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Industrial Revolution to the Rescue of Postgraduate Supervision Curricula with User Interfaces

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Abstract

Interrogating supervision curricula and user interfaces influenced by industrial revolutions helps supervisors and students understand the research identities that drive their research actions. Supervision user interfaces have been influenced by the Fourth/Fifth Industrial Revolution (4/5IR) to integrate WhatsApp/Telegram, Zoom/Microsoft Teams, Google Scholar, ChatGPT, Grammarly, EndNote, and others as part of higher education institutions (HEI). User interfaces are resource spaces where humans interact with computer systems to produce research actions. Industrial revolutions such as the 4/5IR have divided curricula into structured, unstructured, and semi-structured. Findings indicate that structured and unstructured curricula have dominated supervision since the 1IR. The dominance has suppressed the semi-structured curricula driven by self-reflection. The suppression motivated me to conduct this study, which examines the industrial revolution that influences PhD supervision curricula with user interfaces. This study used the pragmatic paradigm, action research, and natural-driven curriculum rationale to frame document analysis, reflective activities, observations, focus group discussions, and semi-structured interviews to collect data. The study used purposive sampling with convenience sampling to select twenty postgraduate supervisors from an HEI in South Africa. A semi-structured curriculum concentrates on actions, beliefs, and the outcomes of supervision. Therefore, this study recommends applying a semi-structured curriculum that promotes and addresses natural needs.

Keywords: Curriculum; industrial revolution; structured; semi-structured; supervision user interface; unstructured

Introduction

The Fourth Industrial Revolution (4IR) that emerged at the turn of the twenty-first century and the Fifth Industrial Revolution (5IR) generated by the COVID-19 era produced digitalised (digitalisation) and personalised (personalisation) curricula, respectively (Sarfraz et al., 2021). A curriculum is a plan for actions if it follows a linear structure (structured, performance, or content-driven) and a plan of actions if it follows a nonlinear structure (unstructured, competency-based, or outcomes-driven) (Zuma et al., 2022). The industrial revolution produced supervision curricula and user interfaces divided into structured (automation or content-driven), unstructured (digitalisation or outcomes-driven), and semi-structured (personalisation or pragmatic). A structured supervision curriculum has prescribed user interfaces with specified steps to be strictly followed by users (researchers). Some user interfaces are WhatsApp/Telegram, Email, Zoom/Microsoft Teams, Google Scholar, YouTube, ChatGPT, DeepSeek (YouTube editing software or AI), Grammarly, and EndNote, to name a few. In other words, if these user interfaces are used within a structured curriculum, users are compelled to use them because they are claimed to represent the truth (objective reality) of supervision. They are perceived to have been assisting users to automatically produce one hundred per cent performance (100%). However, if they are used within an unstructured curriculum (outcomes-driven), users can use any other user interface since they are not prescribed for users. They are mostly used for collaborations with other researchers, which is perceived to improve research outcomes. While the two curricula have

been dominating research supervision processes or systems even in the 4/5IR, there is no conclusive evidence that they always produce 100% performance or outcomes when used.

Studies (Gruzdev et al., 2020; Phillips & Johnson, 2022; Siltanen et al., 2019) point to a combination of the strengths of the two curricula as an optimised supervision curriculum, which can be identified as a semi-structured supervision curriculum (pragmatic). A semi-structured curriculum is needs-driven, where supervisors and students self-reflect and critique their experiences before they start the research processes to understand their research needs, identities, and values. The user interfaces used within this curriculum are identified based on the needs of research activities. However, studies (Gruzdev et al., 2020; Schefer-Wenzl & Miladinovic, 2022; Siltanen et al., 2019) appear to be concerned about the limited or missing application of a semi-structured supervision curriculum in research. The limited application of a semi-structured supervision curriculum, compromised by the tension between structured and unstructured curricula, is a course of concern that motivated me to examine the industrial revolution's influence on postgraduate supervision curricula and user interfaces through a natural-driven curriculum rationale (NDCR). The following research questions are used to drive this study:

A. What industrial revolution influences postgraduate supervision curricula with user interfaces?

B. How does the industrial revolution influence postgraduate supervision curricula with user interfaces?

C. Why does the industrial revolution influence postgraduate supervision curricula with user interfaces in particular ways?

The next sections present a literature review, natural-driven curriculum rationale framework, research design with methodology, quantitative results with qualitative findings, concluding with implications, and references.

