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Factors Influencing the Use of Recommendation Systems for Elderly Research in Thailand

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ABSTRACT

This study examines factors influencing the use of recommendation systems for elderly research in Thailand through a quantitative research design. The target population comprises researchers experienced in elderly studies from 2012 to 2022, totaling 348 participants. Data were collected via a validated questionnaire (Cronbach's alpha=0.955). Employing an extended the Unified Theory of Acceptance and Use of Technology 2 model, the study investigates system use behavior (SUB) based on seven core factors: Performance expectancy (PEF), effort expectancy (EFF), social influence, personal innovativeness (INN), hedonic motivation (MOT), facilitating conditions (FAC), and intention behavior (IBV), alongside three additional factors—system quality (SQU), information quality (IQU), and trust. Multiple correlation and regression analyses reveal statistically significant influences (p<0.05) from eight factors. SQU, PEF, EFF, MOT, FAC, and IBV positively influence SUB. Conversely, IQU and INN negatively affect system usage. The predictive model is expressed as: SUB=1.195+0.116 (SQU)-0.268 (IQU)+0.134 (PEF)+0.181 (EFF)-0.406 (INN)+0.137 (MOT)+0.097 (FAC)+0.866 (IBV). These findings underscore the importance of optimizing system features and recognizing the distinct needs and expectations of elderly research communities to enhance the effectiveness of these recommendation systems.

Keywords: elderly research, influencing factors, Unified Theory of Acceptance and Use of Technology 2 model, multiple regression analysis, system use behavior, Thailand

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1. INTRODUCTION

1.1. Challenges in Accessing and Organizing Elderly Research

Research is an important tool used in various aspects of national development. It is key to the process of discovering new areas of knowledge through systematic research, analysis, or experimentation using equipment or methods. This can uncover facts or principles to use in setting rules, theories, or guidelines for practice, as well as leading to the discovery of facts and leading to guidelines for problem solving and development (Babbie, 2021). Promoting guidelines for the development of research on gerontology is important and attractive in the current era. This makes it possible to know the knowledge that researchers have already studied, and to build on previous knowledge to develop new knowledge. It can also be used to develop important innovations that are consistent with the problems and needs of the country, and to allocate budgets to support research efficiently. There has been a great deal of research on the elderly published in various databases, and so it is difficult to access the knowledge within the research results to use them for benefit. Therefore, it is necessary to use tools to analyze this enormous amount of research data.

In addition, Thailand has entered an aging society since 2021. It appears that the population aged 60 years and above has increased by 32 percent. It is predicted that in 2040 Thailand will have an elderly population (60 years and over) of up to 32.1 percent (Department of Older Persons, the Ministry of Social Development and Human Security, 2021). This is a key challenge in that Thailand needs to recognize the relationship between longer life expectancy and better health. This is considered an extremely important opportunity for the country's economic and social development (Britz, 2007; Klarin, 2018). Entering an aging society is a challenge for Thailand, focusing on research for an aging society to develop policies for people of all ages to have a good quality of life. This can lead to a valuable life on their own by creating a mechanism that facilitates living together happily and welcomes an aging society, encouraging the elderly to have good health and be self-reliant. Developing integrated research that reflects the values of the elderly can create technology and innovation-assisted living for the elderly and disabled, so as to be able to live a quality life according to international standards (Artsanthia & Pomthong, 2018).

1.2. The Imperative of Research

An investigation into research information regarding the elderly was conducted using the Thai National Research Repository (TNRR) of the Office of the Science Promotion Board for Research and Innovation and the Thailand Library Network System over the past decade, from 2012 to 2022. This search yielded a total of 957 items. Upon analyzing this data, it was observed that some research entries contained only abstract documents, while others included full document files. Consequently, themes or critical points of the research focus on the elderly for researchers and searchers. As a result, the search returns results with unrelated content or research details. Therefore, there is a lack of reliability in accessing information in research (Bobadilla et al., 2009; Stair & Reynolds, 2012). In addition, it was found that the information in research document files appearing in the information system was diverse and scattered. It is difficult to collect knowledge and there is still duplicate storage. As a result, searching or accessing information is not efficient. There are obstacles to the use of research information on the elderly. It was also found that in storing research information in the system, there is still a lack of in-depth content relationship analysis. As a result, the search becomes more complicated. It is difficult to use the information system and at the same time, it also reflects the quality of research information system development (Deldjoo et al., 2018; 2020). The current information search system for research on the elderly has revealed that there has not yet been a knowledge organization process for collecting, creating, organizing, storing, and disseminating in-depth research knowledge on the elderly. To support ease of access to research information and ease of use of information systems while reducing duplication, the problem of the distribution of a large amount of information can be solved by linking research data on the elderly in the same or related fields by organizing knowledge systems (Hjørland, 1994). This can also be applied to information systems for organizing collections, document classification, and information extraction as well (Noy & McGuinness, 2001).

1.3. The Unified Theory of Acceptance and Use of Technology

Recommendation systems are the most widely used information systems today. These are systems that use user behavior data to process and present information that is expected to best meet the needs of users, so that users can decide on the information that the system has presented to them. The information advisory system format has

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the characteristics of providing proactive services that automatically present the information that users need. This is different from passive information search, where users only access information when they have a need for it (Ghauth & Abdullah, 2010). The recommendation system has limitations in recommending information (Bjelica, 2010; Bobadilla et al., 2009; 2010). It is only up to users with personal information in the system to be able to recommend information that is most relevant to their needs. Today, recommendation systems are increasingly being used in applications such as the web (Göksedef & Gündüz-Öğüdücü, 2010; Ochi et al., 2010); e-learning books (Bobadilla et al., 2009; Salehi & Kmalabadi, 2012); tourism (Isinkaye et al., 2015; Lorenzi et al., 2011); movies (Bobadilla et al., 2010); music (Yang et al., 2020); e-commerce, news, specialized research resources (Porcel et al., 2009); television programs (Bjelica, 2010; Shin & Woo, 2009), etc.

Therefore, it is very necessary to study the factors influencing the use of the recommendation systems in Thailand, because it is the first step in the principles of system development to know the behavior and needs of system users, and to know important factors that are related to the use of the system to provide research advice on the elderly in Thailand. Using the system to analyze and design quality recommendations is consistent with and responds to the needs of specific user groups. Various theoretical models have been created. To predict the acceptance and use of technology, the Unified Theory of Acceptance and Use of Technology (UTAUT), is a framework developed by Venkatesh et al. (2003). To predict technology adoption for organizations, UTAUT was developed based on the integration of eight previously unique structural models: Theory of Reasoned Action (Ajzen, 1991; 2011; Ajzen & Fishbein, 1975; 1980; 2005), Technology Acceptance Model (Davis, 1986; 1989; Davis et al., 1989; Davis & Venkatesh, 1996), Motivational Model (Davis, 1993), Theory of Planned Behavior (Ajzen, 1991; Ajzen & Fishbein, 1980), Combined Technology Acceptance Model and Theory of Planned Behavior (Taylor & Todd, 1995), Model of Personal Computer Utilization (Thompson et al., 1991), Innovation Diffusion Theory (Moore & Benbasat, 1991), and Social Cognitive Theory (Compeau et al., 1999).

Venkatesh et al. (2012; 2016) presented UTAUT with four main factors that influence the intention and use of information technology. The first factor is performance expectancy (PEF), which is the degree to which a person believes that using the system will help them gain profit in their career. The second factor, effort expectancy (EFF), is the level of ease involved in using the system. The third factor, facilitating conditions (FAC), is the degree to which individuals believe they have the organizational and technical infrastructure to support use of the system. The fourth factor is social influence (SOC), which is the degree to which individuals perceive that SOC influences the use of the new system. Despite the widespread acceptance and popularity of UTAUT, Venkatesh et al. (2003; 2012; 2016) reviewed the importance of changing user behavior. Therefore, we improved and added three main factors to UTAUT, namely hedonic motivation (MOT), price value, and habit. To expand UTAUT to Unified Theory of Acceptance and Use of Technology 2 (UTAUT2) and by comparing UTAUT with UTAUT2, it was found that a key result of this improvement was the explained variance in behavioral intentions (56 percent to 74 percent) and technology use (40 percent to 52 percent) (Chang, 2012; Chauhan, 2015; Van Droogenbroeck & Van Hove, 2021).

While numerous studies on elderly populations have emerged, the effective use of this extensive body of knowledge remains challenging due to the lack of well-organized systems to facilitate research access. Given Thailand's rapid transition into an aging society—projected to reach over 32% of the elderly by 2040—there is an urgent need to develop efficient recommendation systems tailored explicitly for elderly research. Current systems often provide fragmented, incomplete, or irrelevant results, undermining research productivity. Thus, understanding the determinants influencing the adoption of such recommendation systems is essential.

The primary objective of this study is to investigate and analyze factors influencing the use of recommendation systems among researchers specializing in elderly studies in Thailand. Specifically, this study aims to 1) Identify key factors from the UTAUT2 and additional variables—system quality (SQU), information quality (IQU), and trust (TRS)—that influence researchers' system use behavior (SUB); 2) Determine each factor's relative significance in predicting the use of recommendation systems for elderly research; and 3) Provide practical recommendations for system designers and developers to enhance system effectiveness, usability, and adoption among Thai researchers.

By clearly addressing these objectives, the study aims to guide the development of tailored recommendation systems, enhancing their relevance, user-friendliness, and overall effectiveness in supporting elderly research in Thailand.

Developing recommendation systems for elderly re-

search in Thailand presents a significant challenge due to the specialized needs of researchers and stakeholders focused on aging-related issues. These systems must deliver highly accurate, relevant, and user-specific information, differentiating themselves from existing research databases which lack a dedicated focus on elderly studies. Additionally, current systems have limitations that hinder efficient data use and presentation. Therefore, understanding the factors influencing the adoption of recommendation systems is essential for designing features that support the advancement of elderly research, assist in formulating research questions, build upon existing studies, leverage previous findings, and optimize research funding management. This research aims to identify and analyze the factors that influence the effective utilization of recommendation systems in elderly research within Thailand. By exploring key determinants, the study seeks to provide insights that will enhance the design and functionality of such systems. Utilizing the UTAUT2 theoretical framework, this study will investigate the factors influencing system use in this context. The findings are expected to guide the development of systems that are specifically tailored to meet the needs of elderly research and to assess how these factors can improve the system's usability and responsiveness, ensuring it addresses the unique needs of researchers and stakeholders focused on elderly issues in Thailand.

2. LITERATURE REVIEW

In Thailand, the elderly research consultation system is an effective platform for supporting elderly-focused research. This study aims to examine factors influencing the adoption of this system, using the UTAUT2 framework developed by Venkatesh et al. (2012; 2016) and Bile Hassan et al. (2022), to identify key determinants affecting SUB among researchers experienced in elderly studies from 2012 to 2022. Eight factors are investigated: PEF, EFF, SOC, personal innovativeness (INN), satisfaction motivation, FAC, system use intention, and SUB. Additionally, SQU, IQU, and TRS factors highlight the critical factors influencing acceptance, which can guide the development of a comprehensive, effective consultation system for elderly research.

In summary, this research employs the concepts and theoretical framework of UTAUT2 (Bile Hassan et al., 2022; Venkatesh et al., 2012; 2016) to investigate the factors influencing the utilization of recommendation systems for the elderly in Thailand. The study focuses on researchers with experience in elderly-related research conducted in Thailand between 2012 and 2022. By extracting relevant factors from previous studies that impact SUB, eight key factors are identified: PEF, EFF, SOC, INN, MOT, FAC, intention behavior (IBV), and SUB. Additionally, three more factors are incorporated: SQU, IQU, and TRS. This comprehensive framework aims to confirm the significance of these the factors influencing the use of recommendation systems for the elderly research in Thailand, ultimately contributing to the development of an effective and holistic recommendation system for elderly research in Thailand tailored to the needs of this demographic. Upon conducting a comprehensive literature review of prior studies, the significance of each identified factor will now be delineated in detail, as follows:

2.1. System Quality (SQU)

In the context of the UTAUT, SQU plays an important role in determining the acceptance and continued use of technology systems, especially in educational environments. SQU refers to a system that is efficient in its functioning. No error occurred and there is a quick response. This helps users feel that the technology is easy to use and hassle-free. Having a high SQU helps the technology run smoothly. There are no frequent errors, it is easy to use, and it meets the expectations and needs of users. This factor is important because it directly affects users' perceptions and readiness to accept and use the technology (DeLone & McLean, 1992; Venkatesh et al., 2003; 2016).

