 6. Motivation to learn. These principles are most effective when adapted to the uniqueness of each learner. A study done by Purwati et al. (2022, p. 86) adapted the principles to read: "self-concept; experience, readiness to learn; motivation; need to know; problem-centred learning". Teachers also need to know how to apply the principles.

The teacher's role, according to Purwati et al. (2022, p. 86), is to help students understand their needs. To do this, teachers need to choose and implement appropriate activities so that students can learn from the teachings.

Studies also show that Andragogy has been applied in various countries such as Indonesia, Europe, and North America (Purwati et al., 2022, p. 86). Another study is done in Indonesia by Purwanti (2017, p. 30). They mention that the effective incorporation of the six principles needs to be further investigated but mention that the six principles of Andragogy are as follows: These principles are also mentioned by Purwanti (2017, p. 30) as self-concept, readiness to learn, orientation to learning, adult learner experience and motivation to learn. Purwanti (2017, p. 30) omits the principal "need to know" in the study.

2.2.1.1 Self-concept

Simply stated, adults have a better understanding of themselves and thus are more responsible for their own decisions. Thus, implying that they are more independent (Akyıldız, 2019, p. 153; Purwanti, 2017, p. 33; Purwati et al., 2022, p. 88). What makes adults more self-reliant is that course content is developed to meet the expectations of the course and the environment will be conducive to learning (one way to achieve this is to allow learners to be part of the class layout design). It is important to mention that self-directed learning will automatically give the students autonomy over their learning (could ask what learner's expectations are for the following lesson), thus designing content correctly is vital. Another way is to incorporate the learner's experiences into the learning. One can deploy questionnaires to learners to gain input for autonomy (Purwati et al., 2022, p. 88). Another addition is made by Purwanti (2017, p. 33) when saying that the student's independence brings self-reliance, autonomous learning, and self-directed learning to achieve the set learning objectives.

2.2.1.2 Experiences

The following ideas were discussed by Purwati et al. in a study they did about the 6 characteristics of Andragogy (2022, p. 88). The idea here is that students bring with them their own experiences. These experiences will impact the learning experience of students if it is tapped into. This is done when the selection of materials is based on the individual and collective experiences of both the students and lecturers in the teaching and learning environment. Learning is done by employing comparison and contrasting new knowledge against what they know about themselves and their experiences in general. The same sentiment is echoed by Purwanti (2019, p. 153; 2017, p. 33) when it is said that students will relate new information to past events and experiences. Enhancement of the learning experience can be done by employing new innovative teaching techniques such as exhibitions, consumer fairs, etc., and real-time business entrepreneurial activities. Video and online projects could be another way of incorporating innovative experiences. Another way is using discussion groups where students can share their stories and experiences about a specific topic or theme, in other words, project-based learning.

2.2.1.3 Readiness to Learn

Purwati et al. (2022, p. 89) mention that the willingness to learn is sometimes influenced by the environments and social circles we navigate in and is how learners will develop their skills (Akyıldız, 2019, p. 153; Purwanti, 2017, p. 34). Social circles are rich in learning moments and even help the learner with coping mechanisms as echoed by Purwanti (2017, p. 34). Social encounters in class can be facilitated where students can give reviews of the experiences and what they could do differently. Purwati et al. (2022, p. 89) even suggest that students be given a scenario and asked to create posters or presentations in groups about the scenario. This will enhance the readiness by having to work in peer groups to create presentations. The role of the teacher is to ensure that they know the different self-directed readiness tools and techniques to implement them in the classrooms and online classrooms (Purwati et al., 2022, p. 89). Both lecturers and students need the necessary skills and experience to do and implement self-directed learning. Students need to ensure that they set goals in their learning to ensure that they will remain invested in their learning (Purwanti, 2017, p. 34).

2.2.1.4 Motivation

One of the most important aspects of learning is motivation. Simply stated: motivation is the emotional thoughts that affect one's actions and thoughts. Purwati et al. (2022, p. 89), believe that all are naturally motivated to learn. Some factors such as job satisfaction, quality of life, and so on influence one's motivation, so some internal and external factors (Purwanti, 2017, p. 34, Purwati et al., 2022, p. 88) can influence one's motivation to study. Internal motivation can be enhanced by linking learning to students' needs and interests (Purwati et al., 2022, p. 89, Purwanti, 2017, p. 34).

2.2.1.5 Need to know

Essential to adults is the need to know why they are learning the knowledge. This will intern drive the ability to want to learn. It is so important that educators (lecturers) explain the reasoning behind the learning, this will enhance the learning awareness. Purwati et al. (2022, p. 90), suggest this learning takes place by introducing case studies or problem-based learning in the content that is taught. This will enhance the experience that students can gain and build on the knowledge they have already.

2.2.1.6 Problem-centred Learning

An interesting thought is brought into play by Purwati et al. (2022, p. 90). This is also mentioned by Purwanti (2017, p. 34). They say that people are problem-centred learning. In other words when faced with a problem people naturally want to know why and will find out or read up about the reasons for the problem. The reasoning is that is more engaging to learn about the problem as it is based on real life. A good way to tap into this is if lecturers based their scenarios around real-life problems that need to be solved.

2.2.2 Lecturer roles and responsibilities

According to Purwati et al. (2022, p. 92), the lecturer (teacher) has a vital part to play throughout the teaching experience. The lecturer may employ more than one principle of Andragogy in their lesson, the more used, the better the learning. They also go on to say that with pedagogy the children are more reliant on the lecturer, whereas in adult learning the lecturer acts as a facilitator and the adults are self-driven. Purwati et al. (2022, p. 92) mention that in HEI the lecturers rely on the student's ability to be independent and rely on their experience. Lecturers view their professionalism in 5 ways: learning is a mandatory activity (Purwati et al., 2022, p. 92, Purwanti et al., 2017, p. 36); learning influences their experience; lecturers are passionate about learning; level of knowledge or orientation to teaching; and learning is due to internal motivations (Purwanti et al., 2017, p. 36). Alignment can be made to the characteristics of Andragogy namely: self-concept, experience, readiness (willingness) to learn, orientation of learning, and internal motivation (Purwati et al., 2022, p. 93, Purwanti, 2017, p. 34). Purwati et al. (2022, p. 93) also imply that lecturers should apply students' learning in their design of teaching activities. They refer to designs such as project-based learning, discovery learning centres, cooperative learning, and many more that will promote independent learning.

According to Purwanti (2017, p. 31), lecturers in Indonesia should qualify, for such a graduate degree or doctoral degree in teaching. This qualification should ensure that lecturers have competencies in pedagogical, personal, social, and professional development. The importance in Indonesia is that lecturers should constantly improve their qualifications and skills (Purwanti, 2017, p. 31). In Indonesia, lecturers are seen as instructors. Paying attention to students' interests, ensuring that classrooms are ena-

blers of cooperative context, guiding interactions between teacher, learner, and re-source that are developed by the teacher, and ensuring equal partnerships between teacher and learner are but a few responsibilities mentioned by Purwanti (2017, p. 33).

2.3 Heutagogy

Heutagogy offers more than what Andragogy and Pedagogy can offer (Akyıldız, 2019, p. 152). According to Akyıldız (2019, p. 152), neither one can offer to produce enough self-driven learners but a way to perhaps achieve this is through Heutagogy (Blaschke, 2021, p. 1630). Akyıldız (2019, p. 152) reconsiders that Andragogy and Pedagogy are enough to bring the student into the 21st century. The study goes on to say that Peda-gogy is focused on the curriculum of subjects and is fully dependent on the teacher and the subjects are therefore not chosen as per the student's experience (Akyıldız, 2019, p. 152). The focus moved from Pedagogy to Andragogy.

The focus of Andragogy is not on lifelong learning and the self-directed learning pro-cess (Akyıldız, 2019, p. 153). Learners can choose, according to their goals what they want to learn. It is added that the lecturer role is now one of tutoring or mentoring. Tü-men Akyıldız and Blaschke (2019, p. 153; Blaschke, 2021, p. 1632) go on to say that the learner's responsibilities are to ensure the environment will enhance the learning process and that the correct materials are designed; that the needs and goals of learn-ing are identified; the learner evaluates their own experiences and identifies what the learning requirements will be. All of this is done with the guidance of the lecturer.

Student independent learning is increased using Heutagogy (Amiruddin et al., 2022, p. 81). Through Heutagogy the teacher is the facilitator of the classroom and in the learn-ing, process thus making the process student-centred (Amiruddin et al., 2022, p. 8, Akyıldız, 2019, p. 153). Here students also still have autonomy over what they want to study and how it is studied. Students are free to do independent learning with the use of Heutagogy (Amiruddin et al., 2022, p. 81, Akyıldız, 2019, p. 154). In the study done by Amiruddin et al. (2022, p. 84) it was found that Heutagogy was applied the least.

Principles such as self-directed learning are where the learner is responsible for what is learned and how it is learned (Akyıldız, 2019, p. 154; Blaschke, 2021, p. 1630). This means the autonomy and social aspects are in the hands of the learner and guided by the lecturer. Students then must look at the needs in industry and create new knowledge based on experience and have the capability as a skill and where needed

employ collaboration to achieve the autonomy needed (Akyıldız, 2019, p. 154). It is added that capable people are self-efficient, creative, self-directed, self-determined, have collaborative skills, life-long learning skills, and have great values, the values are what is important for the heutagogical approach (Akyıldız, 2019, p. 154; Blaschke, 2021, p. 1630). Another skill to take into consideration is critical thinking, explorative, reflective, innovative, and entrepreneurial skills (Blaschke, 2021, p. 1630). Heutagogy is concerned with assessments and curricula that are adaptable to adhere to self-determined learning.