Literature review

Industrial Revolution and Supervision Curricula with User Interfaces

An industrial revolution is an unprecedented and radical change in human lifestyles and actions. Each industrial revolution generates user interfaces, defined as resource spaces where humans interact with devices or technology systems to produce research actions. For example, the First Industrial Revolution (1IR) promoted animals as user interfaces for transportation, production, and communication. The 1IR further used the steam engine for mechanical production (mechanisation). The Second Industrial Revolution (2IR) used assembly lines and electricity as user interfaces for mass production (electrification) that prepared for automation systems.

The Third Industrial Revolution (3IR) began with mainframe computing (1960s), personal computers (1970s/80s), the World Wide Web (WWW), and the Internet (1990s) as user interfaces (automation) (Makumane et al., 2024; Schwab, 2016). Postgraduate supervision systems were mostly driven by a structured supervision curriculum where user interfaces were programmed with prescribed steps strictly followed by users (researchers) (Gruzdev et al., 2020; Schefer-Wenzl & Miladinovic, 2022). For example, Richard Niles developed EndNote software in 1988, which is programmed to generate references and citations through the users' developed static library (worked on one computer). While EndNote was active, Roy Rosenzweig developed Zotero in October 2006. These were static, based on a single computer where the library was developed. In other words, it was difficult to share a library between more than one computer. There are many other reference management technologies (user interfaces) developed to manage referencing and references. Another example is 1994, when John M. Barrie, a graduate student at the University of California (Berkeley), started inventing Turnitin software to be launched in 1998. Turnitin has been programmed to check researchers' projects to see if they are not plagiarised by checking the world database, generating a similarity index. Similarity indexes indicate world database information that

has already been published. These examples suggest the automation system of the 3IR to generate a structured supervision curriculum through various user interfaces that are useful for different stages of research projects.

The definition of quality during the 3IR was based on strictly following the scientifically prescribed steps that passed the test of evidential arguments (science evidence-based) (Adigun et al., 2024; Nayeri et al., 2023). In other words, what was seen as the truth or objective reality had to follow a deductive reasoning of quantitative studies based on natural sciences. This automation system influenced other fields of study, such as art, humanities, and/or social sciences, to mimic natural sciences research (Stearns, 2020). For example, most HEIs have prescribed thesis/dissertation curricula similar to those of natural sciences. They mostly follow deductive reasoning with theories for testing, even if the studies are qualitatively driven for inductive reasoning. The automation systems led to the digitisation of information influenced by art, humanities, and/or social sciences, from legacy (school or print media knowledge) to future (everyday or electronic) knowledge that produced the 4IR (Callaghan, 2019; Hoadley, 2020; Prensky & Berry, 2001).

The 4IR promoted a digitalisation or datafication process that allowed researchers to access information even in a nonlinear process that promoted an unstructured supervision curriculum (Cortés & Cortés, 2022; Golić, 2019; Noble et al., 2022). Structured technologies generated during the 3IR were improved through digitalisation ideologies (Adewojo et al., 2023; Callaghan, 2023). The digitisation activated the use of Cloud computing, developed in the 1960s by JCR Licklider, to be one of the active user interfaces. For example, supervisors can share their EndNote libraries with their students, especially for an unstructured supervision curriculum collaboration or group sharing activities drive the processes.

Another example, Niklas Zennstrom and his team developed Skype to be released in August 2003, for mostly one-on-one communication. It was difficult for most supervisors to use Skype to generate a group platform for their students (Kovari, 2024; Mattila et al., 2022). In April 2011, Eric Yuan developed a new ideology that produced Zoom for group video conferencing, where supervisors can communicate with their groups of students without creating group platforms. While Zoom was still active in March 2017, Bill Gates's team produced Microsoft Teams with new ideologies to compete with Zoom for video conferencing. Another observable digitalisation advancement process was the introduction of Telegram in 2013 by Nikolai and Pavel Durov, while WhatsApp, developed by Jan Koum in 2009, was still active.

These suggest that the 4IR promoted an unstructured supervision curriculum that may promote inductive reasoning of a qualitative approach based on logical arguments from the user interface inventor's ideologies. For example, Niklas Zennstrom's main ideology in developing Skype was to promote a platform for a one-on-one system of communication, and the main ideologies of developing Zoom and Microsoft Teams were to encourage group work that could mainly support inductive reasoning. Developed countries mostly develop these user interfaces. This suggests that developed countries, unlike developing countries, use user interfaces to understand their truths/objective realities, which are useful in producing user interfaces based on their unique ideologies. For example, when Eric Yuan (Chinese-American) developed Zoom after he had come closer to the truth of Skype, he had to understand how the motherboard, central processing unit (CPU), graphical processing unit (GPU), random access memory (RAM), storage devices, and others were positioned. This is very difficult for end users who are mostly from developing countries to understand the truths/objective realities of the user interfaces (Fields et al., 2018; Prakash et al., 2021). As a result, end users mostly passively use user interfaces for survival without understanding the truths, powers, and ideologies that underpin them. In other words, most end users do not need the truth about the user interfaces they use because they mostly use them for survival, and the truth may delay their activities for survival. However, automation still indirectly influences digitalisation and promotes the personalisation of user interfaces of the 5IR.