2.2. Information Quality (IQU)

IQU in the UTAUT model refers to the relevance, accuracy, and completeness of the information provided by the system. This affects acceptance and continued use by users. IQU is extremely important. This is because it directly affects users' perceptions of the usefulness and ease of use of the system. This is a key component of the UTAUT model. A recent study by Balkaya and Akkucuk (2021) extends this idea by introducing IQU as a key factor in the acceptance and use of e-learning technology. It is found that high IQU helps in increasing the learning experience of students and increases their willingness to use the system continuously. This study suggests that information obtained from e-learning platforms is viewed as reliable and useful. This will help reinforce the user's intention to use. Several studies focusing on the adoption of learning management systems in higher education have highlighted that IQU, combined with factors such as SQU and service quality, plays an important role in creat-

ing user satisfaction and the intention to continue using the system. These studies emphasize that high IQU leads to better decision making and more effective learning outcomes (Dwivedi et al., 2011; 2019; 2020). The study shows that combining IQU with the UTAUT model can provide a more comprehensive understanding of technology adoption and usage behavior. This is especially true in educational environments where accurate and relevant information is important.

2.3. Trust (TRS)

TRS is the belief and confidence of users in service providers and platform integrity, security, and reliability (Aduba et al., 2023; Chandra et al., 2010). Users trusting systems tend to show willingness to use that service or system. For example, research by Okello Candiya Bongomin and Ntayi (2020a; 2020b) on the use of financial services on mobile applications indicates that TRS is an important forecaster of Fintech service use. Users who TRS the protection and respect of their privacy and finances tend to express intentions to use Fintech platforms (Chauhan, 2015; Okello Candiya Bongomin & Ntayi, 2020a; 2020b). Increased system usage and TRS can be promoted by privacy policies, data management, and security practices transparently and clearly communicated by service providers (Bajunaied et al., 2023; Jevsikova et al., 2021). TRS can be greatly influenced by peer recommendations, ratings, and reviews leading to the user's intention to receive and use the system (Laksamana et al., 2023; Zarifis & Cheng, 2022). Building and maintaining TRS is important for system operators who want to promote adoption and long-term use among users (Savitha et al., 2022).

2.4. Performance Expectancy (PEF)

PEF refers to users' perceptions of how goals or tasks can be achieved or performed with a specific system or technology (Venkatesh et al., 2012) and users' beliefs that their work will be made easier or more efficient using technology (de Blanes Sebastián et al., 2023; Martinez & McAndrews, 2023). Belief in improved efficiency or productivity through technology results in more probable adoption and use (Bajunaied et al., 2023). Widespread technology use and adoption requires an optimized user experience of expected performance (Savitha et al., 2022). When individuals perceive that technology has made transactions easier, provides comfort, and increases work efficiency, this will result in a greater tendency to use that specific technology or system (Al nawayseh, 2020; Arner et al., 2020; Senyo & Osabutey, 2020). The strong relationship between technology adoption and performance expectations has been identified by previous studies.

2.5. Effort Expectancy (EFF)

EFF is the difficulty or ease of use of a system or technology as perceived by a user (Bajunaied et al., 2023; Venkatesh et al., 2012). Factors affecting effort expectations include perceived ease of interaction learning, the user interface, the complexity of tasks, and user friendliness (Gansser & Reich, 2021; Tamilmani et al., 2021). For example, behavioral intention to use mobile money services is significantly influenced by effort expectation (Senyo & Osabutey, 2020). A study by Liébana-Cabanillas et al. (2021) on the implementation of mobile banking in Spain found adopting Fintech services is encouraged by awareness of low-effort requirements and users feeling comfortable. A consistent relationship has been found between technology adoption and effort expectations for financial transactions of easy to use mobile payment applications (Martinez & McAndrews, 2023; Savitha et al., 2022; Zaid Kilani et al., 2023).

2.6. Social Influence (SOC)

SOC refers to how an individual's decision to use and adopt technology is affected by social factors and others' opinions (Isinkaye et al., 2015), especially when influential people or groups in their social networks support its use (Zaid Kilani et al., 2023). There is an important element to it: Subjective norms, which is a person's perception of social pressure to use or not use technology. Social factors include the influence of family, friends, and co-workers on a person's use of technology. Image is the perception that the use of technology will increase one's status or image in a social group. In UTAUT2, SOC is one of the determinants that affects both IBV and SUB. The theory states that if people believe that important people think they should use technology, individuals are more likely to intend to use and subsequently use the technology (Chauhan, 2015; Venkatesh et al., 2003; 2012; 2016).

2.7. Personal Innovativeness (INN)

This is a person's enjoyment or happiness from using technology (Dzandu et al., 2022; Venkatesh et al., 2012). Social interaction, enjoyment, or entertainment happiness motivates technology in addition to utilitarian purposes (George & Sunny, 2021; 2023). Gamification increases application use happiness (Yang et al., 2020), positively affecting intention to adopt. While the main goal of stock trading applications is about investment, being fun and

entertaining also increases adoption (Lee et al., 2022; Şenol & Onay, 2023). Research therefore emphasizes that MOT, happiness, and enjoyment can significantly affect a person's intention to use technology services.

2.8. Hedonic Motivation (MOT)

MOT, in the context of the UTAUT2 model, concerns how technology use affects users regarding satisfaction and enjoyment. It is an important element that helps explain the adoption and use of technology in a consumer context. MOT has been added to UTAUT2 to better cover factors influencing technology use behavior in daily life (Savitha et al., 2022; Venkatesh et al., 2012). Behavioral Intention (intention to use) is directly affected by MOT. If the user feels fun or satisfied in using technology, they are more likely to be intent on using technology to increase user satisfaction. Technology that provides a satisfying or fun experience is more likely to be accepted and used. Users who enjoy using technology tend to be more satisfied, and may become long-term users who become ingrained toward automatic behaviors which a person repeatedly performs. It is a habit to respond to specific signals or contexts (George & Sunny, 2023; Venkatesh et al., 2012).

2.9. Facilitating Conditions (FAC)

Individuals' available infrastructure, support, and resources to effectively use a particular technology are represented by FAC (Bajunaied et al., 2023; Venkatesh et al., 2012). For the general public to use technology, it needs to have facilities such as having a mobile device to sign up for applications, and the ability to use mobile devices effectively (Abu-Taieh et al., 2022; Alalwan et al., 2018). Therefore, the existence or availability of a facility can influence interest and adoption of a particular technology or system (Aduba et al., 2023; Arner et al., 2020; Bajunaied et al., 2023).

2.10. Intention Behavior (IBV)

Intentional behavior, also known as "Intention Behavior," as defined in the UTAUT model, plays a very important role. This factor represents a person's motivation or intention to use technology. This is an important indicator that indicates whether users will actually use the technology or not. In the UTAUT model, there are many factors that influence attentional behavior: PEF; belief that performance is benefitted by technology use; EFF; technology ease of use; SOC; how people's beliefs in technology use affects individual perceptions; FAC; and belief in technical and organizational infrastructure support for technology.

There are many other factors that researchers have introduced by extending the UTAUT model for adoption of specific technologies. Similarly, studies on the use of electronic payment systems in Serbia highlight that performance expectations and effort expectations have a significant impact on users' intentions to adopt these systems (Gansser & Reich, 2021; Tomić et al., 2023). Moreover, research on e-learning systems in developing countries has confirmed that performance expectations and effort expectations are important factors in predicting students' intentions to use these systems (Dwivedi et al., 2011; 2019; 2020). Attentional behavior is important because it directly influences the actual use of technology. Studies show that high performance expectations, ease of use, positive SOC, and strong supportive conditions can significantly increase the likelihood of technology acceptance and use.

This study conducted a comprehensive review of relevant literature and research to identify factors influencing the utilization of recommendation systems for elderly research in Thailand. By systematically gathering and analyzing data from diverse sources, the study aims to elucidate user needs and expectations, thereby enhancing the effectiveness of these systems. The key factors in Table 1 (Abu-Taieh et al., 2022; Aduba et al., 2023; Al nawayseh, 2020; Alalwan et al., 2018; Arner et al., 2020; Bajunaied et al., 2023; Balkaya & Akkucuk, 2021; Bile Hassan et al., 2022; Chandra et al., 2010; Chang, 2012; Chauhan, 2015; de Blanes Sebastián et al., 2023; DeLone & McLean, 1992; Dwivedi et al., 2011; 2019; 2020; Dzandu et al., 2022; Gansser & Reich, 2021; George & Sunny, 2021; 2023; Isinkaye et al., 2015; Jevsikova et al., 2021; Laksamana et al., 2023; Lee et al., 2022; Martinez & McAndrews, 2023; Okello Candiya Bongomin & Ntayi, 2020a; 2020b; Savitha et al., 2020; Savitha et al., 2022; Senyo & Osabutey, 2020; Şenol & Onay, 2023; Tamilmani et al., 2021; Tanu Wijaya et al., 2020; Tomić et al., 2023; Venkatesh et al., 2003; 2012; 2016; Yang et al., 2020; Zaid Kilani et al., 2023; Zarifis & Cheng, 2022) offer critical insights into user requirements to improve the performance and relevance of recommendation systems for research targeting the elderly population in Thailand.

3. OBJECTIVES

This research aims to identify and analyze the factors influencing the use of recommendation systems for research on the elderly in Thailand. It seeks to explore key factors essential for researchers' effective and comprehensive utilization of these systems. The study integrates

Table 1. Construction factors for using recommendation systems in elderly research in Thailand

Construct	No. of items	Adapted
System quality	4	DeLone and McLean (1992); Venkatesh et al. (2003; 2016)
Information quality	5	Balkaya and Akkucuk (2021); Dwivedi et al. (2011; 2019; 2020)
Trust	4	Aduba et al. (2023); Chandra et al. (2010); Okello Candiya Bongomin and Ntayi (2020a; 2020b); Chauhan (2015); Jevsikova et al. (2021); Bajunaied et al. (2023); Savitha et al. (2022); Zarifis and Cheng (2022); Laksamana et al. (2023)
Performance expectancy	4	Venkatesh et al. (2012); de Blanes Sebastián et al. (2023); Martinez and McAndrews (2023); Bajunaied et al. (2023); Savitha et al. (2020); Arner et al. (2020); Al nawayseh (2020); Senyo and Osabutey (2020)
Effort expectancy	4	Venkatesh et al. (2012); Bajunaied et al. (2023); Gansser and Reich (2021); Tamilmani et al. (2021); Senyo and Osabutey (2020); Savitha et al. (2022); Zaid Kilani et al. (2023); Martinez and McAndrews (2023)
Social influence	4	Isinkaye et al. (2015); Zaid Kilani et al. (2023); Chauhan (2015); Venkatesh et al. (2003; 2012; 2016)
Personal innovativeness	3	Venkatesh et al. (2012); Dzandu et al. (2022); George and Sunny (2021; 2023); Yang et al. (2020); Lee et al. (2022); Şenol and Onay (2023)
Hedonic motivation	3	Venkatesh et al. (2012); Savitha et al. (2022); George and Sunny (2023)
Facilitating conditions	4	Venkatesh et al. (2012); Bajunaied et al. (2023); Alalwan et al. (2018); Abu-Taieh et al. (2022); Arner et al. (2020); Aduba et al. (2023)
Intention behavior	4	Gansser and Reich (2021); Tomić et al. (2023); Dwivedi et al. (2011; 2019; 2020)
System use behavior	4	Venkatesh et al. (2012; 2016); Bile Hassan et al. (2022); Chang (2012); Tanu Wijaya et al. (2020); Jevsikova et al. (2021)

the UTAUT2 theoretical framework to investigate determinants of system usage in this specific context. Findings from this research will help guide the development and direction of recommendation systems tailored to elderly research in Thailand. Additionally, the study aims to assess how these factors can enhance the functionality and usability of the system, ensuring it meets the unique needs of researchers and stakeholders focused on elderly issues.