Assessments should therefore also be flexible and adaptable. This will make students take responsibility for the assessments and be more motivated to the it (Akyıldız, 2019, p. 155). It is important to mention that assessments must have a way to measure the outcome. This should be decided on by both the lecturer and the student. Thus, students should determine what they learn, how they learn, and how it will be assessed (Akyıldız, 2019, p. 155). Similarly to the views of Akyıldız, Blaschke (2021, p. 1633; 2019, p. 155) adds that formative assessments are vital, but sustainable assessments that help students develop self-efficiency self-regulations, and self-assessment are important. Some Heutagogy principles are identified to help with this idea.

According to Blaschke and Akyıldız (2019, p. 155; Blaschke, 2021, p. 1633), Heutagogy has several principles of learning: 1. self-directed learning; 2 knowing how to learn is a fundamental skill; 3. lecturer focuses on process rather than content; 4. student-centred learning by avoiding lecturer-centred learning; 5. be part of learner's world; 6. self-directed learning and exploration takes place; 7. one can advance beyond one's discipline. Simply stated the student has a say on how what and where they study, thus self-directed and self-determined learning.

It is mentioned that features of Pedagogy, Andragogy, and Heutagogy can be combined to fulfil the needs of students, within the context of studies (Akyıldız, 2019, p. 156; Blaschke, 2021, p. 1634). It is important to mention that both lecturers and students need to be active for this to work.

It is amazing to think that some educators still have not heard of the Heutagogy approach to learning. This implies that educators are not ready for the 21st-century requirements. This study was done in Turkey and at the time of the study the fact that people didn't know the term Heutagogy was a concern to Akyıldız (2019, p. 161). It is worth mentioning that even though they haven't heard of Heutagogy the lecturers will adapt the learn about it, to implement it. Another concern was that the lecturers in HE

couldn't even implement Andragogy let alone Heutagogy and resorted back to implementing Pedagogical principles and models (Akyıldız, 2019, p. 162). Akyıldız (2019, p. 162) goes on to say that it will be better to guide the class into a more modern view thus allowing students the full responsibility to learn. The study suggests that this can be done by engaging students with methods such as projects, problem-based learning, and collaborative group work. With problem-based learning, the student learns to cope with the circumstances and then enhances life-long learning. Another concern is that the student lacks the skills to do self-directed and self-determined learning (Blaschke, 2021, p. 1634). The role of the lecturer thus becomes a facilitator and coach and uses reflective teaching methods (Akyıldız, 2019, p. 162, Blaschke, 2021, p. 1633) to reflect on growth. This applies to both lecturer and student. Students will gain more benefits through Heutagogy.

Heutagogy increases engagement with learners and motivates them more; self-efficacy in learning increases; students are active learners; self-directed and self-determined learning takes place; inquiries are done more critically; students can reflect better thus promoting reflective skills; competence is enhanced; collaboration with others is enhanced, allowing students to learn from each other; and student capabilities to learn in general are improved (Blaschke, 2021, p. 1633).

Akyıldız (2019, p. 156) stresses that learning should become a life-long process that is aided by Heutagogy, and not just short-term.

2.4 4IR vs 5IR

2.4.1 4IR

During the 3IR computers were used in education to address "what" questions. Bringing on the internet to address the "how" questions of education (Khoza, 2023, p. 844). Being able to use the internet brought about societal communication where teachers could share their experiences (Khoza, 2023, p. 844). Khoza (2023, p. 844) also mentions with the addition of digital technologies one can address societal needs. It is important to note that the 4IR focus is on technology and AI and brought the addition of mobile devices to education (Khoza, 2023, p. 845). 4IR in principle changes the way humans interact with each other, their behaviour, and everyday life. During lockdown, 4IR tools were deployed from primary to higher education. Forcing SA into the 4IR environment.

An interesting notion is introduced by Khoza (2023, p. 844) that teachers need to reflect on themselves and understand their personal needs. Khoza (2023, p. 845) mentions that after being influenced to acquire new actions, teachers' identities are formed through professional knowledge, skills, and values. By using these skills, an automated interest of professionals and societies is promoted. Khoza (2023, p. 845) goes on to mention that teachers should use technology to facilitate the learning process and encourage students to do self-driven learning. The focus should shift to student-centred learning.

Barrot (2023, p. 4) mentions that 4IR fuses the physical, digital, and biological spheres. Barrot (2023, p. 4) adds that the focus of jobs is that of data analytics, data sciences, and AI. This is supported by Matits (2022, p. 26) who says that 4IR, also known as Industry 4.0, is categorized by the integration of technologies such as AI, gene editing, and advanced robotics. It is added that this categorization will transform global production and supplier networks. This means skills such as skills are analytical thinking and innovation, active learning and learning strategies, complex problem-solving, critical thinking and analysis, creativity, originality and initiative, leadership and social influence, technology use, monitoring, and control, technology design and programming, resilience, stress tolerance and flexibility, reasoning, problem-solving and ideation, emotional intelligence, troubleshooting and user experience, service orientation, system analysis and evaluation, and persuasion and negotiation (Blaschke, 2021, p. 1631). To support this the need for education to produce students that have more knowledge and more have more work-based skills are needed (Blaschke, 2021, p. 1630). Barrot (2023, p. 4) mentions that students lose interest in traditional lectures and want a new innovative way of learning things. They prefer learning things that are grounded in real life and that will solve real-world issues.

2.4.2   5IR

The definition of 5IR simply says that the Fifth Industrial Revolution, or 5IR, (Barrot, 2023, p. 5) is the idea that humans and technology (or machines) can work in harmony with one another, where humans are at the centre of the processing and not machine-focused.

Barrot (2023, p. 6) then introduces the concept of Curriculum 5.0. It mentions that 65% entering first grade now will go on to work in a career that doesn't exist yet. It is HEI and other educational institutions to find a way to adapt to the changes in the world, to make provision for the changes to bridge the gap between what industry will need and

what HEI produces. This simply means that there is a skills gap. A skills gap happens when the graduates do not have the required skills needed in the industry (Barrot, 2023, p. 2). It is mentioned in a study by Blaschke (2021, p. 1631) that future skills for employability should include: "self-development related skills (ability to reflect, auton-omy, need/innovation for achievement, personal responsiveness, self-efficacy, self-initi-ative, self-management, and tolerance for ambiguity); object-related skills (agility, crea-tivity, digital literacy); and social world/organizational-related skills (cooperation and communication competence, future mindset, and sense-making)". Barrot (2023, p. 5) mentions that 5IR focuses on a human-centric society that balances economic ad-vances with the resolution of social problems using technology. Humans are back, and the focus is on how advances in technology can become human-centred. Added to this 5IR no longer focuses only on mass production but rather adds smart societies and sustainability. Harmony between human-robot collaboration, renewable resources, sus-tainable agriculture, and the production of bionics renewable resources becomes the focus of 5IR (Barrot, 2023, p. 5). To provide for this Curriculum 5.0 allows us to match teaching and learning needs to adapt to the needs of the future employee. "Curriculum 5.0 exhibits the following features: addresses industry and societal demands, balances learning outcomes and processes, harnesses technology to complement human crea-tivity and craftsmanship, zeroes in on developing multiliteracies, taps on learners' self-management skills, and adopts a socio-cultural perspective" (Barrot, 2023, p. 6). Barrot (2023, p. 6) mentions that there needs to be a strong collaboration between universi-ties, government, and industry to make this work. There also needs to be a new look at how courses are assessed as conventional methods will no longer yield the desired ef-fect as the courses will have to be aligned to the skills and needs of the industry.

2.5   Differences in teaching techniques -Andragogy vs Pedagogy

According to Purwati et al., (2022, pp. 90–91). the differences between Andragogy and Pedagogy are the orientation of learning (in pedagogy, students study to pass, whereas adults have reasons for studying); teaching, and learning (in pedagogy, the learning process is guided whereas in andragogy students are self-directed); experi-ence (in pedagogy, students have less experience than adults); readiness to learn (in pedagogy, students are dependent on teacher whereas adults mostly driven to study by own needs); student orientation (in pedagogy, students are taught a curriculum

whereas adults are self-oriented) and lastly, motivation (in pedagogy, students are motivated by adult whereas adults are self-motivated). Another view trying to explain the difference is that of Purwanti (2022, pp. 90–91).

Purwanti (2017, p. 33) believes that pedagogy refers to a child learner and Andragogy describes an adult learner. This echoes the idea previously stated.

2.6   Limitations of Studies

Purwati et al. (2022, p. 93) highlight in several studies that the characteristic of Andragogy is not implemented uniformly in different courses and say that studies should be conducted on how to apply the six characteristics of Andragogy. They also mention that different techniques and applications are needed at different levels.

Human aspects such as religion should also be taken into consideration (Purwanti, 2017, p. 37) so that learning doesn't violate religion and local customs. Not adhering to the local and religious customs could lead to students not trusting their lecturers.

Akyıldız (2019, p. 156) mentions that no studies are looking at the administration of Heutagogy and no study has been done till now on the perception of lecturers with regards to the use of Heutagogy. The study also mentions the use of social media in studies to support self-directed learning (Akyıldız, 2019, p. 164).