The 5IR personalised artificial intelligence (AI), autonomous vehicles, big data (BD), robotics, quantum computing, and the internet of things (IoT), to name a few, through personalisation of a semi-structured supervision curriculum (Khoza, 2023; Noble et al., 2022; Schwab, 2016; Ziatdinov et al., 2024). The 5IR is characterised by personalisation of user interfaces according to users' unique individual needs (Costa et al., 2022; Golić, 2019; Pang et al., 2023). This seems to promote abductive or retroductive reasoning of the mixed methods approach (Le Grange, 2020). For example, other researchers have developed Cloud computing user interfaces (delivery of computer services over the Internet) where they save all their activities. If these users use EndNote, for example, they can access it from all computers connected to the Internet through their Cloud computing. However, even user interface personalisation has only assisted supervisors to graduate postgraduate students at the survival level without always producing 100% performance or throughput as the supervision truth or objective reality (Gruzdev et al., 2020; Prakash et al., 2021). For example, although supervisors in South Africa have used user interfaces to improve postgraduate throughput rates, they have not helped South Africa to produce one hundred doctoral graduates per one million people as a South African target for 2030 (Oh, 2021). This suggests that another process is required to establish what seems to be missing in terms of achieving 100% performance/throughput. Khoza (2025) proposed a nature-driven process to a natural-driven curriculum rationale (NDCR) as a framework for coming closer to the truth of using user interfaces.

Natural-Driven Curriculum Rationale (NDCR)

The NDCR framework is underpinned by content-driven, outcomes-driven, and needs-driven processes/systems (Figure 1)

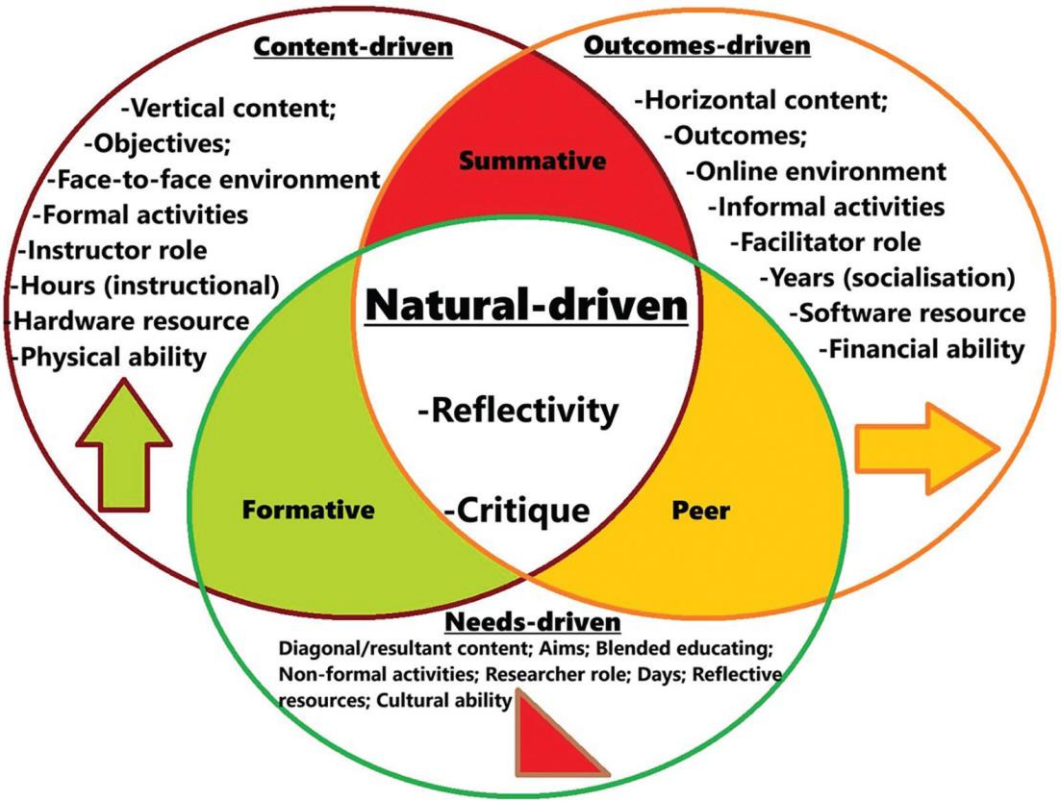

Figure 1: Natural-Driven Curriculum Rationale (NDCR) (Khoza, 2025, p. 11)