4. METHODOLOGY

Factors influencing the adoption and utilization of recommendation systems for research focusing on the elderly population in Thailand were systematically investigated using a quantitative research design. The target population comprised 623 researchers specializing in elderly-focused research, identified through the TNRR (National Research Council of Thailand, n.d.). Following the guidelines of Hair et al. (2014), a sample of more than 20 times the study variables was considered necessary. With 11 variables in the study, the minimum required sample size was 220. However, 348 researchers participated, exceeding the minimum and ensuring the sample size met adequacy standards, thereby enhancing the study's validity. Furthermore, all participants submitted fully completed questionnaires, resulting in a 100% response rate.

Data were collected from January 1 to March 31, 2024, using a structured online questionnaire distributed to researchers and academics engaged in relevant elderly research over the past decade (2013-2023). Researchers were contacted via email and online channels, with formal permission requests submitted to those affiliated with various institutions. During data collection, the researchers ensured that respondents were not subjected to any discomfort, coercion, or undue pressure.

The UTAUT2 model (Venkatesh et al., 2012) underpinned the study's conceptual framework, supplemented by additional factors from validated research to offer a comprehensive view of factors influencing system adoption. The final model included the variables: SQU, IQU, TRS, PEF, EFF, SOC, INN, MOT, FAC, and IBV. This framework guided the development of a customized questionnaire following Rovinelli and Hambleton (1976)'s criteria for content validity, assessed using the item-objective consistency (IOC) index. Each item attained an IOC score between 0.6 and 1.0, demonstrating satisfactory alignment with research objectives. A panel of three content experts rigorously reviewed the questionnaire, providing refine-

ment recommendations.

A pilot test was conducted with 30 respondents to ensure reliability. It yielded a Cronbach's alpha coefficient of 0.995 (Cortina, 1993; Ursachi et al., 2015), affirming the questionnaire's suitability for reliable data collection. Ethics approval was obtained from the Human Research Committee of Khon Kaen University (Approval No. HE663125), following institutional standards. Additional permissions were secured through official letters from the Faculty of Humanities and Social Sciences, Khon Kaen University, and the Office of the Science Promotion Commission Research and Innovation.

Data analysis involved calculating means, conducting correlation and multiple regression analyses, and developing prediction equations using IBM SPSS Statistics 28.0 (IBM Co., Armonk, NY, USA) and Python 3.11.12 (Python Software, Beaverton, OR, USA). This approach assumed interrelationships among the various influencing factors, intending to accurately predict SUB. Table 2 clarifies each independent variable's role and connection to the study, addressing the reviewer's feedback by providing transparency in the variables analyzed for correlation and regression. Through a rigorous process encompassing sampling, ethical compliance, and detailed data analysis, valuable insights regarding factors affecting adoption of elderly research recommendation systems in Thailand are shown in Fig. 1 (Hair et al., 2014).

Hypotheses of the study

- H1: SQU has a statistically significant influence on the use of recommendation systems for elderly research in Thailand.
- H2: IQU has a statistically significant influence on the use of recommendation systems for elderly research in Thailand.
- H3: TRS has a statistically significant influence on the use of recommendation systems for elderly research in Thailand.
- H4: PEF has a statistically significant influence on the use of recommendation systems for elderly research in Thailand.
- H5: EFF has a statistically significant influence on the use of recommendation systems for elderly research in Thailand.
- H6: SOC has a statistically significant influence on the use of recommendation systems for elderly research in Thailand.
- H7: INN has a statistically significant influence on

Table 2. Independent variables and their characteristics

Variable name	Abbreviation	Description	Relevance to study
System quality	SQU	Measures the efficiency, stability, and user-friendliness of the system	Ensures that the system meets users' needs with minimal issues
Information quality	IQU	Assesses the relevance, accuracy, and completeness of information provided by the system	Evaluates the value of content for users, influencing system adoption
Trust	TRS	Confidence in the system's reliability, security, and data privacy	Determines users' willingness to adopt based on security concerns
Performance expectancy	PEF	Users' belief that using the system will enhance their research productivity	Drives motivation for adoption due to anticipated benefits
Effort expectancy	EFF	Ease of use and learnability of the system	Lower effort expectations can lead to higher adoption rates
Social influence	SOC	Influence of colleagues or societal norms on users' decisions to adopt the system	Reflects the effect of peer pressure or trends on adoption behavior
Personal innovativeness	INN	Users' willingness to try new technologies	Indicates openness to adopting novel systems
Hedonic motivation	MOT	The enjoyment or satisfaction derived from using the system	Positively impacts adoption if users find the system engaging
Facilitating conditions	FAC	Availability of resources and support for system use	Ensures users have access to necessary resources, impacting adoption
Intention behavior	IBV	Users' intent or planned behavior to use the system	Directly predicts the likelihood of actual system use

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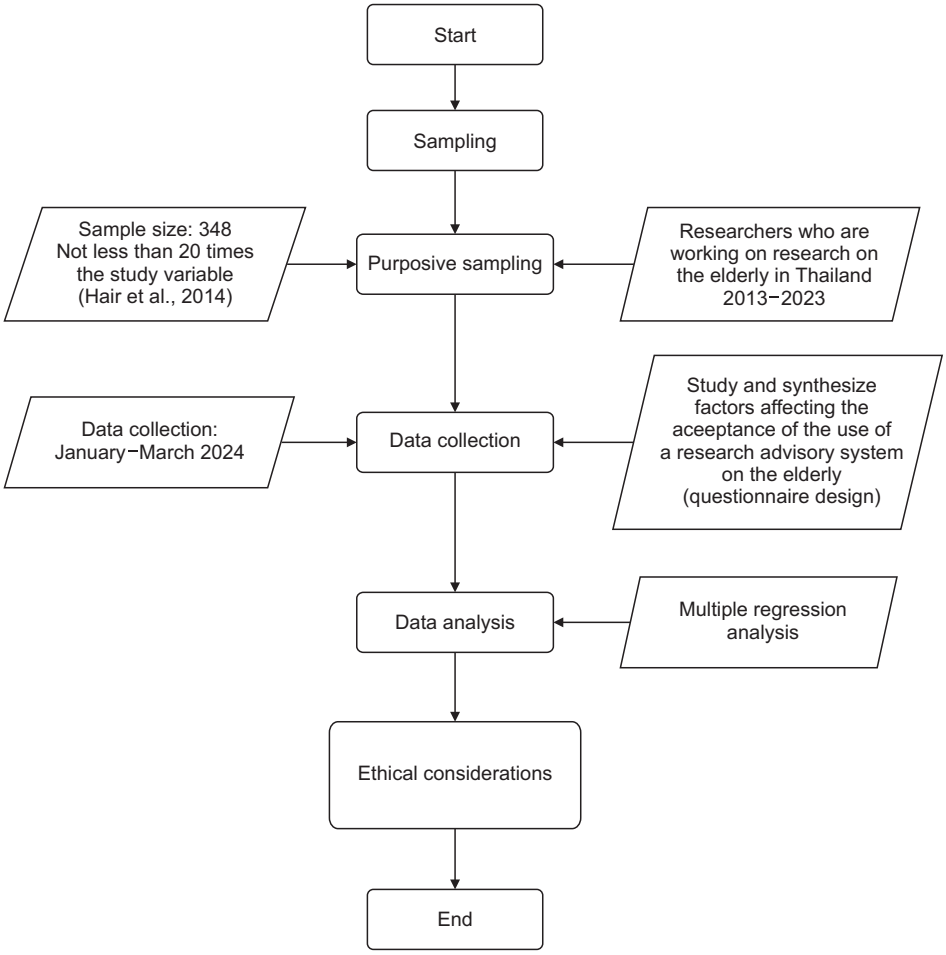


Fig. 1. Research methodology process (source: authors).

the use of recommendation systems for elderly research in Thailand.

- H8: MOT has a statistically significant influence on the use of recommendation systems for elderly research in Thailand.
- H9: FAC has a statistically significant influence on the use of recommendation systems for elderly research in Thailand.
- H10: IBV has a statistically significant influence on the use of recommendation systems for elderly research in Thailand (Fig. 2).

5. RESULTS

The assessment of Cronbach's alpha is a critical process for evaluating the internal consistency of a measurement tool, focusing on the coherence among items in a questionnaire or tool designed to measure the same construct. Cronbach's alpha helps to confirm the reliability of the measurement tool and is crucial for ensuring the accuracy of the collected data. The analysis reveals consistently high Cronbach's alpha values ($\alpha \approx 0.953$-0.955), indicating excellent internal consistency reliability of the scale (Cortina, 1993; Tavakol & Dennick, 2011). The minimal variation in these values upon individual item deletion suggests a uniform contribution of all items to the scale's reliability. Corrected item-total correlations exhibit a range of 0.37 to 0.74, with the majority of items demonstrating moderately strong to strong correlations with the total scale, further supporting the scale's internal consistency (Field, 2022; Ursachi et al., 2015). The presence of diverse item code prefixes (e.g., SQU, IQU, TRS, PEF) implies a multidimensional scale structure, potentially comprising several subscales or factors (DeVellis & Thorpe, 2021). This Item-Total Statistics output provides valuable insights for assessing the reliability and internal consistency of the multi-item scale, facilitating the identification of potentially problematic items that may not significantly contribute to the overall scale measurement (Pallant, 2020). Nevertheless, a literature review and expert judgment support the contin-

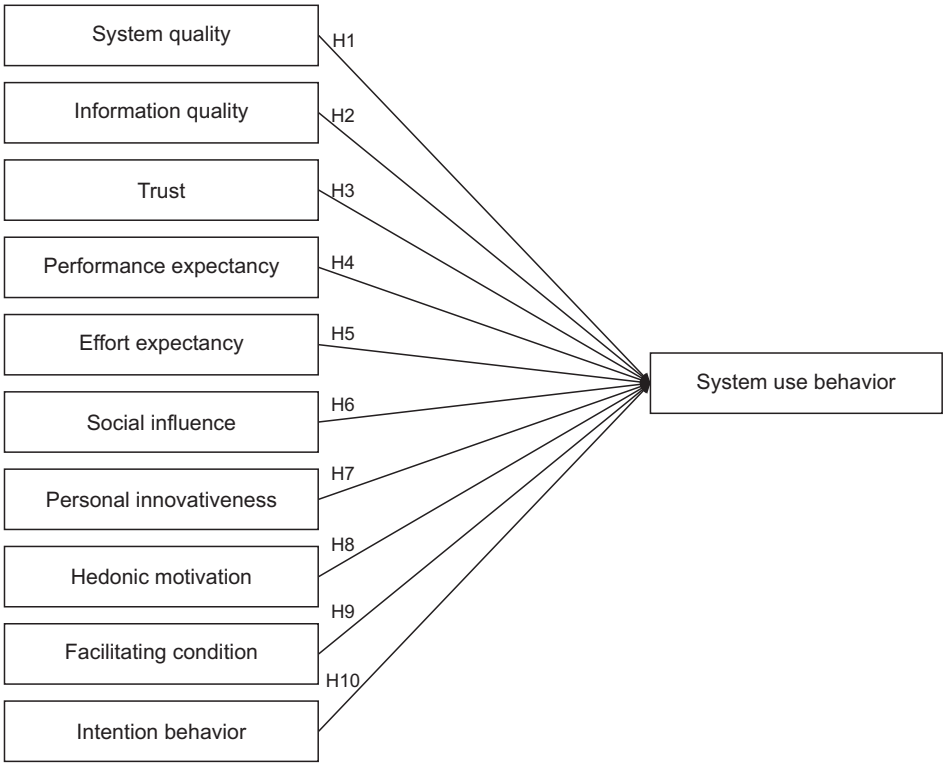


Fig. 2. Research hypotheses (source: authors).

ued use of these items, as outlined in Table 3.