3   Research Methodology

The interpretive (constructivist) view is that people have an active role as it is their view or perception that is important (Wahyuni, 2012, p. 71). Based on this a social constructivist qualitative study will be needed. This will allow for the determination of the commonalities, differences, and applications of the different teaching methods. This shows the view of the social constructivist as it will look at the interaction between individuals (Creswell, 2013, p. 37). Using the interpretivist approach, one looks at the details of the person in the specific situation, the details behind the reality and subjective meaning, actions, and motivations of the participants (Wahyuni, 2012, p. 71). Based on the interpretive and social constructivist nature of the study, it will be best to use a qualitative research method to conduct the study and make abductions from the literature.

Based on the research questions and the design of the study, it will be advisable to create a narrative case study of the situation (Wahyuni, 2012, p. 71, Creswell, 2013, p. 42). Creswell (2018, p. 272) mentions that case studies are bound by the situation which will produce an in-depth view of the situation.

A structured literature review with a thematic approach will be used to collect and synthesize the data.

3.1   Problem Statement

Students were forced into the new digital era of teaching and learning namely the 4IR and more recently 5IR, when forced to go online during the COVID-19 pandemic. Traditional methods of teaching could no longer be implemented, and new ways needed to be adopted. In the mists of the pandemic, HEI still had to produce graduates who needed skills such as critical thinking; had innovative mindsets to make them more employable; self-sustaining attributes; and could create a knowledge-basis to drive the nation's development, economic, and innovation (Simon et al., 2024, p. 359). Unfortunately, this principle of making teaching student-centred is still only paper-based (Simon et al., 2024, p. 358). Even though Andragogy is more student-centred it hasn't been implemented as it should be. The research seeks to compare Montessori's pedagogy to both Andragogy and Heutagogy. The research will identify the commonalities, differences, and gaps that exist in the different methods and seek to design a framework that encompasses the best of all the methods to bridge a skills gap in the 5IR.

3.2   Purpose of the Study

Higher education is driven by the need to produce students who will contribute to the economics of our country (Simon et al., 2024, p. 358). How is this possible if even the literature says that HEI is still driving teacher-centred approaches rather than student-driven approaches (Simon et al., 2024, p. 14).

The study will investigate the literature to design a new framework for HE to bridge the skills gap in 5IR. The study aims to understand what the latest research says about Montessori's pedagogy, Andragogy, and Heutagogy principles in the 4IR/5IR environment. The work will include:

- Defining Montessori philosophy, Andragogy, and Heutagogy in a class setting.
- Define the principles of 4IR and 5IR skills.
- Identifying overlap, if any, to see if the new framework (Montessori philosophy, andragogy, and Heutagogy combination) has a place in the 4IR/5IR future.
- Develop the guidelines to manage and present the curriculum to students.

From the points above, the study aims to exploration of the commonalities and differences that will aid in creating a new framework with Montessori philosophy as the backbone. This framework should aid the implementation of 5IR education requirements in creating a student that will be suited to the future of work. The investigation of Montessori pedagogy, Andragogy-and Heutagogy principles in the 4IR/5IR environment is needed to see if upskilling and sharing of knowledge is feasible.

3.3   Research Questions

The following main questions and sub-questions can be asked in fulfilment of the purpose of this study:

Q1: Could 5IR education dilemmas be solved by combining the Montessori pedagogy, Andragogy, and Heutagogy?

Q1.1: What are the common attributes, if any?

Q1.2: Are there any mismatches, concerns, or dilemmas identifiable?

Q1.3: What are the 5IR education requirements?

Q1.4: Is there a recommended framework for HEI in the 5IR using Montessori's pedagogy?

3.3.1 Objectives of the Study

Using a qualitative thematic structured literature review the following main objectives will be investigated:

O1: Investigate whether the combination of Montessori pedagogy, Andragogy, and Heutagogy can be combined to solve the 5IR education needs.

O1.1: Identify the commonalities of Montessori pedagogy, Andragogy, and Heutagogy.

O1.2: Identify any mismatches, concerns, or dilemmas.

O1.3: Identify the 5IR educational requirements that the study needs to accommodate.

O1.4: Create a new Montessori-inspired framework for HEI that will address the 5IR educational needs.

3.3.2 Population and Sample

The study is a Qualitative Structured Literature review using a Thematic approach. There is no human sample that will be used. However, the paper samples will be limited to the last ten years, and only papers that fulfil the brief and answer the research questions will be selected. Searches will be done on various search engines such as Scopus, Google Scholar, BASE, CORE, and any other appropriate academic search engine. A rapid literature methodology will be implemented.

3.3.3 Data Collection

Data will be collected primarily through academic articles, books, reports, and other scholarly articles. Scholarly databases such as Scopus, Google Scholar, BASE, and Core will be searched. Other digital libraries, institutional repositories, and scholarly websites will be used to gather and search for relevant information related to Montessori, Andragogy, and Heutagogy. The search will not be limited to only one country but will however be limited to the last (10) ten years. Variations of the keywords such as

"Andragogy" + "Montessori" + "Heutagogy" + "4IR", "Andragogy" + "Montessori" + "Heutagogy" + "5IR", "Andragogy" + "Montessori" + "Heutagogy", "Pedagogy-Andragogy-Heutagogy", "Andragogy + Adult learning", "Montessori +Adult learning", "Heutagogy + Adult learning", "Andragogy + Higher Education", "Montessori + Higher Education", "Heutagogy + Higher Education" "adult learning problems", "4IR skills gap", "5IR skills gap", "4IR skills needs" and "5IR skills needs". The article gathered will further data reduction (Bell et al., 2019, p. 58) will be done by looking at abstracts and evaluating them against the research questions to ensure that it will fulfil the brief of the problem statement and the research questions, any article that doesn't fulfil the scope of the study will be eliminated. Once articles are identified that fulfil the research questions, a thorough review will be done of those articles, the synthesis will take place and the report will be written. Another way to add data is to look at the bibliography of the articles to identify more possible articles for study. Data reduction aims to reduce the large number of data collected to make sense of it (Bell et al., 2019, p. 58). As Torraco (2016, p. 64) said in his article the idea of systematic literature review is to create a comprehensive summary of the related literature that will relate to the research questions. What this study aims to do is get a better understanding of the teaching methods best suited to Higher Education. This will allow the bringing together of ideas to create a new framework for Higher Education (Torraco, 2016, p. 66).

3.3.4   Data Analysis

The study will be using a systematic literature analysis therefore it will need to be analysed using a qualitative method. The underlying principles applied will be to analyze, synthesize, and report back using the thematic approach. Patterns, transitions, similarities or differences, or recurring themes will be identified and grouped (Bell et al., 2019, p. 58, Zawacki-Richter et al., 2020, p. 14), critically evaluated, and reported on. Synthesis also takes place by taking information from the primary source, summarizing and explaining the findings of multiple sources (Zawacki-Richter et al., 2020, p. 154). It is mentioned that the information reviewed should be relevant to the topic under investigation; should be in a peer-reviewed journal or article; and should be empirical studies (Zawacki-Richter et al., 2020, p. 149). It is also important to mention that any "missing", or omitted data should also be identified and reported on (Bell et al., 2019, p. 565). All data extracted will be related and in answer to the research questions asked. Reporting will be done as per a narrative case study layout, looking at the data identified in a Higher Education setting.

3.3.5 Quality of Data

According to Andrews (2005, p. 401), a systematic literature review's value judgment is based on the subjectiveness of the researcher. Andrews goes on to say that it is vital that as much care is taken to minimize bias. One should judge the trustworthiness of the evidence when compared to the research question. Another aspect to consider is to what extent is the research design and analysis appropriate to the review questions and lastly, one should weigh the overall weight of the evidence to the relevance of the focus of the study (Andrews, 2005, p. 401). The content of the articles will be weighed against the research questions to ensure that it will be valid for the study and so ensure the quality of the data (Andrews, 2005, p. 401).
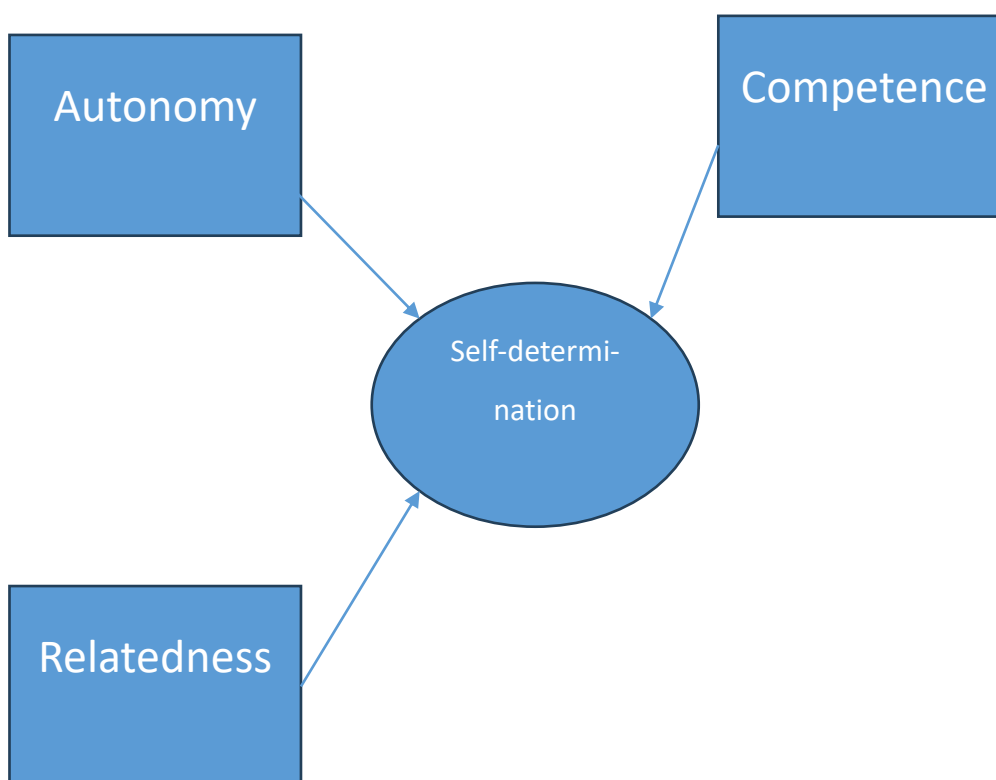
3.3.6 Conceptual Model

Figure 3. SDT Conceptual Framework

For this study, the Self-Determination Theory (SDT) will be applied. The learner-centred paradigm makes the point that institutional-level and teacher culture must be learner-centred (L. M. Jeno, 2015, p. 694). SDT focuses on the satisfaction of basic

needs concerning: Autonomy (student wants to feel like they have a choice), competence (feeling capable of doing the work), and relatedness (they feel they are cared for) (Jeno, et al., 2018, p. 1165). By using the SDT, one will be able to determine the willingness of students to adopt the proposed framework. The SDT aligns with both Andragogy and Heutagogy skills, competencies and what the adult-learning theories encompass as shown in the literature review chapter (Chapter 2) above. It therefore lends itself to this study.