Content-driven systems of action assume that there is only one truth in any action that can be found through prescribed steps that produce one truth (objective reality). They favour a structured supervision curriculum where supervisors define and explain each step to be strictly followed by their students. For example, HEI's prescribed content of a thesis, formal activities, objectives, supervision time, and resources are explained in person by supervisors who assume instructor roles, and students are expected to follow the supervisors' instructions strictly. Researchers tend to address descriptive "what" questions of research (what of the phenomena, research design with methodology, findings or results, literature review, and frameworks). The content-driven concepts suggest an automation system of the 3IR. The automation needed to measure the success of mastery of prescribed content or structure, using objectives as the supervisors' short-term goals. But the demand for measuring students' success based on outcomes, as the students' goals came into action.

Outcomes-driven processes of achieving outcomes assume that many realities are based on everyday knowledge (horizontal content). They favour an unstructured supervision curriculum where supervisors encourage students to collaborate with people, especially using social media sites (SMS) (Khoza, 2020) that are facilitated through informal activities. Researchers tend to address operational "how" questions of research (how should the process work). The outcomes-driven concepts suggest a digitalisation process of the 4IR. For example, supervisors establish cohorts and encourage their students to join any other existing cohorts. Students tend to join groups that seem to afford (financially) user interfaces that can be shared among group members. Although they may work in groups, they have individual, unique needs that drive the writing of their research projects.

Needs-driven systems/processes begin with self-reflective resources that are formatively used to address individual unique needs based on one's culture of doing activities. The needs-driven concepts suggest a personalisation process/system of the 5IR that addresses a personal "who" question of supervision.

Forms of assessment, such as peer, formative, and summative, connect the Outcomes-driven, Content-driven, and Needs-driven to the Natural-driven curriculum rationale (NDCR) that addresses the philosophical "why" questions of research.

Research design and methodology

This study uses a pragmatic paradigm driven by abductive reasoning and a mixed-methods approach (quantitative and/or qualitative). A pragmatic paradigm focuses on human actions that emerge from individual past experiences, evidence, and/or beliefs (Govender & Khoza, 2024; Morgan, 2014). The quantitative part of the pragmatic paradigm is based on scientifically tested evidence using specific theories. The NDCR is used in this study to test the issues that emerged from the literature and data. The qualitative part of the pragmatic paradigm is mostly based on beliefs. Both the beliefs of the researcher and participants are used in this study to shape the findings. The meaning of actions (evidence) and beliefs (opinions) is found in their outcomes, which predict future actions, beliefs, and outcomes. Human actions intrinsically, uniquely, and naturally evolve at every turn. Each human has unique needs that require self-reflection to understand one's identity for the task. This suggests multiple realities based on the unique human needs that may be accommodated by a mixed-methods approach that allows both qualitative and quantitative approaches in action or one of them based on the unique needs of the situation to be addressed (Creswell & Creswell, 2018). This approach is supported by participatory action research in this study, which involves planning, action, observation, and reflection stages (Cohen et al., 2018).

The planning stage mostly addresses the first research question (descriptive) through document review and focus group discussion. The action and observation stages mostly address the second "how" research question (operational) through participant observation. The reflection stage mostly addresses the third "why" research question (philosophical) through reflective activities and semi-structured interviews. The data collection methods were conducted twice, each for

approximately an hour. Only two cycles/phases of participatory action research (PAR) were performed on twenty purposively and conveniently sampled participants from a HEI in South Africa. Graphs are used to address the descriptive "what" research question to represent all the participants' experiences. The themes are used to present qualitative findings generated through thematic guided analysis to address the "how" and "why" research questions. Pseudonyms (P 1-20 for participant) were used to represent the participants' real names to observe ethical principles (confidentiality, anonymity, voluntary, etc) based on protocol reference number 00008248/2025 of the HEI where the participants came from.

Validity/Trustworthiness was addressed in terms of confirmability (neutrality—all participants knew the purpose of the study), credibility (truth value—audit trail and tape recorder), dependability/reliability (consistency—direct quotations from the participants), and external validity/transferability (applicability—by providing sufficient details of the relevant context) (Khoza, 2023).