Correlation analysis was used to assess the existence of heterogeneity in independent variables within the research model by examining the Pearson correlation coefficient. The correlation matrix measures the independence of every independent variable with a tolerance test value that must be greater than 0.2 and closer to 1. This means that the independent variable has a low relationship with other independent variables; but if the value is close to 0, it means that the independent variable has a high relationship with other independent variables. If the value is lower than 0.2, then there is a problem with severe multicollinearity tolerance (Detthamrong et al., 2024). This research has a value greater than 0.2 for every variable. Although the general guideline suggests that a variance inflation factor (VIF) value should be greater than 10, it is only a rule of thumb and not a strict requirement. High VIF values indicate strong correlations between variables, which may affect parameter estimates. In this study, all VIF values are below 10 (Gujarati & Porter, 2009; Miles, 2014; Stoltzfus, 2011), suggesting no significant multicollinearity.

As the results of the analysis are presented in Table 4 and Fig. 3, it was found that the highest correlation coefficient of the variables between IQU and SOC was 0.66, with statistical significance at the 0.01 level. The coefficient meets the accepted criteria of not exceeding 0.80, which clearly confirms that the results of this analysis are not multicollinearity. Therefore, the research results can be trusted (Gujarati & Porter, 2009).

The regression results presented in Table 5 offer valuable insights into the predictive impact of each factor on SUB in the context of recommendation systems for elderly research in Thailand. These findings highlight each variable's relative contribution and significance in shaping user engagement and system adoption within this specific research framework. The regression model has an R-squared value of 0.757, indicating that approximately 75.7% of the variance in SUB can be explained by the model, which includes the key variables: SQU, IQU, TRS, PEF, EFF, SOC, INN, MOT, FAC, and IBV. Key findings from the regression analysis are as follows:

- IBV (β=0.866, p<0.05): This factor has the highest positive coefficient, indicating it is the most significant predictor of SUB. This suggests that users' intention to use the system strongly influences their actual use behavior.
- INN (β=-0.406, p<0.05): This factor has a negative coefficient, suggesting that higher levels of INN are

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Table 3. Analysis results of Cronbach's alpha

Constructs	Factor number	Reliability
System quality (SQU)		
1. The recommendation systems for elderly research in Thailand must be stable	SQU1	0.955
2. The recommendation systems for elderly research in Thailand must have a responsive feature between the system and the user	SQU2	0.955
3. The recommendation systems for elderly research in Thailand must be user-friendly	SQU3	0.955
4. The recommendation systems for elderly research in Thailand must have a clear and simple navigation menu	SQU4	0.955
Information quality (IQU)		
1. The recommendation systems for elderly research in Thailand can provide information and research content on the elderly that meets the specific needs of users	IQU1	0.955
2. The recommendation systems for elderly research in Thailand can provide accurate, comprehensive, and complete research information on the elderly to users	IQU2	0.955
3. The recommendation systems for elderly research in Thailand can provide reliable research information on the elderly to users	IQU3	0.955
4. The recommendation systems for elderly research in Thailand can provide users with up-to-date research information and content on the elderly	IQU4	0.954
5. The recommendation systems for elderly research in Thailand can provide easy-to-understand research information and content on the elderly	IQU5	0.954
Trust (TRS)		
1. I have confidence in the reliability of the recommendation systems for elderly research in Thailand	TRS1	0.955
2. I have confidence in the recommendation systems for elderly research in Thailand	TRS2	0.954
3. I am confident in the system's security measures to protect the research data and access for the elderly	TRS3	0.954
4. I am confident that the recommendation systems for elderly research in Thailand will empower users to successfully develop their research on aging	TRS4	0.954
Performance expectancy (PEF)		
1. The recommendation systems for elderly research in Thailand are expected to provide support for research	PEF1	0.954
2. The recommendation systems for elderly research in Thailand are expected to expand research opportunities	PEF2	0.954
3. The recommendation systems for elderly research in Thailand are expected to anticipate speeding up research timelines	PEF3	0.954
4. The recommendation systems for elderly research in Thailand are expected to enhance research efficiency	PEF4	0.954
Effort expectancy (EFF)		
1. Learning how to use the recommendation systems for elderly research in Thailand is very easy	EFF1	0.954
2. The recommendation systems for elderly research in Thailand will provide clear and easy-to-understand interactions for the elderly research recommendation system	EFF2	0.955
3. My experience makes using the recommendation systems for elderly research in Thailand straightforward	EFF3	0.954
4. I am confident that I can easily use the recommendation systems for elderly research in Thailand	EFF4	0.954
Social influence (SOC)		
1. The recommendation systems for elderly research should be implemented in Thailand	SOC1	0.953
2. I am interested in piloting the recommendation systems for elderly research in Thailand	SOC2	0.954
3. I believe that the recommendation systems for elderly research in Thailand will contribute to the advancement of research	SOC3	0.954
4. I will consider using the recommendation systems for elderly research in Thailand once they become more widely adopted	SOC4	0.954

Table 3. Continued

Constructs	Factor number	Reliability
Personal innovativeness (INN)		
1. I am eager to learn about new information technologies and will find ways to implement them effectively	INN1	0.954
2. I am a pioneer when it comes to adopting new information technologies in the workplace	INN2	0.955
3. I am interested in and enjoy trying out new information technologies	INN3	0.955
Hedonic motivation (MOT)		
1. The recommendation systems for elderly research in Thailand can reduce anxiety and stress associated with research development	MOT1	0.954
2. The recommendation systems for elderly research in Thailand can reduce obstacles and challenges in research development	MOT2	0.954
3. The recommendation systems for elderly research in Thailand allows me to enjoy the research development process	MOT3	0.955
Facilitating conditions (FAC)		
1. There are essential resources available for utilizing the recommendation systems for elderly research in Thailand	FAC1	0.954
2. There is full access to the necessary hardware, software, and services to utilize the recommendation systems for elderly research in Thailand	FAC2	0.954
3. There is sufficient funding to implement the recommendation systems for elderly research in Thailand	FAC3	0.955
4. There is sufficient and adequate knowledge to utilize the recommendation systems for elderly research in Thailand	FAC4	0.955
Intention behavior (IBV)		
1. I intend to use the recommendation systems for elderly research in Thailand in the future	IBV1	0.954
2. I anticipate using the recommendation systems for elderly research in Thailand the future	IBV2	0.954
3. I have a plan to use the recommendation systems for elderly research in Thailand in the future	IBV3	0.954
4. I would recommend other researchers to use the recommendation systems for elderly research in Thailand	IBV4	0.953
System use behavior (SUB)		
1. I am certain that I will use the recommendation systems for elderly research in Thailand on a regular basis	SUB1	0.954
2. I am confident that I will definitely use the recommendation systems for elderly research in Thailand once it is fully developed and ready for use	SUB2	0.954
3. I will use the recommendation systems for elderly research in Thailand as my primary database for developing research on the elderly	SUB3	0.955
4. There is a high likelihood of using the recommendation systems for elderly research in Thailand	SUB4	0.954

associated with a decrease in SUB. This finding may indicate that highly innovative users are less dependent on the system for their research, possibly preferring alternative resources.

- EFF (β=0.181, p<0.05): The positive coefficient suggests that when users find the system easy to use, their likelihood of engaging with it increases.
- PEF (β=0.134, p<0.05): This positive influence reflects that the more users perceive the system as beneficial to their research performance, the more likely they are to use it.
- MOT (β=0.137, p<0.05): This factor indicates that enjoyment or satisfaction derived from using the system positively contributes to SUB.
- SQU (β=0.116, p<0.05): SQU positively influences SUB, underscoring that a reliable, responsive, and user-friendly system is crucial for encouraging usage.
- IQU (β=-0.268, p<0.05): Interestingly, this factor negatively impacts SUB, suggesting that perceived IQU may not meet users' specific needs, thereby decreasing engagement with the system.

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Table 4. Correlation analyses matrix

Variables	SQU	IQU	TRS	PEF	EFF	SOC	INN	MOT	FAC	IBV	SUB	Tolerance	VIF
$\bar{x}$	4.600	4.710	4.540	4.590	4.540	4.500	4.130	4.200	4.410	4.240			
S.D.	0.440	0.333	0.398	0.449	0.467	0.485	0.667	0.648	0.499	0.624			
SQU		0.579	0.504	0.372	0.310	0.350	0.268	0.182	0.419	0.355	0.295	0.540	1.853
IQU			0.606	0.547	0.585	0.661	0.446	0.430	0.536	0.470	0.258	0.318	3.145
TRS				0.494	0.436	0.544	0.450	0.280	0.343	0.647	0.428	0.369	2.708
PEF					0.513	0.567	0.357	0.389	0.406	0.403	0.371	0.532	1.880
EFF						0.617	0.569	0.504	0.330	0.275	0.187	0.411	2.430
SOC							0.467	0.513	0.527	0.501	0.341	0.359	2.784
INN								0.585	0.428	0.319	0.013	0.524	1.907
MOT									0.585	0.344	0.264	0.449	2.226
FAC										0.409	0.335	0.484	2.066
IBV											0.793	0.492	2.031
SUB													

Correlation is significant at the 0.01 level (2-tailed).
S.D., standard deviation; SQU, system quality; IQU, information quality; TRS, trust; PEF, performance expectancy; EFF, effort expectancy; SOC, social influence; INN, personal innovativeness; MOT, hedonic motivation; FAC, facilitating conditions; IBV, intention behavior; SUB, system use behavior; VIF, variance inflation factor.

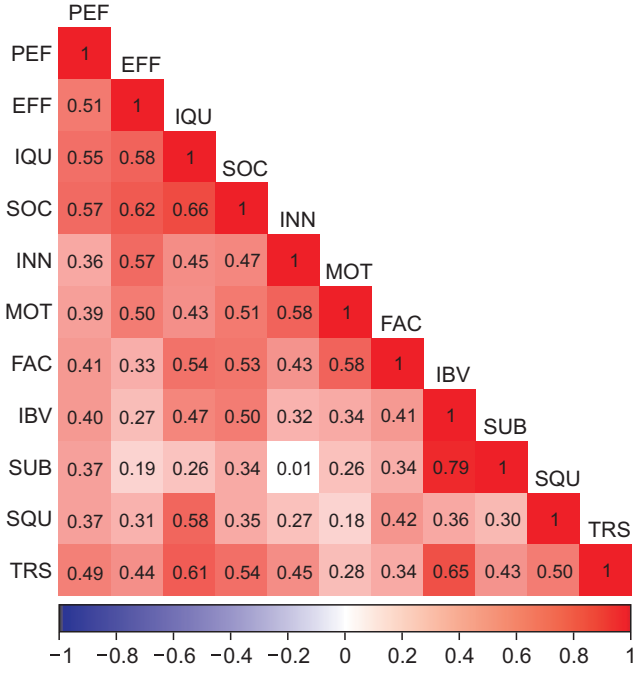


Fig. 3. Correlation analyses matrix graph (source: authors, using Python in Colab). PEF, performance expectancy; EFF, effort expectancy; IQU, information quality; SOC, social influence; INN, personal innovativeness; MOT, hedonic motivation; FAC, facilitating conditions; IBV, intention behavior; SUB, system use behavior; SQU, system quality; TRS, trust.

- FAC (β=0.097, p<0.05): This positive effect implies that when adequate resources and support are available, users are more likely to adopt the system.

TRS and SOC did not significantly affect SUB, suggesting that these elements may not be critical drivers in the system's adoption for this user group.

In summary, the regression model provides predictive insights into each factor's contribution to SUB, highlighting the importance of IBV, SQU, and ease of use as primary drivers. Factors like INN and IQU negatively influence usage, requiring further exploration.