3.3.7   Ethical Concerns

No informed consent will be needed as this is a structured literature review. The only ethical concern is partial bias, but necessary steps will be taken to ensure that bias will not influence the outcome of the study. Ethical clearance is required but has a low to no impact on the institutions and students at large. No students or staff will be contacted or consulted during this study. According to Rajendran (2001, p. 1), researchers need to check themselves constantly to check their interpretation and prejudices toward the data. To do this the data will be critically analyzed to ensure that prejudices or personal interpretations are implemented.

The researcher will do her level best to ensure no plagiarism exists and to ensure that all data is kept strictly according to copyright regulations and will not go against the proprietary rights of authors.

3.3.8   Limitations in the Study

The limitation of the study is the duration. Because of various factors, the study became a rapidly structured literature review. The limitations could change if the due date and submission date are changed. Some articles were eliminated due to time constraints on the study. Another limitation is that the study is dependent on other people's work and their interpretation of the work that may have their understanding connected to it. It can also be mentioned that the study tries to encompass the full view, but some sources may not allow a full view such as geographics to be explored. Future work would include possible qualitative studies to see the effectiveness and willingness to accept the study's outcomes. Future work could also have quantitative studies to see to which extent the different teaching methods are implemented and how

"successful" it has been implemented when interviewing students and staff on the understanding and teaching of work. The number of graduates could also be seen as a success factor for the chosen teaching style. A longitudinal study could also be done to see the long-term impact of the new framework in HEI.

3.3.9 Chapter Outline

Chapter 1: Introduction

The background and introduction of the study will be discussed.

Show the context and importance, demographics, and periodic information of the study. Give a clear indication of the research questions and what the aim of the study will be.

Chapter 2: Literature review and theoretical framework

Emphasis will be given to Montessori pedagogy, Andragogy, and Heutagogy. Each teaching method will be reviewed to identify any commonalities, differences, and commonalities. Any gaps in studies will be highlighted. A literature review with regards to 4IR/5IR skills needs will also be investigated.

Chapter 3: Research design and methodology

The qualitative structured literature review method for the inquiry will be discussed, looking at the narrative case study write-up of the rapid literature review. Data collection methods and data analysis methods will be outlined and discussed.

Chapter 4: Discussion and analysis of findings

The findings from the structured thematic literature using a rapid approach will be synthesized and discussed against the research questions. The Montessori-inspired framework will be explained.

Chapter 5: Summary, conclusion, and recommendations of the study.

Findings and discussions will be recapped, the contribution of the study will be highlighted, and future work will be recommended.

4   Findings and Discussion

4.1   Introduction

The study and search for information was started by searching Google Scholar, BASE, and CORE. When searching Montessori AND andragogy AND Heutagogy AND 4IR, not many results were obtained. To be precise: 1 return on Google Scholar. No returns for Montessori AND andragogy AND Heutagogy AND 5IR on any of the search engines. Further searches had to be pursued. Research articles will be collected and downloaded, after which the articles will be entered into the Mendeley reference database. Mendeley will be used to maintain and reference all data collected. The time frame is very limited.

Due to the time limit the criteria were reduced and the search was done for Montessori AND andragogy AND Heutagogy. In the next section, the results will be shown before the exclusion criteria and after the exclusion criteria are implemented.

4.2   Search Results

The search results will be shown in the table below:

Table 2. Search Results of Study

Search Engine	Topic	Search engine results	Results after exclusion criteria	Decision taken	Further steps
Google Scholar	Montessori AND andragogy AND Heutagogy AND 4IR	1	Date 2014-2024 = 1	Critique for content to see if usable in the study	Search for alternative keywords to try and find more results
Google Scholar	Montessori AND andragogy AND Heutagogy AND 5IR	0	0	None	Search for alternative keywords to try and find more results
	Montessori AND andragogy AND Heutagogy	117	2014-2024 = 87 Review article	Critique for content to	Look at the search criteria to see what can be further elim-

			setting = 5	see if usable in the study. After critiques, one can look at related articles to increase	inated. Review articles were implemented and returned only 5. Will look at 5 and then remove the review only to find more.
CORE	Montessori AND andragogy AND Heutagogy AND 4IR	0	0	None	Search for alternative keywords to try and find more results
CORE	Montessori AND andragogy AND Heutagogy AND 5IR	0	0	None	Search for alternative keywords to try and find more results
	Montessori AND andragogy AND Heutagogy	28	2014-2024 = 26	Critique for content to see if usable in the study	
BASE	Montessori AND andragogy AND Heutagogy AND 4IR	0	0	None	Search for alternative keywords to try and find more results
BASE	Montessori AND andragogy AND Heutagogy AND 5IR	0	0	None	Search for alternative keywords to try and find more results
	Montessori AND andragogy AND Heutagogy	0	0	None	Search for alternative keywords to try and find more results

After the search, the abstracts of the articles were read. After the reduction process, 4 of the Google Scholar articles and books were downloaded and another 5 were identified as recommended articles by Google Scholar. CORE had only 2 usable articles. Base yielded zero articles. An article was later eliminated due to its incompleteness of the article. Some pages were missing in publication, another was eliminated purely

due to lack of time to read the entire book. Another source was used in the literature review section of the thesis and thus could not be used gain. Giving 10 sources to use in this study. Thematic principles will be applied to answer the research questions. Each question will show the findings, and the discussion will follow directly afterwards. The final research question will be answered in the recommendations section.

4.3 Identify the commonalities of Montessori pedagogy, Andragogy, and Heu-tagogy

In the table below the relevant articles are summarised in a table. Showing the commonalities and findings for each Pedagogy, Andragogy, and Heutagogy. None of the articles refer to Montessori pedagogy but to pedagogy in general. The findings are made in bullet-type format to easily identify commonalities in the discussions that follow below the table.

Table 3. Summary of Findings of Pedagogy, Andragogy, and Heutagogy

Research Topic and Author	Methodology and size	Pedagogy	Andragogy	Heutagogy	Other findings
Structural Model of Pedagogy-Andragogy-Heutagogy Continuum on Pedagogical Competencies of Indonesian Vocational High School Teacher (Amiruddin et al., 2023)	Structural equation model 393 Teachers	The pedagogical competencies mostly accommodate teacher-centred learning. (p. 7). Those competencies are: student characteristics such as physical, moral, social, cultural, emotional, and intellectual aspects need to be mastered; learning theories and learning principles need mastering; curriculum of subject field needs developing to teach; conducting educational learning, using technology for educational purposes; facilitating the activation of students' potential; effective and courteous communication with students;	Facilitation is the focus of the teacher competencies. These competencies will help students develop the student's potential (p. 7). Students show more maturity and autonomy as the teachers have less control over the classroom (p. 8).	The same is true for the teacher's facilitation of the student's potential (p. 7).	The interplay between pedagogy, Andragogy, and Heutagogy is possible (p. 1).

		and, evaluating students employing assessments to ensure outcomes are met (p. 2).			
Implementation of Pedagogical, Andragogical, and Heutagogical Approaches in Education System Sustainability. (Budiarto et al., 2023)	Literature Review 14 Articles	Mentions that Pedagogy is appropriate for early education level (p. 281). Integration is referred to as effective teaching and learning and sustainable learning is developed (p. 282). Students should be equipped with knowledge, and skills, and be able to address the needs of the economy society, and the environment by exploring real-world problems, asking questions, finding solutions to the questions identified, and working collaboratively (p. 282).	Andragogic is appropriate for adult learning (p. 281). Designed for adult-based learning, to fulfil unique needs (p. 282). Educational strategies and methods need adjustment to engage and support adult learners (p. 282). Learning happens when a student feels the content is geared to their interests and goals and learners can take responsibility for their learning (p. 282). Students should be guided to set their	The heutagogy approach is suitable for adult learning too (p. 821). Educational approach that focuses on self-determined and self-directed learning (p. 282). The learner takes charge (has full autonomy) of their learning process and promotes lifelong and independent learning (p. 282). To use this method in HE, the focus should move from traditional teaching to learner-centred education (p. 282).	All the approaches are appropriate to use in HE (p. 281). Education functions are 1. Developing abilities; 2. Developing students' character, and 3. becoming part of the community (p. 281). It is added that other characteristics such as being knowledgeable, skilled, creative, and independent should also be developed (p. 282).

| | | Activities should be hands-on, be able to conduct experiments, analyze data, and develop critical-thinking skills in real-life situations (p. 282).