Results

Quantitative Results and Qualitative Findings

The first part of the findings/results presents graphs that show the influence of the 3IR, 4IR, and 5IR in supervision curricula based on the NDCR principles. The second part discusses three themes that emerged from the quantitative results (graphs) to produce qualitative findings.

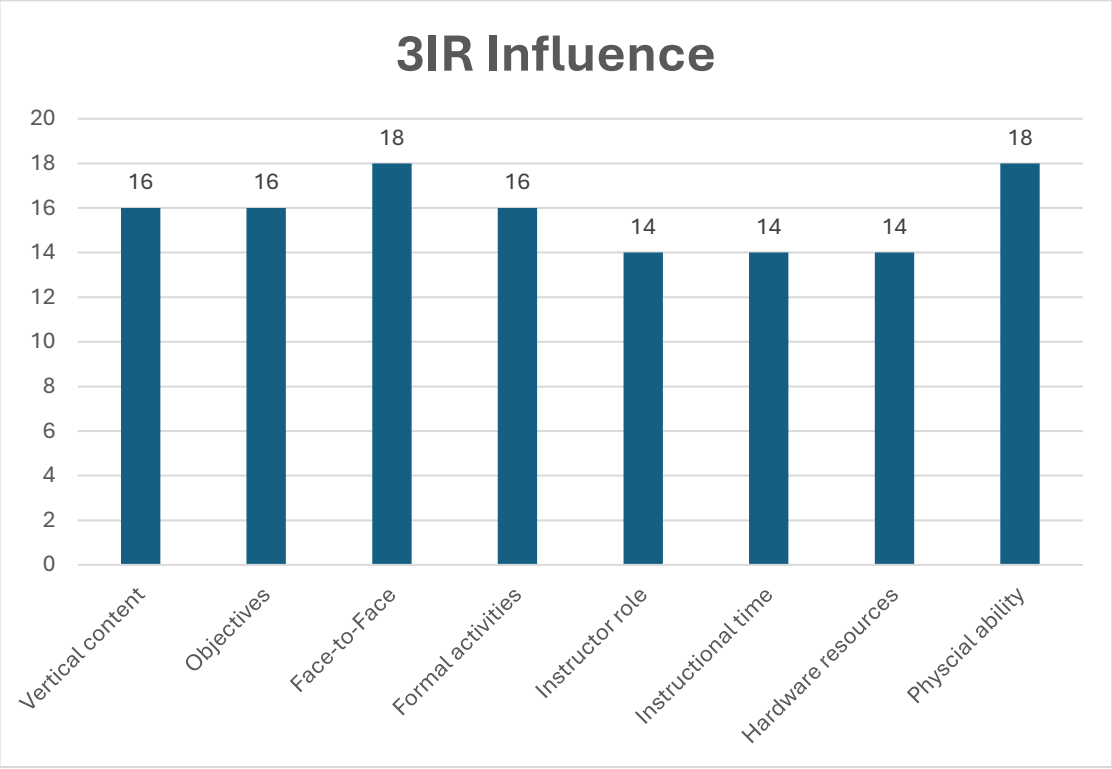

Figure 2: 3IR influence

The results (Figure 2) reveal that fourteen participants (postgraduate supervisors) assumed their supervision role as instructors, had supervision prescribed time (instructional time), and hardware resources. Sixteen participants had prescribed supervision steps, objectives, and formal activities that were explained to their students. Eighteen participants preferred face-to-face (F2F) supervision and were able to define their students who were supervised based on the physical abilities of attending the F2F supervision. The results suggest that the 3IR had the most influence on the participants' supervision curriculum to follow a structured supervision curriculum of automation.

Theme 1: Automation of Structured Supervision Curriculum

Automation became clear when the participants passively followed HEI's strict and prescribed rules or structures of writing a research proposal and dissertation/thesis. When eighteen out of twenty participants used the F2F environment, they wanted "*to drill students with research concepts relevant to the prescribed structure of the proposal and project in venues that are physically accessible to all students…"* (P-5, others 17 agreed). This sounds like one of the symptoms of digital immigrants identified by Prensky and Berry (2001) as people who are scared of technologies and were born before 1982. Those who enjoy the use of technology and were born after 1982 were identified as digital natives. In this current study, age did not influence because other supervisors who preferred the F2F environment and structured supervision curriculum were young, although others were old, and used HEI-prescribed technologies (user interfaces).