In Table 5, SQU, PEF, EFF, MOT, FAC, and IBV showed positive relationships. IQU and INN showed a negative relationship. All variables demonstrated statistical significance at the 0.05 level, except for TRS (β=-0.030, p=0.080) and SOC (β=-0.059, p=0.217), and so for Thailand elderly research social factors (e.g. societal trends or peer influence) appear to have little impact on decisions to use the recommendation system. Based on the findings of this research, it is evident that there is no significant relationship between TRS and SOC and the utilization of the recommendation systems for elderly research in Thailand. This suggests that these two variables do not impact this demographic's adoption and use of such systems. Con-

Table 5. Multiple linear regression analysis

Model	System use behavior		t	*p*-value
	β	Standard error		
Intercept	1.195	0.305	3.919	0.001[a)]
System quality	0.116	0.059	2.943	0.004[a)]
Information quality	-0.268	0.100	-5.349	0.001[a)]
Trust	-0.030	0.080	-0.618	0.534
Performance expectancy	0.134	0.058	3.393	0.001[a)]
Effort expectancy	0.181	0.065	3.982	0.001[a)]
Social influence	-0.059	0.066	-1.237	0.217
Personal innovativeness	-0.406	0.042	-9.702	0.001[a)]
Hedonic motivation	0.137	0.045	3.095	0.002[a)]
Facilitating conditions	0.097	0.057	2.256	0.025[a)]
Intention behavior	0.866	0.044	20.695	0.001[a)]
R^2=0.766, adj R^2=0.757, SE_{est}=0.327, F=86.085				

[a)]Significance at the 0.05 level (2-tailed).

versely, the study identifies several factors that are crucial in influencing the use of the recommendation systems for elderly research in Thailand. These factors include SQU, PEF, EFF, MOT, FAC, IBV, IQU, and INN. These elements collectively contribute significantly to the effectiveness and acceptance of the recommendation systems in the specified context.

The results of the multiple regression analysis support the idea that eight factors: SQU, PEF, EFF, MOT, FAC, IBV, IQU, and INN are important factors influencing the use of recommendation systems for elderly research in Thailand. The results of this study highlight that these identified factors play an important role in optimizing the use of the geriatric recommendation systems for elderly research in Thailand. Additionally, these factors serve as reliable indicators for predicting future participation in the use of recommendation systems for elderly research in Thailand.

Equations for predicting the factors influencing the use of the recommendation systems for elderly research in Thailand can be defined as follows:

SUB=1.195+0.116 (SQU)-0.268 (IQU)+0.134 (PEF)+0.181 (EFF)-0.406 (INN)+0.137 (MOT)+0.097 (FAC)+0.866 (IBV)

where:
SUB=system use behavior
SQU=system quality
IQU=information quality
PEF=performance expectancy
EFF=effort expectancy
INN=personal innovativeness
MOT=hedonic motivation
FAC=facilitating conditions
IBV=intention behavior

The above equation offers valuable insights into the defining factors of this research to reflect the impact on the use of recommendation systems for elderly research in Thailand. It represents the positive impact of six factors: SQU, PEF, EFF, MOT, FAC, and IBV. It shows the negative impact of two factors: IQU and INN. From the results of this research, it can be inferred that the above eight factors are important factors that play an important role in the phenomenon of using recommendation systems for elderly research in Thailand. Moreover, the obtained equations serve as a prediction tool. This allows researcher to estimate and predict how likely individuals or users are to make use of the recommendation systems for elderly research in Thailand, based on SQU, PEF, EFF, MOT, FAC, IBV, IQU, and INN. This prediction model improves understanding of the interplay between individual behavior and the use of research guidance systems on the elderly in Thailand, by presenting predictions about actual use and planning strategies for the effective use of recommendation systems for elderly research in Thailand.

6. DISCUSSION

The findings of the study on factors influencing the use of recommendation systems for elderly research in Thailand provide crucial insights into the factors that affect the acceptance and utilization of recommendation systems in elderly research in Thailand, using a quality-validated dataset from 348 researchers experienced in elderly research from 2012 to 2022. Drawing on the UTAUT2 framework and extending it with variables relevant to this research, multiple regression analysis indicated an intercept of 1.195 and an R^2 of 0.757, explaining 75.70% of the variance in system use. Statistically significant influences were observed in several key factors. SQU, which emphasizes stability, responsiveness, and user-friendliness, had a positive effect (β=0.116), supporting findings from Baabdullah et al. (2019), Ramkumar et al. (2019), and Rafique et al. (2020), who identified SQU as pivotal for usability and engagement.

Similarly, the study found that IQU and INN have a negative impact on SUB, contradicting traditional expectations of their effects. IQU negatively correlated with system usage (β=-0.268, p<0.05). This suggests an incongruence between system-delivered information and the specialized needs of senior researchers, implying that the information might be perceived as either too general, redundant, or not adequately customized to their specific research questions. Such misalignment can lead to user dissatisfaction and decreased system engagement. Therefore, system developers must prioritize the optimization of information relevance, accessibility, and clarity rather than merely adding more information or complexity, as noted by Abu-Taieh et al. (2022) and Alassafi (2022). While comprehensive and accurate information is generally advantageous, excessive detail or complexity may hinder users' ability to swiftly access information in time-sensitive situations, which can reduce overall system usage (Zwain, 2019). Hence, designers should focus on presenting relevant and easily interpretable information to meet users' specific demands effectively.

Further, PEF (β=0.134) positively impacted system adoption, consistent with Venkatesh et al. (2003; 2016), Yang et al. (2020), and Jevsikova et al. (2021), underscoring that users expect technology to enhance research efficiency. EFF (β=0.181), indicating ease of system use, aligns with Jevsikova et al. (2021) and Tanu Wijaya et al. (2020), reinforcing that accessible and clear interfaces support user engagement. Interestingly, INN negatively impacted system usage (β=-0.406), as more innovative users seek systems with advanced features beyond those offered, as supported by Yang et al. (2020) and Jevsikova et al. (2021). This aligns with studies on smart meter adoption, which show that high innovativeness leads to higher expectations. If systems fail to meet these expectations, it results in dissatisfaction and reduced usage intention. Thus, system development should address the needs of users with high INN (Alkawsi et al., 2021). MOT (β=0.137), associated with enjoyment and reduced stress, had a positive influence, as previously noted by Jevsikova et al. (2021). Additionally, FAC (β=0.097), representing available resources, were significant, confirming findings from adequate infrastructure is crucial for system adoption. IBV (β=0.866) emerged as a robust predictor, affirming that users' future use of the system is strongly tied to perceived benefits, aligning with Davis (1986; 1989) and Dwivedi et al. (2019).

SOC (β=-0.059) and TRS (β=-0.030) were, however, not significant, conflicting with Dirsehan and Can (2020) and Alalwan et al. (2018) finding these elements important in technology acceptance. TRS may be related to other factors such as SQU. SOC may be affected by Chang (2012)'s and Zarifis and Cheng (2022)'s suggestion that Thailand's individual benefit outweighs peer influence. In elderly research contexts a system effectiveness approach, focusing on FAC, PEF, and SQU would appear to better suit Thailand researchers.

Contrary to expectations, SOC had no significant effect on system usage in this study (β=-0.059, p>0.05). While previous literature (Chauhan, 2015; Venkatesh et al., 2012) commonly identifies SOC as a significant determinant of technology adoption, this finding suggests that researchers in elderly studies in Thailand may place greater emphasis on individual needs, personal efficiency, and convenience rather than external social pressures. Given the specialized nature of elderly research and the professional autonomy typical of this research community, SOC or peer pressure might be less impactful than individual performance-related factors or usability considerations.

The absence of a significant effect of SOC aligns with the notion that researchers in elderly-related fields in Thailand may rely more heavily on personal judgment or direct experience rather than external peer opinions or societal trends. Given the specialized nature of elderly research, users may value practical functionality over social validation when adopting such recommendation systems.

These insights highlight the factors that influence the adoption of recommendation systems tailored to the needs of elderly research in Thailand. Recognizing the

unique sociocultural landscape, this system addresses essential factors—SQU, Performance Expectation, Effort Expectation, MOT, FAC, IBV, IQU, and INN—that shape the effectiveness and acceptance of such a system among Thai researchers. Cultural context and family dynamics are central to understanding elderly care in Thailand, where traditional family caregiving roles are being reshaped by urbanization and changes in family structures. Thus, sustainable community or institutional care models are increasingly essential.

The research recommends incorporating these evolving caregiving trends into advisory systems to support researchers in evaluating new care models. The health and long-term care needs of Thailand's elderly, who frequently face chronic conditions and disabilities, necessitate community-based, long-term care solutions. The findings emphasize the need for systems that allow researchers to assess these care models' adaptability and effectiveness, aligning with the complex health profiles typical of an aging population. Economic security is another pressing issue, as many Thai elderly lack adequate retirement savings, compelling some to continue working. Addressing this, the recommendation system can facilitate research into the economic factors affecting the financial stability and workforce participation of the elderly, which could inform policy solutions promoting economic security for the aging population. Finally, policy and social support systems, particularly through government initiatives like Thailand's National Plan for Older Persons, are crucial in this rapidly aging society. This research underscores the importance of integrating tools within the advisory system to evaluate the efficacy of existing policies and identify areas for policy innovation. The findings underscore the importance of culturally and contextually adapted recommendation systems for research to optimize participation and effectiveness. This ultimately contributes to a more comprehensive understanding and support of elderly care in Thailand.

Limitations of the study should be acknowledged, as while this study provides meaningful insights into the factors influencing the adoption of recommendation systems for elderly research in Thailand, several limitations should be noted.

First, the study utilized a cross-sectional design, limiting causal inferences. Future longitudinal studies could validate these findings by tracking changes over time.

Second, the sampling approach, targeting researchers experienced in elderly-focused research between 2012 and 2022, may introduce sampling biases, thus affecting the generalizability of the results. Expanding the sample to include diverse user groups or researchers from different contexts would enhance generalizability.

Third, the research did not explicitly consider cultural and contextual factors specific to Thailand's aging society, which could significantly influence SUB. Further qualitative or mixed-method studies incorporating cultural analyses could address this gap.

Fourth, data were collected through self-reported questionnaires, introducing potential biases related to social desirability and subjective perceptions. Triangulating self-report data with objective measures or behavioral analytics could strengthen future research.

Fifth, the short data collection period (January-March 2024) could limit understanding of temporal or seasonal variations in system usage. Extending the data collection period across different timeframes could provide a more comprehensive view.

Finally, the study's findings may not be generalizable beyond researchers specializing in elderly studies in Thailand. Additional studies across diverse research contexts and geographical locations could enhance the external validity of these results.

These limitations offer future research opportunities to refine and deepen understanding of technology adoption in elderly-focused research systems.

7. CONCLUSION

This study offers important insights into the factors influencing the adoption of recommendation systems for elderly research in Thailand. The findings identify eight key factors that significantly affect the acceptance of these systems: SQU, PEF, EFF, MOT, FAC, IBV, IQU, and INN. These factors are critical in determining the participation and engagement with recommendation systems for elderly research in Thailand in this research population. In addition, the results of the study show insights into the behavior of demand for the recommendation systems for elderly research in Thailand, leading to joint analysis and system design, in order to be able to develop such a system in line with the needs of users and achieve maximum efficiency from this population. It is also an important starting point for examining the importance of factors in using recommendation systems for elderly research in Thailand: SQU, PEF, EFF, MOT, FAC, IBV, IQU, and INN towards the behavior of using the SUB regarding the elderly in Thailand. It also considers academic and research participation in adding to the body of knowledge and helping to confirm

insights in areas that have not been studied before.

Specifically, the prediction equation part of this study will be a practical tool for understanding and predicting the pattern of factors influencing the adoption of recommendation system on the elderly in Thailand. These findings highlight the importance of SQU, PEF, EFF, MOT, FAC, IBV, IQU, and INN. As a catalyst for the adoption of recommendation systems, this study provides valuable insights into strategies for promoting the development and effective utilization of these systems in elderly research within the Thai academic and research community.

CONFLICTS OF INTEREST

No potential conflict of interest relevant to this article was reported.