Teachers should be able to understand students; apply classroom management; use technology appropriately in learning; evaluate students according to determined objectives; and help students reach their potential (p. 285).

Teachers must have the following competence: educational intuition and foundation; must be able to understand students; must be able to design the curriculum to be taught; have the necessary learning design; must be able to manage learning and implement the | own "learning objectives, identify their learning needs, and actively participate in the learning process" (p. 282).

The content must be geared toward real-life, problem-solving to apply knowledge and skills learned (p. 282).

The lecturer keeps communication open between student and lecturer by being a facilitator so that the students can learn more (p. 291).

Seen as adult education (p. 291).

Andragogy has characteristics such as learner controlled; students are responsible self-responsibility for their learning; self-chosen learning goals by the relevance of | Learners are active in the learning process, set their own goals, design their learning plans, select their resources and strategies to learn, self-reflections in promoted and they should monitor their progress, identify their own learning needs, and take responsibility for their learning outcomes (p. 282).

Heutagogy helps students develop content that is non-linear in design; has repetition, is learner-directed, and helps the students understand how they learn and understand content (p. 293).

The student decides first what the content is that they want to learn and then defines the learning contracts. After that they decide | |

| | | appropriate learning at the right time; incorporate technology into learning; evaluate learning; and assist students to develop their true nature (p. 291).

Learning principles such as motivation and attention; activeness; experience and direct involvement; repetition; challenge; reinforcement and feedback; and individual differences, should all be used by the teacher to ensure competence in learners (p. 291). | own learning; learning is done employing problem-solving, self-directed learning; problem-solving approaches to learning, self-directed learning; motivates self in learning; and experiential learner is part of the learning process; support students in transformative learning; help students choose goals and planning for self-directed learning (p. 291)

The aim is to guide the student to gain knowledge, skills, attitudes, and values (p 283).

There are several adult learning principles: 1. Motor skills will not change because of practical learning; 2. Verbal instructions will be given as per student | on the flexibility of the curriculum; the questions that will guide their learning and lastly, how the assessment will take place (p. 293). | |

			needs; 3. Intellectual skills will be learned before learning skills; 4. Reasoning will increase in relation to the increased process of thinking (p. 292). Learning skills needed are problem-solving, to fulfil everyday needs. To allow for this, the teacher needs to: facilitate and assist students; the curriculum should be problem-based; and should be designed based on concerns or needs of students. The facilitator should also provide an environment that will allow for self-directed learning and problem-solving (p. 292). Other roles of the facilitator include roles of the facilitators include ensuring interactive and active		

			learning; motivating when needed; helping students design learning; evaluating learning with students; focusing on understanding and not just learning; and that the learning process is based on participation (p. 292).		
A thematic review on the implementation of Heutagogy in universities (Hairi et al., 2022)	Quantitative and Qualitative Systematic Literature Review 23 Articles			Heutagogy has the potential to be implemented in different fields with a specific purpose. The different approaches used to implement Heutagogy were ICT, blended learning, distant learning, module/curriculum-related, and outside-classroom activities (p. 6686). Blended learning was done employing three strategies: flipped classroom, andragogy, heutagogy, and	Further studies are recommended for the implementation of Heutagogy (p. 6699).

				effective tutoring (p. 6694).
				Flipped classrooms are problem-based and group-based (p. 6694).
				Heutagogy is pro-moted with blended learning as it allows the students to be self-driven and self-paced, thus making the students more in-volved with the pro-cess. (p. 6694)
				Adaptive learning in the Heutagogy ap-proach aids explora-tion, creation, collabo-ration, connection, re-flection, and sharing (p. 6695).
				Coaching allows for life-long learning, heu-tagogy, and asset-led coaching (p. 6697).
				"Heutagogy is self-de-termined learning that

				focuses on the emergence of a learner-centred environment to help students define their paths" (p. 6698). Students must collaborate with others to determine how and what will be learned (p. 6698). Lecturers will provide a topic from the curriculum and students will decide the content and how it will be assessed. With this deeper learning can take place as stress is decreased for both the student and lecturer (p. 6698).	
Pedagogy, Andragogy, and Heutagogy as a continuum in Higher education: description and measurement models	Descriptive quantitative approach 316 students			Andragogy is used more in HE (p. 81). Andragogy increases student autonomy by reducing the lecturer's role in the classroom	Study shows that Heutagogy practices are least implemented in HE and are not practised enough in lectures (p. 80).	The statement is made that no empirical evidence regarding the use of pedagogy, andragogy, and heutagogy together in the classroom (p. 80).

(Amiruddin et al. , 2022)			and increasing the student's role (p. 81).		Found that theoretical, Andragogy, and Heutagogy are similar concepts (p. 84).
The use of Pedagogical, Andragogical, and Heutagogical learning principles in undergraduate humanities courses: an examination of students and faculty perceptions. (Alpert, 2021)	Quantitative descriptive survey 15 Faculty members 53 students	It is found that students who can test themselves and learn a topic till they understand has a deep root in pedagogy (p. 50). Attitudes of faculty staff showed that an andragogical approach toward helping students talk about beliefs and feelings helped deepen and create a relationship with students (p. 53). Teacher-focused principles concerning information transmission correspond to pedagogical approaches. Teachers will give a basic set of notes and facts to study, known as Information transmission-	Motivation to study and learning strategy of what, when, and where to study are principles of both Andragogy and Heutagogy (p. 7, p. 12). The student feels that they will repeat work and find out more about a topic until they are happy (p. 20, p. 51). Teaching is more learner-centred in practice (p.69). Once teaching shifts from information transmission to concept the student focus shifts from pedagogy to andragogy and heutagogy (p. 55 – 56).	These mentioned principles are found in students who are keen to create their own goals, pursue those goals based on their previous experiences, and want to find meaning in what they learn (p. 61). Students showed that they are willing to learn knowledge that they find valuable and will actively engage in the learning (p. 56). Staff feel they are responsible for what, and how students learn, and what is expected of them (p. 56). Conceptual Change-Student Focused (CCFS) approach	HEI should forget the "college-ready paradigm" and rather focus on what the student needs to succeed, and it should recognize the risk factors that impact success (p. 70). Pedagogical, andragogical, and heutagogical principles, still provide the framework that is used to develop learners and their characteristics (p. 71).

| | | teacher focused (ITTF) (p. 56). | Andragogy principles identified were: needing to know (what, how, and why they learn); self-concept (self-directed and autonomous learning); experience (student brings own life experience into studies); readiness to learn (applying what is learned to real-life problems); orientation to learning (goal-oriented, experiences to change skills, behaviour, attitudes or knowledge, they want to apply problem-solving to deal with problems or issues) (p. 14, p. 60).

Andragogy concepts such as critical thinking and inquiry, self-reflection, students' experiences, goals, and interests, and mentorship as a means of teaching were acknowledged | moves the focus to students, and they are involved in the process of learning. They participate in the activities to learn more than just cover the materials. This approach ends in self-directed learning (p. 56).

Andragogy and Heutagogy learning principles that were identified: learner-centred practices such as active participation, opportunities for choice, analytical and conceptual thinking, and interest in and recognition of student experiences (p.69).

Peer collaboration was indicated in the article (p.73).

Bridging to Andragogy can be done by helping students to know how to learn; focusing | |

| | | | as ways to foster a relationship with students (p. 62).

Cultivation of andragogical knowledge is built upon the engagement done using pedagogical approaches (p. 63).

Can expand andragogical principles by allowing for repetition of learning; creating a culture of learning; ensuring self-directed learning can take place; and ensuring collaboration rather than competition takes place (p. 64). | on the learning process; ensuring that students understand that learning is a discipline; giving opportunities for repetition, action learning, research, reflection, experience, and interaction with others will allow for knowledge and skills to be built (p. 72).

Heutagogical experiences for self-determined learning: experience-based learning, self-paced learning, course design that allows flexibility and negotiation on assessments, and action research that allows learners to find meaning in learning (p.73). | |
| Leadership, Contexts, and Learning - Part 2. Theories of Learning, Channels, and Curricula | Survey research | Pedagogy is appropriate for children and adults (p. 29). | Due to changes in technology, social change, and longer life expectancy, adults | Learning is focused on personalized, self-determined, and interest-based (p. 36). | |

| (Digital et al., 2020) | | The statement is made that the curriculum is content-based and teacher-driven, this means the student is dependent on the teacher to learn content. The teacher is responsible for the students to reach the learning outcomes (p. 30).

In the context of HEI, students have to know the context based on outcomes; they are dependent on the teacher for the content and how it will be evaluated; experience in the world is limited and limited to the content that is taught; that all learners are able and equal in learning ability to pass the subject; that content is subject-centred, which means that content is all they learn; .learning takes place by | must learn adaptability through life-long learning (p. 32).

Andragogy is to be life and application-centred. This means that content is delivered based on the situation and not the content. It adds that adult learners are self-directed, work independently, and that content is problem-based, thus giving students autonomy for their learning. This increases the ability to understand the work and become competent (p. 32).

The lecturer becomes a facilitator but specifies the learning outcome and thus directs the narrative (p. 33).

The four conditions of learning are engagement (involved with planning and develop- | Learning is not designed by the instructional designer or facilitator, but rather by the problem-solving, innovation, and creativity of the learner (p. 36).