For example, during the F2F environment sessions, they trained students on the use of "*Google Scholar (publication search engine), EndNote (reference management system), Zoom, …*" (P-3, others agreed). However, although they used these, they passively used them as user interfaces for survival without knowing their ideologies. They used these without knowing their underpinning ideologies and truth or objective reality because 18 out of 20 did not specialise in the "*field of computer science or educational technology*…" (P-1, others agreed). They strived "*to come closer to the research truth to produce 100% throughput more than closer to the truth about technologies* [user interfaces]" (P-2, other 17 agreed). Even the two participants whose specialisations were computer science and educational technology, who had a better understanding of digital technologies, did not "*produce 100% throughput in supervising students*" (P-11, 12 agreed). This suggests that quality supervision goes beyond knowing the truth about technology user interfaces to a better understanding of the truth of supervision. This further suggests that knowing the truth of supervision and user interfaces may not be enough if supervisors do not know the truth about their students and user interfaces' ideologies of the founders. However, participants were happy because the number of graduating students was increasing "*as evidence of the effective system of supervision*…" (P-4, others agreed). Therefore, as much as a structured supervision curriculum may graduate more students than others, students whose identities or needs are in an unstructured supervision curriculum are denied the opportunity of working according to their strengths (Bäckryd, 2022)

The results (Figure 3) reveal that ten participants (supervisors) used informal activities such as social media sites (SMS) activities as part of their supervision curricula. Eleven participants used everyday knowledge (horizontal content), outcomes, socialisation, software resources, and financial accessibility to drive supervision. They allow their students to follow any means to finish their studies (achieve outcomes) without prescribing steps for them to follow. Fifteen had a supervision role as facilitators to facilitate supervision online. The results suggest that the 4IR had the second most influence on the participants' supervision curriculum to follow an unstructured supervision curriculum of digitalisation.

Theme 2: Digitalisation of Unstructured Supervision Curriculum

Digitalisation has exploded various flexible processes that include collaborative processes between supervisors and students, where students can influence supervisors through the everyday knowledge generated. The participants allowed their "*students to collaborate with other researchers through any form of communication or technology based on their research beliefs…*" (P-15, 10 other participants agreed). Students' research beliefs are influenced by the language of their social groups, especially generated through SMSs (Makumane et al., 2024). When supervisors encourage their students to use user interfaces used by other groups of researchers, they believe that they "*increase chances for students to achieve research outcomes through socialisation, informal activities facilitated by leaders of the groups*" (P-16, other 10 participants).

While research collaborations may promote active students, who may be good with socialisation, to help them with distractions when they feel lonely, they may follow a group that can limit the achievement of desirable outcomes. Social group identifications should be based on belief and evidence that signal the effectiveness of achieving desirable outcomes (Mthembu & Khoza, 2024). It is difficult to separate the belief from the evidence because it is not clear which comes first between the two. For example, if a student followed all known steps to produce a qualitative study, but it is examined by an examiner who believes in quantitative methods and fails the study. This means the produced study as evidence is affected by the belief. The belief may have been generated by previous evidence. Therefore, the issue of the belief and the evidence should be driven by the unique individual needs of the 5IR personalisation (Adewojo et al., 2023; Sarfraz et al., 2021).