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Information Management and Absorptive Capacity in Open Innovation Practices: A Conceptual Model

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ABSTRACT

This study addresses information management and absorptive capacity in the context of open innovation projects—essential topics for public and private organizations. The construction of the conceptual model is based on the consolidated literature on these topics, also incorporating recent empirical studies that highlight their complementarity and confirm existing gaps in the area. The proposed theoretical model considers the stages of innovation development, represented by the innovation funnel, integrating the information process model and the absorptive capacity model. The proposed model aims to support managers in systematizing the innovation process, using information as a foundation for absorptive capacity and promoting the integration of information management, absorptive capacity, and open innovation. The implementation of open innovation can be carried out through the effective management of information flow and the application of new knowledge, facilitating decision-making and enhancing innovation outcomes. It is expected that this study will contribute to the advancement of these topics and offer practical instruments that strengthen the agenda of innovation managers.

Keywords: information management, absorptive capacity, innovation funnel, open innovation, conceptual model

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1. INTRODUCTION

Information is an essential resource for organizational decision-making, enabling companies and institutions to respond swiftly to the demands of a competitive environment (Laudon & Laudon, 2000). However, for this process to be effective, it is necessary not only to access information but also to absorb and transform external knowledge into a strategic advantage. In this regard, absorptive capacity has become one of the main drivers of business competitiveness, allowing organizations to incorporate new knowledge and enhance their innovative capabilities (Spithoven et al., 2010).

Information management (IM) is still not standardized in many firms, despite its increasing significance, which restricts its strategic potential (Choo, 1998). The lack of organized procedures for gathering, analyzing, and using data impedes flexibility and creativity, posing problems for public and private sectors alike. In order to transform knowledge into a competitive advantage and spur innovation, this situation serves as further evidence of the necessity of incorporating IM into organizational dynamics.

The theory of dynamic capabilities provides a theoretical framework for understanding this challenge, highlighting the importance of acquiring, processing, and strategically applying information as essential factors for innovation (Barney, 1991; Helfat & Winter, 2011). Within this perspective, absorptive capacity (AC) refers to an organisation's ability to recognise the value of new external information, assimilate it, and apply it effectively, as defined by Cohen and Levinthal (1990). Subsequent studies emphasize that this capacity, particularly through research and development (R&D) activities, plays a crucial role in organizational innovation (Fosfuri & Tribó, 2008; Grama-Vigouroux et al., 2020; Lopes & de Carvalho, 2018; Murovec & Prodan, 2009; Naqshbandi & Jasimuddin, 2022; Zahra & George, 2002).

Chesbrough (2006) established the idea of open innovation, which emphasizes the value of teamwork in creating novel concepts and solutions. Open innovation stresses the sharing of resources, technology, and expertise among businesses, increasing potential for digital transformation and the creation of new goods and services, in contrast to the traditional innovation model, which only uses internal efforts. Therefore, the ability to build strategic and interorganizational relationships is just as important to innovation success as internal R&D investments.

To explore the relationship between information, knowledge, and collaborative innovation, this study suggests a conceptual model that combines IM and AC inside the open innovation environment. Despite the extensive discussion of these ideas in the literature, there is still a lack of knowledge regarding the impact of stakeholder roles and interorganizational relationships outside of the conventional emphasis on R&D investments (Grama-Vigouroux et al., 2020; Zobel, 2017). While previous work offers a descriptive study of the challenges associated with managing open innovation in practice, the proposal model seeks to provide prescriptive theoretical direction. By bridging the gap between formal frameworks and the dynamic realities of collaborative innovation, these complementary approaches enhance scholarly knowledge and the real-world implementation of innovation management.

This paper is structured into four sections. Section 1 introduces the topic. Section 2 discusses the theoretical foundations of IM, AC, and open innovation. Section 3 integrates these concepts and presents the conceptual model. Finally, Section 4 provides concluding remarks.

2. THEORETICAL BACKGROUND

This section outlines the key theoretical concepts that form the foundation of the model proposed in this article: IM, AC, and open innovation. It provides a comprehensive review of the literature on these three themes, examines their interrelationships, and emphasizes how their integration can enhance an organization's ability to innovate.

2.1. Information Management

IM is the application of the principles of contemporary management to the tasks of acquisition, processing, dissemination (distribution), and use of information in organization environments. This statement is within the scope of information theory, presenting a model composed of sender, message, and receiver, where the information is in the message, enabling communication. In this regard, it is possible to affirm that IM acts centrally in organizational communication, hence the strategic importance of managing information content aiming at broad access to support decision support systems and generating an environment favoring open innovation. In this context, Claude Shannon's classic proposition in his 1948 article "Mathematical Theory of Communication" states that a communication system consists of five components, emphasizing that the communication channel should maintain neutrality (Shannon, 1948). This reinforces the importance of promoting impartiality and objectivity in an IM model, ensuring unbiased access to information as

the final product.

According to Shannon's 1948 definition (as cited in Guedes & Júnior, 2014), a communication system includes: (i) a source of information that produces messages; (ii) a transmitter that generates a signal from the messages; (iii) a channel that transmits the signal from the transmitter to the receiver; (iv) a receiver that decodes the signal; and (v) a final recipient, which can be a person (user) or equipment to which the original message is directed. The system proposed by Shannon bears similarities to Coadic and François (2004)'s theory of information, incorporating technical elements related to signal compatibility and emphasizing the preservation of neutrality and objectivity in the reception and destination of the signal, as reflected in the information retrieval process. This is the analogy between a proposal of significant influence in the organization and IM, with the integrity of the basis that allows access to the receiver (user) of information.

IM, a general model for applying methods, tools, and solutions to control information flows, presents the informational (documentary) cycle as a unifying element of the steps and tasks involved in IM. Each stage of the information cycle includes technical measures, from which information is represented and organized to enable searching and retrieving information. This primary purpose makes the use of information in the organizational context feasible.

The information cycle combines two dimensions of processing and organization of information records. The dimension of technical processing is represented in steps that involve the representation of the information content to generate metadata that will be inserted into the system for later retrieval by users. The other dimension is represented by the division of IM tasks, organized into cumulative and subsequent steps of arrangements in a format like a flowchart.

IM, within the framework of a communication system, should consider the mathematical theory of information as an element of improvement of the information cycle. It is possible to consider three central aspects in an open innovation model in IM: I. information storage; II. organization of information; and III. information retrieval.

Storage refers to the process in which information items are allocated in a system to be found when requested by users, from a set of metadata that describe them and are the result of classification systems.

According to de Albuquerque and de Araújo Júnior (2014), the organization of information addresses the techniques applied to analyzing and synthesizing informational objects, to represent them to be identified and retrieved later through their attributes and main characteristics.

Information retrieval is the central step of an information system. It consists of identifying informational items in a system or collection that have been stored and demanded by users with the support of professional mediation, or autonomously in databases or information systems.

According to Cacaly et al. (2008), because specialized mediation is a prerequisite for retrieval operations and the delivery of results to users, it is both feasible and essential to enhance the information retrieval process by diagnosing users' informational needs. This is true both at the level of the form of response and the extension of the field to be explored. Mediation between applicants and the available documentary and informational resources typically requires a high level of interaction between the user and the information expert.

IM is only effective in organization environments based on the full knowledge of the informational needs of users of information systems. This statement is the assumption of IM and has repercussions in constructing management models. It is possible to detect in the various models that we will present below common characteristics, all revealing a conductive wire in the communication system.

The Open Archival Information System model, in the proposition by Serra Serra (2008), establishes input and output interfaces to the archival IM system. The input interface is referred to in the English acronym *SIP* as *Submission Information Package* and is under the responsibility of the document producers. In IM, as part of the technical processing stage, the responsibility interface of the system managers is represented by the AIP (Archival Information Package). The interface is called the Dissemination Information Package (DIP) at system output or information retrieval. In this model, the input, processing, and output steps that characterize the models and IM are well delineated.

IM must be able to support the choice of organization strategy and the management model of information systems. The full knowledge of the informational needs of the users of the systems must support this dual function. This fact can be corroborated by the analysis of the IM models presented, where the dissemination of information is the final and most important result in a communication system, as proposed by Shannon (1948) and Coadic and François (2004).

The three basic tasks of IM, 1. collection; 2. process-

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ing; and 3. systemic dissemination of information in the organization, should follow the basic requirement to be considered in IM, which is the adaptation of information transfer models in the organization environment. Thus, the management of user requirements, as proposed by Davenport (2005), must combine the information needs of users and those of supplier channels through knowledge of the requirements of those who need information to consolidate the trust of suppliers and decision-makers.

In a more current context, IM is also being shaped by new technologies (e.g. artificial intelligence, cloud computing, and big data), which enable the processing of large volumes of data and the generation of real-time insights. These tools allow for more agile and efficient IM, expanding the scope of innovation and enhancing organizations' ability to respond to market changes and uncertainties. According to Laudon and Laudon (2020), integrating these technologies into IM has the potential to revolutionize how organizations capture, analyze, and use information, making them more dynamic and competitive.

The adoption of effective IM practices is essential to optimizing knowledge sharing and transfer—processes that serve as key drivers in strengthening organizational capabilities (Pavão et al., 2023).

In this study we use the IM process Model proposed by Choo (1998). This model outlines the systematic flow of information within an organization, highlighting how information is transformed into knowledge that supports decision-making and adaptive behavior. The following is an explanation of each stage (Fig. 1 [Choo, 1998] is presented at the end of the article):

1. Identifying Information Needs: The IM process begins with recognizing what information is necessary for the organization. This step involves understanding the internal and external information requirements that are critical for achieving organizational goals.

2. Information Acquisition: Once the information needs are identified, relevant data is gathered from various sources. This can include both internal databases and external environments, ensuring that the organization has access to the information it needs.

3. Information Organization and Storage: The acquired information is then systematically organized and stored. Proper classification, indexing, and archiving of information enable easy retrieval and ensure that the information remains useful over time.

4. Development of Information Products and Services: At this stage, raw information is transformed into meaningful products and services that cater to the organization's needs. This can include reports, dashboards, analytical tools, or customized information services.

5. Information Dissemination: After processing, information is distributed to relevant stakeholders. This ensures that the right information reaches the right people at the right time, facilitating informed decision-making.

6. Information Use: This stage refers to how information is applied within the organization. It is used to support decision-making, problem-solving, and strategy formulation.

7. Adaptive Behavior: The final stage involves using information to adapt to the environment. This reflects the organization's ability to learn, innovate, and evolve based on the insights gained from information use.

It is evident that IM is essential to gathering, analyzing, and sharing strategic data that informs choices and helps businesses adjust to ever-changing market conditions. AC—the ability of an organization to recognize, absorb, and use external information to optimize value creation—is intimately related to this process. The main ideas surrounding AC will be covered in the section that follows.

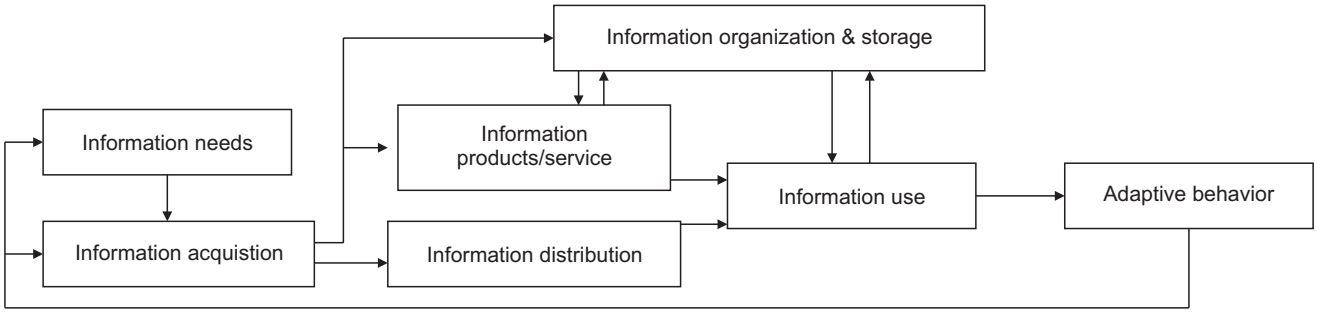


Fig. 1. Model of information management (adapted from Choo, 1998).