The idea behind or underpinning Heutagogy is that the learner is the agent of learning. They question and decide if the content is formulated properly. This means they need to change the way they look at content. They need to understand all aspects of the topic, and what tools and methods are needed to solve the dilemma or problem. This implies that the student is self-determined in his learning and reflection. In a nutshell, Heutagogy is self-determined, independent, and practical- | |

		punishment or reward and/or pressure from parents (p. 30). Content is chosen by the teacher and taught to students by the teacher (p. 31).	ment of learning); experience (students bring their life experiences with them to learning); relevance (learning value is increased when knowledge can be applied to their own life); and problem-centred learning (allows the student to solve problems in real-life scenarios) (p.33 – 34).	based learning (p. 37). Lecturers take on the role of facilitator, tutor, or mentor. The role is determined by the active learning of the student (p. 38). Heutagogy process: 1. Learners should what and how they want to learn; 2. Guide learners in the exploration, discovery, and application of content; 3. Be the tutor or guide on the side; 4. Allow collaboration between learners to aid learning; and 5. Guide learners in the learning process of how to learn (p. 39). Skills needed to be a 21st-century learner: the ability to accept and manage ambiguity (project management, social media	

				competence, have the big 5 personality traits); ability to engage with people (interpersonal traits; communication and motivation skills); the ability to learn (collaboration, research capabilities, build networks); and, being able to use open system thinking (the adaptability of being able to work with others, be aware of changes) (p. 42).	
Professional practice shape shifting. Applying agile design principles to self-determined learning (O'Brien, 2019)	Narrative	Defined as a process of learning that is used for children (p. 40).	A term that describes the learning process of adults and mentions the cornerstone is self-directed learning of adults (p. 40).	Introduced as a self-determined learning theory (p. 40). The learner is responsible for what is included in the curriculum, thus determining what to learn, when to learn it, and how to learn it (p. 40).	Agile principles are described as lightness, leanness, nimbleness, quickness, dexterity, suppleness, or alertness (p. 39). They define agility as the means to make a quick change or embrace change, to learn from that change, and add to the economy, quality, and simplicity of the

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				Associated with life-long learning, professional and social learning (p. 40). Problem-solving strategies are common between agile and heutagogy, this should become more responsive when trying to solve a real-world problem (p. 40).	environment. This is normally done in a re-petitive means (p. 39). Learning takes place from pedagogy to an-dragogy to heutagogy (p. 40).
Childhood Learning vs. Adulthood Learn-ing: The Theory of Pedagogy and Andra-gogy (Edosomwan, 2016)		Explain the difference between maturation learning theory (focus on physical and men-tal aspects of the child), and environ-mental learning theory (child will learn from its environment, ob-serving others in the environment and mimicking others in the environment will lead to decision-mak-ing skills and develop-ment), constructivist learning theory (Based on Piaget, Montessori, and	Adult learning helps share information, ad-vance knowledge, aids skills develop-ment, and shape the world (p. 118). Adult learning moti-vates students to im-prove themselves, ful-fil literacy and educa-tional demands through goal-directed learning, and respond to changes in life, making one more em-ployable, personal, or	Heutagogy is self-de-termined learning, that incorporates prin-ciples and practices of Andragogy (p. 121). The teacher acts as a facilitator of the learn-ing process, by guid-ing and providing re-sources. Students take ownership of the learning process by negotiating what en when the information will be learned (p. 121).	Jarvis's learning the-ory says that transfor-mation is what cre-ates knowledge, atti-tudes, values, feel-ings, and responses to the goal of learning (p. 119). Experience, critical re-flection, reflective dis-course, and action are the 4 main compo-nents of transforma-tive learning theory. All learning will take place by shaping learners' experiences. One can also invoke

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		Vygotsky, children develop and learn by participating and interacting in the learning process, learning takes place in the "Zone of proximal development") (p 116 – 118).	professional development or life-long learning (p. 120). Andragogy and pedagogy can be substituted, depending on the circumstances (p. 122). Adults learn from what they see, experience, and feel. They model and observe others in the learning process (p. 122).		learning by giving task-oriented self-reflecting tasks to do (p. 119). Humanistic learning is based on value; thus, learning is directed inwardly. Focuses on self-fulfilment and self-actualization (p. 120).
The Future of Ubiquitous Learning (Gros et al., 2016)	Book chapters	Technology can be incorporated employing introducing subject matter and evaluation of technology; facilitating learning using a tool, and programming the technology (p. 4). Learning through the connection of learner, teacher, and resources is aided by technology and the	Self-determined learning has the following qualities: ownership of learning; self-management and self-monitoring; which must be an addition to own learning (p. 13). The teacher will provide guidance and resources (p. 13). Later it is mentioned that andragogy is self-	Learning is autonomous and self-determined. The aim is to produce students who will be prepared for today's ever-changing workplace (p. 13). Learning is a proactive process where the learner is the agent of learning and is based on their own experience (p. 13).	

| | | ways to access the internet (p. 4).

With the introduction of technology, the following changes will be needed: Learning becomes learner-centred, individual, and social; learning is made according to individual needs; new innovative pedagogies need implementation to accommodate for technology; more flexibility and integration of learning into everyday life; and education and training must be more accessible (p. 8).

Training strategies such as personalization, active learning, collaboration, and self-directed learning can be included (p. 8).

Professional competencies should include content -, pedagogical | directed learning (p. 27). | The teacher provides guidance and resources but relinquishes control to a student who will decide what, how, and when content will be learned (p. 13).

Learning takes place by self-image; they consider the problem and what the action coming from the problem will be and then use problem-solving techniques to process the learning (p. 13).

Learner is the main agent of their learning and that is the result of personal experiences. They add that the learner and teacher work in partnership to decide what will be learned and how (p. 13).

Principles of Heutagogy: Learner-cen- | |

		-, technological -, and the knowledge generated by the intersections of the areas (p. 9).		tred and Learner-determined, capability; self-reflection of not only on what was learned but also how it was obtained; double-loop learning; and nonlinear learning and teaching (p. 28). Allows for each transition into the workforce by equipping them with the skills to cope and adapt to the environment. Skills such as problem-solving, critical thinking, innovation, good communication, collaboration, digital literacy, and the ability to apply what is learned to real life (p. 29). Teacher and learner agree and design learning together, they then select the appropriate learning activity and the learning goals (p. 31).	

| | | | | Design principles are given as learners involved in what and how they learn; curriculum should be flexible and address students' questions, and motivation and allow for a shift of mind of student; assessments must be designed and agreed upon together; teacher becomes guide, proving feedback; environment should be rich in opportunities to explore and reflect on learning (p. 32). The design element is explore, create, collaborate, connect, share, and reflect (p. 32). | |
| Online, Hybrid, Blended, and Technology-mediated Learning in Social Studies. | Thematic Literature review Articles from 2014, 3 years only | Teachers had to revert to pedagogical methods to ensure that the environment would promote teaching and learning during hybrid learning. It | The hybrid learning model is used to frame content through an inquiry-based, student-centred approach, thus allowing students to take an | For deeper learning, the teacher will send questions to ensure and determine the | Hybrid learning through means of self-created screencasts, video-based lectures, and prior |

(Heafner & Handler, 2014)		also said that this decision on pedagogy will determine how effective the learning will be. Teacher-directed documents can be shared with students and that will keep learning at a knowledge level. Teachers thus must scaffold the learning (p. 338). Pedagogical choices should be high in learning options by allowing debates, and high-level thinking and promoting this by asking challenging questions to the students (p. 341).	active role in their learning. It is added that collaborative work happens outside the classroom (p. 338). Critical thinking toward information and analyzing sources coupled with collaboration and interaction with students will build knowledge (p. 339). Teacher focus shifts from instruction to supporting students in an interactive environment (p. 339). Still uses structured and standardized tests (p. 339).	student's understanding of the work (p. 339). Blended learning can step into Heutagogy when the option to create products comes into play. Students must show an understanding of the work by creating some products such as videos (p. 342). Students take charge of learning by creating digital products. This allows them to create their ideas, beliefs, and understanding of the work utilizing digital media products (p. 348).	reading learning materials (p. 338). Blended learning also takes advantage of problem-based learning activities to build knowledge and critical thinking skills (p. 341).

Pedagogy is dedicated or meant to be used for children in pre and primary schools. The aim of pedagogy is that it will create a sustainable learning environment that will allow for the harmonious integration of teaching and learning. Children should be taught the necessary knowledge and skills to contribute and be part of the civilization around them. They need to learn to solve real-world problems and be able to work with others to solve those problems. All activities should be hands-on learning, based on the real world so that the children can learn critical thinking and in turn, use that the solve the problems. The method however is teacher-based learning.

Teacher-based learning means that the teacher sets the curriculum, and decides what is learned, how, and when it is taught. It doesn't give freedom for children to choose what they want to learn and when. This is in contradiction to what Montessori believed. She believed that the child's innate need was to learn and that the environment should be set up so that the environment spoke to the child's needs. The child through exploration and self-determined learning chose the equipment and worked with the equipment. Learning exactly what is needed at the right time. The teacher acts as a guide to ensure that the students reach their full potential. This is the same in normal pedagogical approaches. The teacher guides by teaching in a parrot-type format for the child to reach the content requirements or curriculum outcomes. Pedagogies applied in most schools are thus not geared to Montessori's philosophy. Pedagogical learning principles need to be applied and monitored.

Learning principles are the most important aspect of pedagogy. Those principles include motivating students; paying attention to what they are doing and what is done; ensuring that students stay actively busy with content (engaged); giving opportunities for students to gain experience through direct involvement with content; allowing for repetition; challenging students to make sense of what they are learning; reinforce content and give feedback. Most, if not all are present in the Montessori philosophy with the basis that all children become independent and social beings within their social environment, being the class. This shows that students can reinforce through repetition until they have mastered the concept the material offers the child. Montessori believed that you follow the child to ensure that the child learns what is needed and at the right time. Children then take responsibility for their learning and the teacher acts as a guide. The child thus determines their learning.