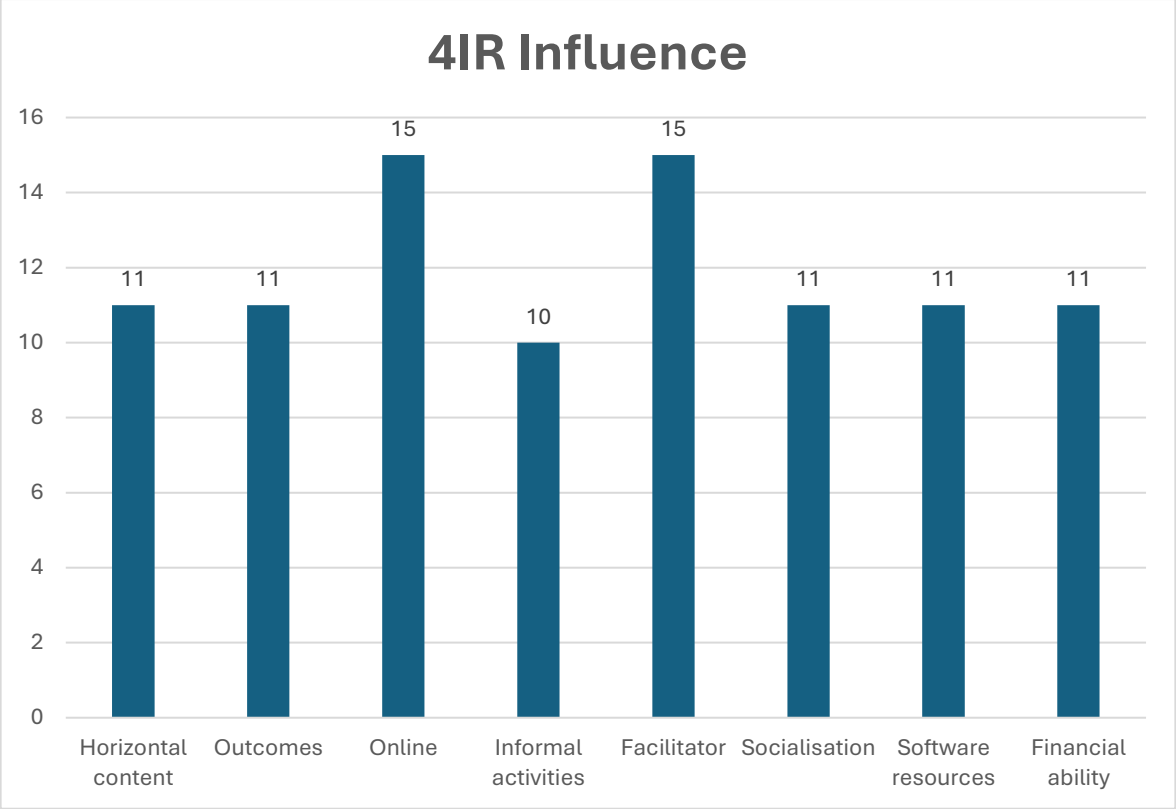

Figure 3: 4IR influence

The results (Figure 4) reveal that only five participants allowed their students to reflect (reflective resources) on their experiences to understand their identities before they were supervised. Eight participants knew their students through their cultural identities. Ten participants used aims (long-term supervision goals), a combination of formal and informal activities, day preparation, and their role as researchers to supervise their students. Eleven participants preferred a combination of prescribed supervision steps/stages and everyday knowledge (blended content), as well as online with an F2F environment. This suggests that the 5IR had the least influence on the participants' supervision curriculum to follow a semi-structured supervision curriculum of personalisation.

Theme 3: Personalisation of Semi-structured Supervision Curriculum

Personalisation is driven by self-reflection and critique with accountability based on one's experiences, beliefs, and evidence (Adewojo et al., 2023; Fields et al., 2018; Khoza, 2023; Sarfraz et al., 2021). Only 5 participants developed reflective spaces for their students to self-reflect on their experiences and needs before/during/after supervision. The 5 participants believed that "*every human has a unique identity with intelligence of defining the truth based on*

experienced beliefs and evidence that needs to be considered in supervision" (P-9, the other 4 agreed). The findings support what studies (Adewojo et al., 2023; Callaghan, 2023; Costa et al., 2022; Sarfraz et al., 2021) identify as the 5IR, where the personalisation process influenced all sectors, including HEIs, since the emergence of COVID-19.

However, the key to the 5IR is based on self-reflection to assess one's experiences and needs to identify the most relevant user interfaces that address one's needs (Khoza, 2024). For example, Samual Altman used different forms of Artificial Intelligence (AI) to understand the truth of AI and decided to develop ChatGPT in November 2022 to mimic the human mind in dealing with academic work (personalisation). The participants were able to use some of the personalisation technologies (user interfaces) only as end users without developing their own new ones to be personalised to address the "who" questions of supervision. Therefore, when user interfaces are used, they represent someone's ideology. The question of "who" is supervising or is being supervised helps user interface developers to align the user interface with relevant ideologies. But what seems to be confusing to supervisors is the fact that a 100% throughput rate is still not achievable even when they use the 5IR user interfaces capable of personalisation. This seems to point to natural forces/laws as the ones to be considered (naturalisation).