2.2. Absorptive Capacity

AC starts from the epistemological perspective of the theory of resource-based view (RBV), proposed by Wernerfelt (1984) and Barney (1991). RBV handles the firm's specific resources to develop competitive advantages. The concept is defined by Cohen and Levinthal (1990) as the ability of an organization to recognize the value of new, external information, assimilate it, and apply it to commercial ends, as critical to its innovative capabilities.

According to the model of Cohen and Levinthal (1990), AC depends on two antecedents: the previous level of prior knowledge of the organization, and the direct interface of the organization with its external environment and sources of knowledge. Both are dependent on the effects of the conditions of the appropriability regimes. They allow the organization to develop the AC process, consisting of identifying new information, assimilating the acquired information, and applying the acquired knowledge for commercial purposes capable of promoting innovation and/or innovative performance.

Cohen and Levinthal (1990) also highlight the relevance of the R&D department associated with appropriation capacity. Also, the R&D area generates new knowledge and contributes to developing the organization's AC. Hence, the model analyzes the empirical importance of AC based on the responsiveness of the R&D activity compared to the existing learning environment (Cohen & Levinthal, 1990).

A decade after the initial publication of Cohen and Levinthal (1990) on AC, Zahra and George (2002, p. 186) revisited the theoretical model. They broadened its concept by defining it as "a set of routines and organizational processes by which organizations acquire, assimilate, transform and apply knowledge to produce a dynamic organizational capability."

Zahra and George (2002) propose the relevance of prior knowledge of the organization, combined with the acquisition of new sources of information from the relationship of organizations with their external environment through organizational processes and routines, to develop new competencies (Zahra & George, 2002).

The multidimensional concept proposed by Zahra and George (2002) points out that AC is divided into two different sets: the potential capacity (PACAP)—which involves the dimensions of acquisition and assimilation of knowledge; and the realized capacity (RACAP), which emphasizes the dimensions of knowledge transformation and application. These two subsets defined by the authors can be useful, since organizations permeate different contexts. An organization may have a greater ability to understand technical problems (acquisition and assimilation), but may not be able to use this knowledge for innovation (transformation and application).

Moreover, Zahra and George (2002) indicate that different levels of interaction are necessary when it comes to knowledge transfer processes, namely: (1) individual, which has the focus of analysis on the organization's employees; (2) group, which refers to work teams, functional areas and divisions, business divisions, and branches; (3) organizational, which relates to the organization as a whole; and (4) inter-organizational, which refers to different levels of interactions with other partners and stakeholders, which can be through strategic alliances, clusters, industries, joint ventures, and national innovation systems. Here, through Fig. 2 (Zahra & George, 2002) presented at the end, we present the model developed by Zahra and George that will serve as a basis for analysis in this work.

Zahra and George (2002) proposed a model that indicates that previous experience and the need to acquire new knowledge from the external environment are important antecedents for potential AC. From the activation triggers, called events that cause the organization to need adaptation and/or respond to new demands (internal or external), the authors define the need for new information for the maintenance and survival of the organization in

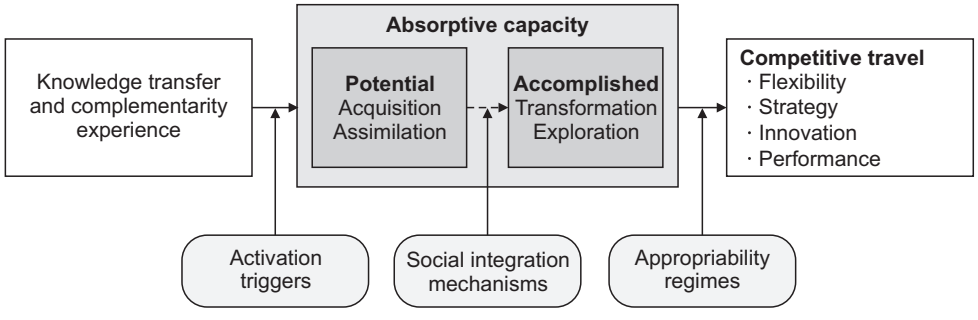


Fig. 2. Absorptive capacity model (adapted from Zahra & George, 2002).

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the environment where inserted.

Thus, in starting to acquire and assimilate new information acquired in the organizational environment (internal or external), the organization starts to develop mechanisms of social integration (structural, cognitive, and relational), which require knowledge sharing among internal players. This step is necessary so that, after the organization and storage of new information, it can be conceived and internalized by all organization members (Zahra & George, 2002).

Implementing these mechanisms facilitates information flows and reduces the distance between PACAP and RACAP. This improves the assimilation and transformation of information and may explain some performance variations between companies in the same industry. As a result, the exploitation/application of new knowledge drives organizational performance, innovation, and competitive advantage, with differences among organizations arising from the way they utilize resources and develop their organizational capabilities (Zahra & George, 2002).

AC enables organizations to identify, assimilate, and apply information from the external environment, which is essential in open innovation environments where the exchange of information across organizational boundaries is crucial. By effectively managing and integrating external information, organizations can leverage diverse insights, accelerate the innovation process, and reduce the risks associated with internal development. The following section will address the key concepts of open innovation to understand its relationship with IM and AC.

2.3. Open Innovation

Open innovation has consolidated itself as a relevant theme on the agenda of organizations over the last few years. The collaborative character of the model instigates networking initiatives and the improvement of new relationships between partners. Innovation development without considering the external environment to obtain resources, ideas, and technologies, and establish strategic partnerships is indefensible in the current scenario.

Given this context, adaptations were necessary. Large corporations began to learn about new processes and ways of innovating with those who started in a smaller structure—for example, startups who quickly established themselves, creating new markets or even breaking with existing markets.

Regarding open innovation partners, the following can be mentioned: customers, suppliers, research institutions, universities, and associations, among others, and even competitors themselves (Chesbrough, 2006). In the case of the latter they are characterized, above all, by cooperation processes in which, at the beginning of certain projects, there is a collaborative relationship. When the common objective of the partnership is reached, each party involved follows its market strategy, establishing an environment of competition. A common situation in projects in the pharmaceutical area, for example, is where laboratories first partner to study a medicine for a disease. Secondly, when the project results are obtained, each laboratory follows its own marketing strategy. This approach is called coopetition, first a moment of cooperation and then, next, a stage characterized by competition.

It should be noted here that human resources are an important part of the innovation process. Besides people, another resource that is essential for conducting organizational activities is the information element, one of this study's central subjects.

A recent study by Engelsberger et al. (2023) addresses human resource management in collaboration, underscoring the importance of raising awareness among teams and individuals to succeed in open innovation processes. In the words of Majchrzak et al. (2023, p. 1), "managing human interaction across organizational boundaries is therefore central to open innovation." Together with people, at the heart of this importance is the role that information and informational resources play in working among teams and partners.

Therefore, concerning the 'information' resource in collaborative innovation processes, it is possible to state that information is consolidated as a fundamental input in such processes. From how the partner network handles information, the degree of trust may or may not be accentuated, which is one of the indispensable elements for the success of the collaboration. Thus, the proper sharing of information will dictate the performance of collaborative work. Observations are also punctuated by the study by Wang et al. (2023) on the different conditions of the members of a strategic alliance and the impact of information sharing on expected results, which concludes: "If these problems cannot be resolved, the operation of alliances may fail" (Wang et al., 2023, p. 1).

In a collaboration context, different open innovation practices can be observed from the study by Chesbrough and Brunswicker (2013), these being monetary and non-monetary. Next are some innovation practices, separating them by the dimensions of open (inbound and outbound): inbound—dealing with licensing (intellectual property); innovation awards for suppliers; collaboration with exter-

nal suppliers of R&D services; idea and start-up contests (related to business ideas); specialist services from open innovation intermediaries (e.g. Ninesigma, InnoCentive); university fellowships; co-creation with customers and consumers; crowdsourcing to solve innovation problems; informal networks (e.g. fairs, networked institutions); R&D consortia supported by public funding.

The flow of partnership in inbound practices reveals a strategy to obtain resources, ideas, and technologies from the external environment to the organization. When observing the intellectual property strategy, companies can obtain licensing from the payment of royalties to inventors for use in part of developing a new product/service, and with the possibility of establishing partnerships beyond licensing if it is of mutual interest.

Identifying key partners can be enhanced by participating in established network associations and organizations in informal networks such as fairs and events. Promoting competition of ideas (some examples are hackathons and crowdsourcing) in addition to capturing new ideas and solutions to known problems can also be a more proactive way to identify partners. In these terms, co-creation rounds bring good insights to organizations from the customer/user experience that can contribute to improvements or even the proposal of new products/services, for example, through prototyping processes.

Some companies have used partnerships with universities through R&D contracts with or without the support of public funds to conduct the initial stage of their projects—basic research.

As for open innovation practices, outbound, some examples are listed: selling patents and intellectual property licences; incubating businesses and venture capital for businesses (e.g. incubation programs for new start-ups); spin-offs; selling market-ready products; participating in standardisation programs (e.g. in Brazil: International Organization for Standardization, Brazilian Technical Standards Association); joint venture activities with external partners; donations to for-profit or non-profit organizations.

In the definition of dimensions of open innovation practices, inbound (from outside to inside) and outbound (from inside to outside) flows can be classified. The use of ideas and technologies obtained in the external environment characterizes the inbound flow from the point of view of the organization that absorbs these external resources. In turn, when the organization makes ideas, technologies, etc., available to the external environment, the outbound flow is what describes the opening dimension.

According to Chesbrough and Crowther (2006), inbound open innovation means generating ideas and results in R&D from information from suppliers, customers, and other external players (acquisition or joint development of technologies), which can enhance the innovation capacity of organizations. On the other hand, outbound open innovation is characterized by the delivery of new technologies by the organization through the commercialization of new products or services for specific organizations.

Vanhaverbeke and Gilsing (2024) reinforce that the motivation for inside-out and outside-in practices is strategically perceived to develop new products. Still, some practices can be adopted for financial benefits, such as the availability of unused technologies and ideas and the commercialization of intellectual property. Therefore, the authors focus on open innovation inbound activities and the AC that needs to be built to successfully engage in these activities (Spithoven et al., 2010). In the words of Aliasghar and Haar (2023, p. 1), "in order to engage simultaneously in both 'buying' and 'selling' activities, organizations need to develop specific capabilities to manage knowledge inflows and outflows, e.g., absorptive and desorptive capacities."

El Maalouf and Bahemia (2023, p. 2) study the results obtained in open innovation practices in the inbound dimension and find that "there are 'learning' benefits from openness to the knowledge of external partners as organizations create routines of processing information to find and choose appropriate partners."

The study by Spithoven et al. (2010, p. 10) assumes the recognition of the approximation between open innovation and AC: "The discussion on open innovation suggests that the ability to absorb external knowledge has become a major driver for competition. For R&D intensive large organizations, the concept of open innovation in relation to AC is relatively well understood." Spithoven et al. (2010) point out that, in the process of inbound open innovation, organizations use the external environment to seek knowledge and technology, not depending only on internal R&D. For this, they must develop AC to internalize and use external knowledge.

Based on their findings, Spithoven et al. (2010) state that the main source of information for developing R&D and innovation lies in the previous experience of the organization's team. However, other important sources of information are universities, events, publications, and specialized journals. Further, Spithoven et al. (2010) still comment that to develop AC, organizations may need the

help of external players, such as research centers and universities, to build AC at the inter-organizational level. Finally, their article defines the concept of AC as a precondition for open innovation and points out that organizations without AC use knowledge collectively through external players.

In turn, open innovation expands the available sources of information, strengthening AC and fostering a continuous cycle of learning and innovation. This symbiotic relationship highlights the importance of aligning AC with open innovation strategies to maximize the benefits of external collaboration and knowledge flow. Having concluded the presentation of the concepts that guided the development of this article, the following section will outline the methodological procedures used in the research.