The self-determined learning sounds very much like Heutagogy. However, before unpacking Heutagogy, another principle of self-directed learning comes through strongly with Montessori. The student brings their own life experiences to the learning and will learn

better if the problem is set in the real world. Andragogy focuses strongly on allowing the child to discover the content based on their interests and knows that if the student/learner is invested they will learn better. For learning to be classified as Andragogy, it must fulfil certain principles.

Andragogy principles are identified as student needs to know what, how, and why they are learning the content; they want to do autonomous learning thus determining when to learn; they want the content to be based on their own experiences; students want to be able to apply what they have learned to real-life problems; students want to learn to be goal-oriented, and want the learning to change their behaviour or skills; they want to apply and build their knowledge in such a way that they will be able to solve everyday problems in society.

In the Montessori environment, the student/learner chooses when he/she wants to learn. This is a description of self-determined learning. Self-determined learning is where the students/learners choose what they want to learn, where they want to learn, and how they want to learn. The student/learners best work in collaboration with others. This aids the learning process. The teacher/lecturer is purely the guide and facilitator, acting as a tutor from time to time. It is mentioned that the teacher's role, in the beginning, is to aid the student/learner to become independent and then act as the facilitator. Evaluation or assessment is determined by the student/learner and that means the method of assessment is also determined by the student/learner. This is agreed upon ahead of time by both the student/learner and the teacher/lecturer. Teachers/lecturers need to ensure a safe environment for Heutagogy to take place.

The environment should ensure that students/learners know how to learn; should allow students/learners to focus on the learning process; ensure that the learner understands that learning is a process; give opportunities for repetition of work; action learning to take place; research reflection experience and interact with others. By having the environment facilitate this, the student/learner will be able to gain knowledge and therefore build their skills. The main idea behind Heutagogy is that the student/learner becomes a lifelong learner. But this is not achieved immediately.

Most of the literature, mentions that the combination of pedagogy, Andragogy, and Heutagogy can be found in HE. They also mention that it progressively moves from Pedagogy to Andragogy to Heutagogy. Building on each of the principles until the student has self-determined learning. This simply means that the learner/student starts depending less on the teacher to guide and structure the learning process (pedagogy), they start tak-

ing more responsibility and less structured learning contexts and environments (andragogy). This ensures that students become more autonomous in their learning, taking more initiative to select learning, and creating their own goals, and learning objectives (heutagogy). They also decide to what extent the teacher/lecturer will be involved and the value they will offer to the student/learner (Digital et al., 2020, p. 38). It is also mentioned that there are some commonalities between pedagogy, andragogy, and heutagogy.

The commonalities are found in the learner-centred approach to learning. Montessori's approach emphasizes the prepared environment that allows the student/learner to engage in self-directed learning and allows the student/learner to explore for themselves (Budiarto et al., 2023, p. 282). Andragogy very much has the same view. It admits the importance of self-directed learning in adults and allows students/learners to take responsibility for their learning process (Digital et al., 2020, p. 32). Heutagogy builds further on this and allows the student/learner to take control of what, how, and where learning will take place. This is the essence of self-determined learning (Edosomwan, 2016, p. 121). All three approaches prioritize learner autonomy and involvement in setting goals, designing learning plans, and selecting resources and strategies (Amiruddin et al., 2023, p. 8; Budiarto et al., 2023, p. 282). Important is that all three allow the student/learner to reflect and understand the process of their thinking in the learning process. The shift from traditional teacher-centred teaching methods to learner-centred methods, enables individuals to become lifelong, independent learners. While Montessori pedagogy is mainly focused on early childhood education, Andragogy and Heutagogy are valid to learners of all ages, stressing the lifelong learning aspect.

4.4   Identify any mismatches, concerns, or dilemmas

The mismatches, concerns and dilemmas as found in the analysis will be discussed below the table.

Table 4. Mismatches, concerns, or dilemmas

Article	Description
Implementation of Pedagogical, Andragogical, and Heutagogical approaches in Education System sustainability. (Budiarto et al., 2023)	"…implementation of education is largely determined by the approach used by educators or teachers in conveying the material to students who prioritize the characteristics of students as learning subjects" (p. 282) "…framework of identification and imitation, while adult education is carried out within the framework

	of personal self-direction to solve problems. (p. 292)
A Thematic review on the implementation of Heutagogy in Universities. (Hairi et al., 2022)	"Some of the elements of heutagogy; exploring, connecting, collaborating, creating, reflecting, and sharing that are rarely discussed in all strategies, therefore, create a gap in the implementation of heutagogy in teaching and learning". (p. 6698)
The Use of Pedagogical, Andragogical, and Heutagogical Learning Principles in Undergraduate Humanities Courses: An Examination of Student and Faculty Perceptions – ProQuest (Alpert, 2021)	"Research needs to be done to understand the perceptions of humanities faculty and students" (p. 80)
Leadership, Contexts, and Learning-Part 2. Theories of Learning, Leadership, Contexts, and Learning-Part 2. Theories of Learning, Channels, and Curricula Channels, and Curricula (Digital et al., 2020)	reported that "almost half of today's overall college student body are adult learners, but many facets of higher education are not designed with adult learners in mind" (p. 32). "Knowles noted that adult learners felt this was insufficient and frequently resisted teaching strategies that pedagogy prescribed such as lectures, assigned readings, drills, quizzes, note memorizing, and examinations" (p. 33). "With pedagogy, the teacher sets content objectives, i.e., what the student needs to learn about leadership, controls the teaching processes, i.e., how to deliver the content to the student, and assumes that if assessments are properly carried out, the student will learn leadership" (p. 35) "While in andragogy, a learner may demonstrate self-direction by deciding how to learn the present content objectives in a leadership course, in heutagogy the curriculum itself can be decided by the learners." (p. 37) Heutagogy vs Andragogy (p. 39) "Heutagogy…. requires double-loop learning rather than single-loop learning. emphasizes capability development, not only competency development. is learner-determined (the learner designs the curriculum and makes the assessment) rather than learner-directed by the instructor. is a learner-managed approach in contrast with instructor–learner–managed. has a non-linear design and learning approach instead of a linear approach. focuses on the

	process of how to understand how to learn as opposed to getting students to learn content."
Professional Practice Shape Shifting. Applying Agile Design Principles to Self-Determined Learning (O'Brien, 2019)	"A gap exists in the literature with regards to how to undertake self-determined learning thus not showing how learner determines what, when and how learning takes place" (p. 41).
Online, Hybrid, Blended, and Technology-mediated Learning in Social Studies (Heafner & Handler, 2014)	"Some issue arises from technology and lack thereof when using hybrid and blended learning. The issues stem from outdated technology or teachers not having the necessary skills to operate the technology" p. 242).

One of the most concerning statements is that adult learning is not being designed with the adult learner in mind. The idea behind adult learning is that it should teach the student/learner the ability to be self-directed in their learning process. If the design is not making provision for this then the exercise is of no worth. It is worrying that students/learners still must sit through lectures, and boring classes, teaching content that students/learners could simply read on their own time. They are given assignments that simply regurgitate the content found in books. Content is still being drilled into students' minds and quizzed using old methods, examination is still the old 3-hour papers where content is simply recited from books. No wonder students/learners "cram" the work the night before. This shows that the content is still based on old pedagogical approaches where the teacher/lecturer still decides what is learned, how it is learned, and how it is assessed. With Heutagogy and Andragogy, the biggest difference or concern is that the content is decided on by the student and when and where they will learn. What makes it a concern is that students might not know the process of learning. The gap of not knowing how to study could lead the student/learner to not being able to explore, connect, collaborate, create, and reflect on the content. Students/learners will thus not be able to implement self-determined learning. It is also mentioned that the true perception of students concerning Heutagogy remains unknown. Another concern is how technology and the implementation of technology could aid or hinder Heutagogy.

4.5   Identify the 5IR educational requirements that the study needs to accommodate.

"Learners need to be more adaptive and able to solve problems using agile design methods" (O'Brien, 2019, p. 40).

Gros et al. (2016, p. 37) mention that today's learners need to be "agile and adaptive; have good communication skills in both verbal and written media; need great collaborative skills, be curious, and imaginative; be optimistic; have critical thinking and problem-solving skill; demonstrate initiative; be entrepreneurial; have a vision; be resilient; and have empathy and be a citizen of the world".

With both the statements above if one wants to produce students/learners that are future-ready graduates, one needs to equip them with the skills mentioned. These skills of Gros et al. (2016, p. 29) align directly with the skills mentioned by Blaschke (2012, p. 1630). Both emphasize that the skills necessary to be 5IR-ready are critical- thinking, problem-solving, being resilient, and taking leadership, students need to be creative in their approaches and be able to harness collaborative skills to combat the needs of society. It is also clear that students/learners will have to adapt to the ever-changing environments and not be reliant on others thus entrepreneurial skills will be needed to combat the high unemployment rates in the world and the society they live in.

The study doesn't completely emphasize the readiness for 5IR or even 4IR. Attributes such as stress tolerance, troubleshooting, service orientation, technology-driven production; emotional intelligence, and negotiation are not mentioned but could be inherited in Heutagogy.