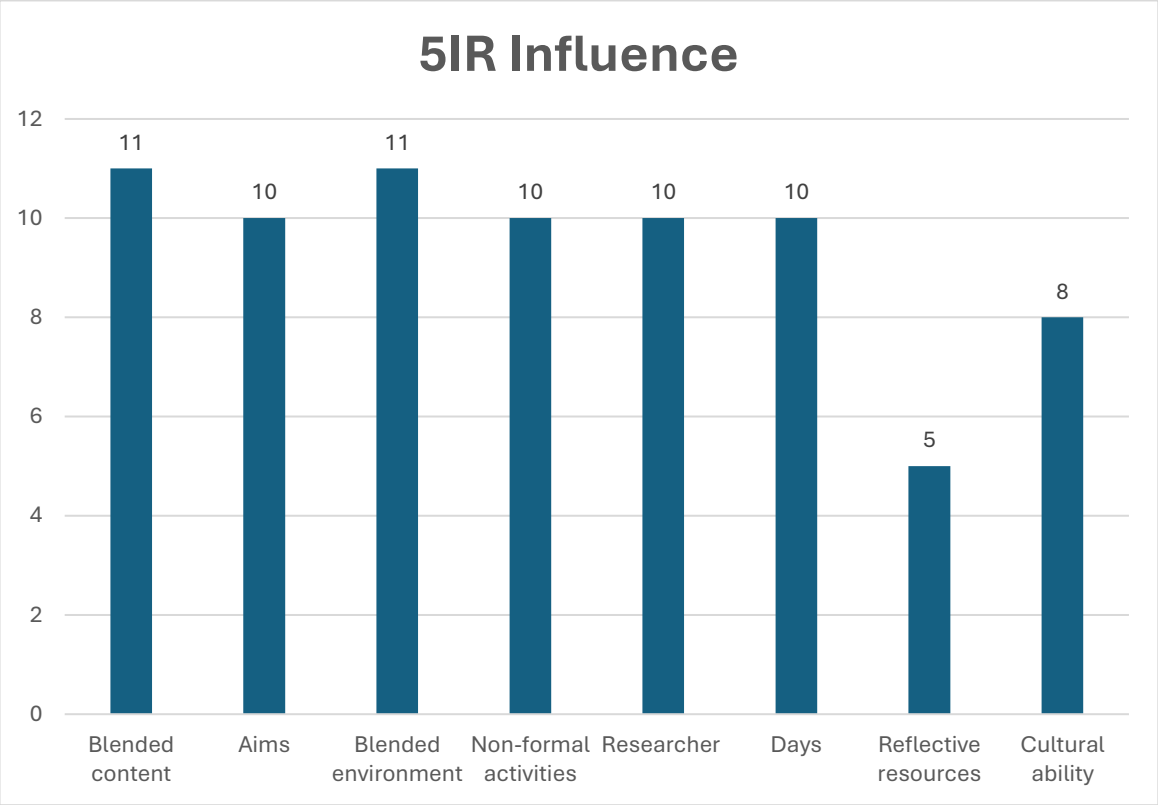

Figure 4: 5IR influence

Conclusions and implications

Naturalisation suggests a combination of automation, digitalisation, and personalisation in research action, so that if a 100% performance is not achievable, one may accept that it is because of the uncontrollable natural forces (Khoza, 2025). Most supervisors and their students use theories and user interfaces that are developed by other people. The founders of the theories and user interfaces used in supervision developed them for their own unique needs and other purposes that may not be supervision. For instance, Eric Yuan's purpose of inventing Zoom was to develop a fundamentally simpler and more user-friendly video conferencing solution that was intuitive for end users, not necessary for supervision. Steve Chen, Chad Hurley, and Jawed Karim developed YouTube, allowing ordinary people to upload and

share their personal videos without requiring supervision. Based on these examples and others, theories and user interfaces should be naturalised according to the relevant supervision curriculum used by supervisors and their students. Naturalisation (importing them from outside supervision) of theories and user interfaces needs supervisors' self-reflexivity so that they understand their unique identities, values, and needs. This may align their unique identities and ideologies of supervision curriculum with relevant theories and user interfaces that can help them achieve 100% performance or outcomes. If they fail to achieve 100% after they have optimised the naturalisation of relevant theories and user interfaces, the supervisor may accept the outcomes as they are because they may be aware that the outcomes are naturally driven. With such knowledge of supervision, they can produce their own unique and relevant theories and user interfaces that can rescue supervision from the inability to produce 100% outcomes.

During the COVID-19 lockdown, supervisors continued to supervise students using a variety of user interfaces because they could not stop the COVID-19 pandemic (natural force). They accepted that they did not know the truth of the pandemic in the same way; they did not know the truth about the user interfaces they used, although they completed the academic calendar under those circumstances.

This suggests that one's needs should determine the process or system to be followed for one's survival in any situation if it is difficult for one to know the truth of the process/system (Prakash et al., 2021). Naturally, when it is known who is supervising and is being supervised, one can proceed and ask a philosophical "why" question of supervision, and it can be said that supervision curriculum and user interfaces came to the rescue.

Therefore, this study recommends applying a semi-structured supervision curriculum and user interface that promotes natural actions, thus addressing personal/natural needs. This may lead to naturalisation processes and systems useful to supervisors and students.

Disclosures

Conflict of Interests

The author declares no conflict of interest.

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