4.6   Create a new Montessori-inspired framework for HEI that will address the 5IR educational needs.

Figure 4 below shows the Montessori-inspired Framework. This framework was developed as a result of the work done in this study. This framework could be used in all Universities, Universities of Technologies, TVET colleges and any other HEI in South Africa. By implementing this one is not limited to the classroom setup, and subject type (e.g. practical or theory). One simply must ensure that the favourable environment (that being a place that is a "safe space", a place that is geared towards learning and a place that will aid learning).

The explanation that follows will help better understand the framework. Montessori believed that a favourable environment would ensure that the child would be able to do great work. The environment makes it safe for students to explore and create their work without fear of prejudice. The framework inspires self-directed and self-determined learning. This is done by the student/learner being able to decide when, how, and why they want to study. Speaking to the student's innate need to learn and solve problems. This content they will develop to learn will be guided not only by the curriculum (graduate attributes) but also by the teacher/lecturer. Graduate attributes are outcomes that students need to exhibit upon completion of their studies. Kensington-Miller et al. (2018, p. 1439) mention that students should be taught more than just the knowledge and disciplinary content. These outcomes will be decided by utilizing external partners (industry/employers), government requirements and the universities' strategies (Kensington-Miller et al., 2018, p. 1442). The teacher/lecturer will ensure that the student knows what the outcomes will be and guide the student/learner in the right direction. Teachers/lecturers will only get involved when it is needed, allowing for student-centred learning. There will be assessments that will be agreed upon ahead of time. This will allow the student/learner to know what they are working toward and how this will be assessed. These assessments could also be based in the real world where students will have to resolve a real-world issue/problem, again speaking to the innate need of students to fix the world around them. The environment will also allow the student/learner the freedom to interact with the other students, not only of their age or level but of other levels and ages. This is what sets it aside from Heutagogy. The approach is known as vertical grouping. Vertical grouping as shown in Figure 1, shows that students are grouped in 3-year age bands. The one used here is the age group of 18 to 21 and 21 to 24. The age group 18 to 21 is where great work takes place and learning is optimal. Interaction or collaboration with peers and those older or younger will allow students to learn to negotiate, fulfil their interests, and gain experience from each other. These experiences will allow for problem-solving and allow the student/learner to be part of the world around them. All the components in the framework must work in unison.

Every part of the framework has an important role to play. Students learn from each other and the teachers/lecturers. The lecturers guide and help develop the guidelines and curriculum that need to be completed. The environment must be a "place" that allows for learning. It is important to mention that the framework will be most effective when there are subjects that follow one another, simply meaning that content builds or scaffolds on each other. Stand-alone subjects (subjects that don't follow or scaffold) can also use the vertical grouping principle by allowing older students to assist or mentor them. This shows that it will be utilized in all kinds of subjects.
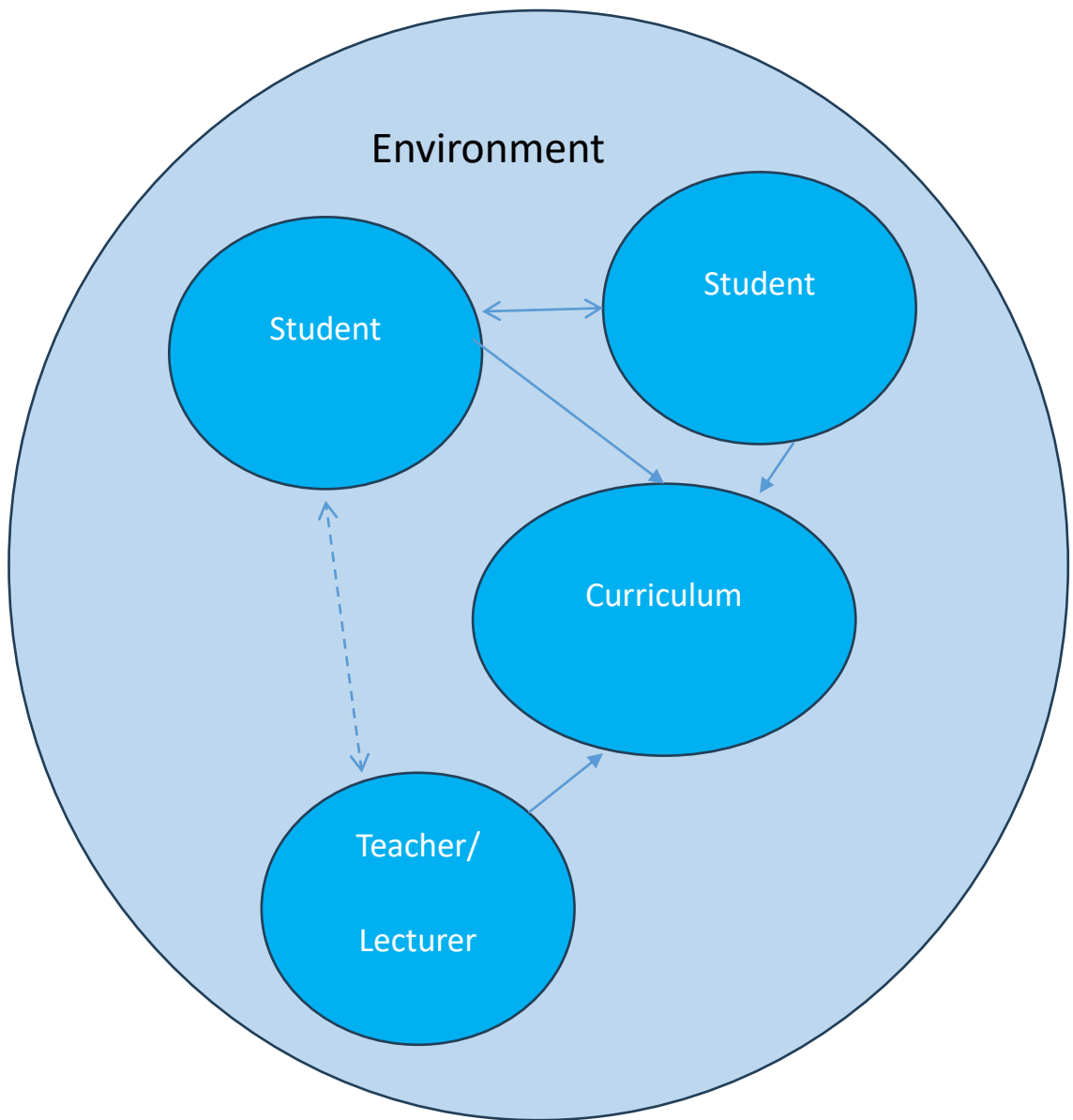
Figure 4. Montessori Framework

5 Recommendations and Conclusion

5.1 Personal Lessons Learnt

This has been one of the hardest projects I have embarked on. I have learned that I can do anything no matter what happens. The time was more than enough but not always possible to get to work. Many obstacles had to be overcome to do this project.

About the content. I have evaluated my teaching style and the methods I use. I realize that there is much left to improve on and that the application of the theories is not that clear-cut, especially when it comes to practical subjects where software packages are being taught. I notice that staff that don't have teaching qualifications mostly apply pedagogical approaches. The old "chalk and board" methods still are predominantly used today. I think there is much work left to be done for organizations to align and prepare students with the 5IR that is here to dominate the world.

I have learned that not all is clear cut and when you try to make a difference in the way you do things, students still want to fall back on the old spoon-feeding ways. Systematically I will start preparing students to be more self-reliant and self-determined in their studies. Students need to start taking more responsibility and staff need to start stepping back. The framework developed here is only a small step in the right direction and will want to develop it in more detail. Create sample work and do pilot groups to see how this could be implemented successfully.

5.2 Recommendations

The following recommendations are warranted:

Further studies into the methods and implemented methods at the university where I teach. This will be great to see if my observations are true about the extent to which teachers can implement adult learning using the appropriate teaching methods.

Another study that can be done is the study that will look at the extent and willingness of students/learners to work in collaborative groups using mentors/tutors, basically playing on the extent to which vertical grouping could be used or is being used unknowingly in the environment in which I work.

Staff should all go for educational vocational training to bring them up to speed with the latest and most innovative ways to teach. A lot of emphasis is placed on a qualification in

the field one educates in but not on how it is done. This is detrimental to the students being taught.

Lastly, the universities should not only in theory speak about the future of work but also start bringing it into practice. The time for talking is over. Now is the time to start acting. If we want our students to be ready for the future of work, we need to start doing it and not just talk about it.

5.3   Conclusion

Heutagogy should be the driving force for adult education, however, it seems like some universities are still stuck in the pedagogical approach. Montessori believed: "Never help a child with a task at which he feels he can succeed". Yet in today's day and age, teachers/educators still believe that things should be done for a child. Universities are doing more harm than good by not allowing an environment that is geared to self-directed, self-determined learning. The students/learners are capable of so much more if they are guided into taking on the responsibility of their learning. The 5IR requires all persons to be able to adapt as quickly as the work environment is changing and by not equipping our students/learning with this self-directed learning mindset, we are creating real-world problems that will not be solved in our lifetimes.

In conclusion: the combination of Montessori's pedagogy, Andragogy, and Heutagogy has the potential to address the dilemmas found in 5IR education. Montessori strongly emphasises self-directed, self-determined learning and is guided by individualised instruction that fulfils the principles of Andragogy. Andragogy focuses on the learner's autonomy and own experiences. Coupled with this is Heutagogy, which focuses on self-determined learning. This could only contribute to the idea of Montessori's pedagogy in HEI. Montessori's method should provide a strong philosophical foundation and perspective to the combined approach idea. Future work could look at the practical application to fully explore the potential of the combination to address 5IR educational dilemmas.

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