3. METHODOLOGICAL PROCEDURES

The methodological approach for this conceptual model study involves a comprehensive review of the existing literature related to open innovation, IM, and AC. Initially, relevant scholarly articles and books were identified and analyzed to understand the theoretical underpinnings and establish a foundational basis for the proposed model. The conceptual framework integrates key elements from two seminal models: the procedural model of information (Choo, 1998) and the AC model (Zahra & George, 2002).

In order to provide a framework that corresponds with the phases of the innovation funnel, the study uses a qualitative technique, emphasizing theoretical synthesis and conceptual integration. The body of research on open innovation, IM, and AC was compiled and interpreted using the narrative review as a methodological technique. Narrative reviews (Baumeister & Leary, 1997) provide a more flexible and interpretative approach than systematic reviews, which adhere to a predetermined protocol for data collection and analysis. This enables researchers to critically engage with a variety of theoretical perspectives and discover conceptual connections between various studies. This approach makes it possible to identify theoretical gaps and create a cohesive conceptual model by facilitating a thorough knowledge of the development of important concepts, combining knowledge from important studies and empirical research.

The process toward a conceptual model proposal involved a systematic synthesis of concepts from different domains to ensure that the resulting framework adequately reflects the complexity of IM and AC within open innovation projects. The primary goal of this methodology is to contribute to theoretical advancements, and provide actionable insights for both academic researchers and practitioners in public and private organizations engaged in innovation initiatives.

4. EMPIRICAL STUDIES OF ABSORPTIVE CAPACITY AND INFORMATION MANAGEMENT AND OPEN INNOVATION

This section discusses the concept of AC and IM as a necessary resource for this process that contributes to developing open innovation in the organizational context. Initially, Cohen and Levinthal (1990) and Zahra and George (2002) have already mentioned the importance of information for innovation. According to Lane et al. (2006) and Camisón and Forés (2010), the dynamism of AC is vital to improve the innovation performance of organizations, as well as enhance competitive advantage. Thus, studies that relate AC and innovation affirm that the use of knowledge external to the organization enables the increase and creation of new skills through the transformation of knowledge and/or its integration with the other resources of the organization (Camisón & Forés, 2010; Cassiman & Veugelers, 2006).

The concept of open innovation is related to the concept of AC when considering external knowledge as an important source for innovation. As organizations manage the internal and external information of their stakeholders, they need to develop an adequate IM infrastructure that allows integrating tools, techniques, and programs that will help the players involved in the process to share, collaborate, and communicate more effectively, making efficient use of information (Davenport & Prusak, 2000).

Tether and Tajar (2008) conducted a study to investigate organizations' main sources of information for innovation from specific sources of knowledge. Their main findings indicate that the main information can be found in specific companies or informal media sources. The authors point out that there are specialized sources of information in consulting companies, public or private teaching, and research organizations, and that more innovative companies usually consult these sources with a greater propensity for AC, more significant social capital, and relationship capacity.

Organizations that seek this type of knowledge usually use it to promote innovation, combined with previously existing knowledge in the internal organizational environment. The study also found significant differences between the sources of information used by industries

compared to service providers, which are more likely to use specialized knowledge. The latter mostly rely on hiring consulting services, rather than utilizing scientific research results and relationships with public universities (Tether & Tajar, 2008).

However, AC does not depend on a formal relationship with an external source of knowledge. This may come from reading an industry journal, trend analysis, and patent documents, among other forms. Most of the time, the innovations created in an organization are not new in the world, but new in the specific context of an organization. Thus, access to external sources such as consultants, experts, or professionals with previous experience in similar innovation projects can help promote the innovation process (Tether & Tajar, 2008). In the context of open innovation, the main source of information is one in which both parties are aware of the purpose of their engagement. Therefore, organizations must establish collaborative relationships with research groups, universities, consultants, and other relevant knowledge sources, working in synergy to develop innovation projects (Tether & Tajar, 2008).

Huang et al. (2015), in an empirical investigation of Chinese organizations, researched the main barriers to open innovation and identified that low AC is one of the factors that most inhibit this process. Spithoven et al. (2010) and Patterson and Ambrosini (2015) also corroborate, with their studies, that lack of AC can be considered a restriction to open innovation.

Naqshbandi (2016) indicates that for the success of the open innovation process, organizations need to have the capacity to absorb knowledge, acquiring, assimilating, transforming, and applying the knowledge acquired externally. Also, Naqshbandi (2016) highlights the importance of the organization's interaction with different players in its environment, universities, educational institutions, or even government agencies to acquire and positively take advantage of knowledge in open innovation practices.

Limaj and Bernroider (2019) aimed to investigate the relationship between AC and exploratory and exploitative innovation in the context of small and medium-sized enterprises. Their study found that PACAP has a direct impact on RACAP. Therefore, organizations need to build a strategic innovation mechanism that is initially based on the development of higher levels of AC. The authors believe that RACAP is the main way to promote innovation in organizations, contributing to the findings of Zahra and George (2002).

Lopes and de Carvalho (2018), from a literature review on open innovation, identified that organizations need to develop skills and AC to better take advantage of the results obtained through open innovation and generate competitive advantage. The authors suggest that AC is a relevant skill. The organization must invest time and resources to understand how best to acquire, assimilate, transform, and leverage information for business purposes.

Grama-Vigouroux et al. (2020) conducted a qualitative study with small and medium-sized companies to understand the importance of stakeholders' relationships in the open innovation process. Their findings suggest that using the multidimensional AC model is necessary to understand open innovation better. The open innovation process can be enhanced through AC, as the organization's relationship with its external environment and stakeholders demands the absorption of knowledge based on the dimensions of the ACAP construct.

The research evidence indicates that the organizations studied have developed initiatives to absorb knowledge from their external stakeholders. In an example firm, "its employees are motivated to capture external information related to market changes, technological advances, and external patents via their participation in various events such as exhibitions and conferences. Customer and supplier feedback is exploited to increase internal innovation" (Grama-Vigouroux et al., 2020, p. 6).

Furthermore, organizations have developed other initiatives and collaborative platforms to co-create and capture external knowledge to generate innovations. The main source of information for organizations is stakeholders: suppliers, universities, designers, and producers from other industries.

Small and medium-sized enterprises are increasingly becoming part of collaborative innovation networks. In this context, acquiring external knowledge from other players with different expertise is possible. Thus, it is possible to absorb this knowledge and increase organizational performance. Benhayoun et al. (2020) developed a study to identify and propose a scale for measuring AC for small and medium-sized enterprises in the context of innovation networks. As their main results, Benhayoun et al. (2020) identified that organizations could develop knowledge AC to co-develop and commercialize innovations with participation in collaborative innovation networks. Their findings show that acting in a collaborative environment promotes the development of AC and enhances open innovation practices. According to Naqshbandi and Jasimuddin (2022), when organizations have links with other external sources of knowledge, they can find and use

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necessary information along with information internal to the organization, thus promoting the innovation process.

5. CONCEPTUAL MODEL: CONSTRUCTION

Studies that examine the connection between IM and AC in the increasingly common collaborative setting promoted by open innovation practices are lacking from a theoretical standpoint. The findings of Teirlinck and Spithoven (2013), who note that large organizations typically do better in open innovation because of their greater maturity in AC, support this connection. The authors emphasize the significance of AC in fostering external collaboration and enhancing innovation outcomes, by claiming that small firms with greater internal R&D competence are also more inclined to participate in research cooperation and R&D outsourcing.

The work of Arsanti et al. (2024), which emphasizes regulating information flows within open innovation through absorption mechanisms and knowledge-sharing in collaborative contexts, is very different from the conceptual model put forward in this study. Our model takes a top-down approach by providing a structured integration of well-established theoretical frameworks for managing information and AC within innovation projects, whereas their study takes a bottom-up approach, emphasizing emergent and practical processes that naturally arise through dynamic interactions among actors. Specifically, our model highlights systematic processes and the sequential stages of the innovation funnel, providing a formalized perspective to guide innovation management. In contrast, Arsanti et al. (2024) focus on real-world applications, emphasizing how knowledge sharing and absorption unfold through the intermediary roles of actors across organizational boundaries.

The studies by El Maalouf and Bahemia (2023) and other related works reinforce the need for the proposed model by highlighting critical gaps in the literature. Their analysis identifies key support needs for managers regarding learning routines in the implementation of open innovation practices, emphasizing that only a limited number of recent studies have examined how organizations adjust their capabilities to effectively adopt open innovation (Pinarello et al., 2022; Zobel, 2017).

While previous research focuses on essential organizational capabilities—such as top management support, AC, project management, and dedicated open innovation teams—it overlooks the systematization of IM, a crucial step preceding knowledge absorption. This gap underscores the necessity of a structured approach to managing information flows, as effective open innovation relies not only on dynamic capabilities but also on organized processes that facilitate the acquisition, processing, and application of external knowledge.

The suggested approach overcomes these drawbacks by combining absorptive ability and IM into a unified framework. In order to strengthen open innovation processes and an organization's capacity to adapt to changing circumstances, this organized perspective seeks to assist businesses in methodically managing information flows.

By including key components from Zahra and George (2002)'s AC framework and Choo (1998)'s information process model, this study expands on this realization. By integrating these viewpoints, the model seeks to offer a thorough framework that unites absorptive ability and IM, providing useful advice for businesses looking to improve their open innovation procedures in a methodical manner.

Initially, Fig. 3 presents an approximation of the subjects based on the main concepts presented by the authors

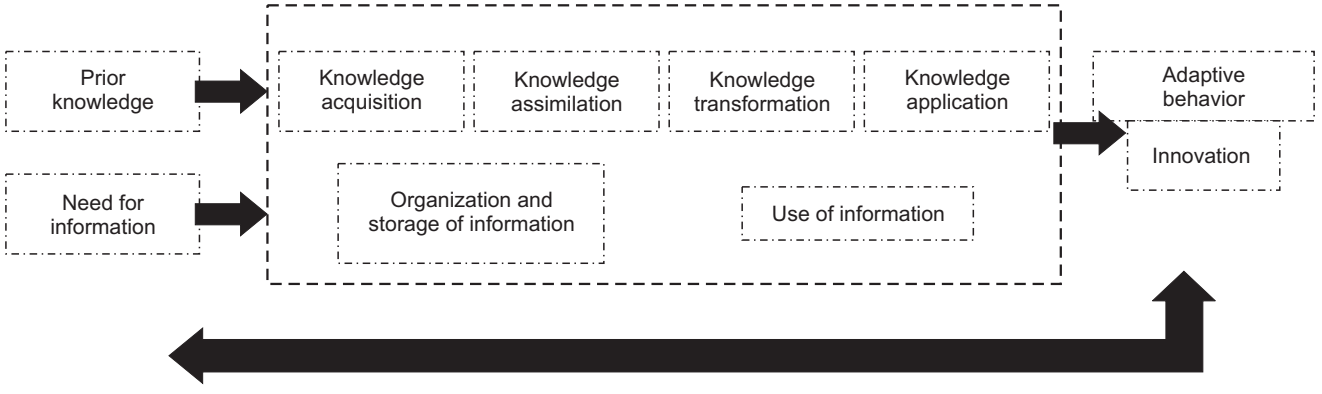


Fig. 3. Integration model: Information management X absorptive capacity.

mentioned above. Prior knowledge AC and identification of customer/user needs IM is the starting point for systematization by assuming previous experiences impact the current reality, whether these lessons are learned and/or consolidated skills. Similarly, new situations may cause the organization to need adaptation and/or respond to new demands, thus requiring the acquisition of new information.

Therefore, the process of potential AC (acquisition and assimilation) requires the social integration of players and organizational structures (AC), so that new information is organized and stored to make it available to all involved (IM).

For this new information to be used effectively, it is necessary that the organization also develops potential AC (transformation and application). This process of using information is developed through organizational routines, which are developed uniquely by each organization (IM). As a result, the exploitation/application of information transformed into knowledge promotes the organization's results in terms of performance, innovation, and competitive advantage (AC and IM). Thus, it is evident that organizations' adaptability and innovation capacity can come from the efficient use of information available in the environment.

Fig. 4 presents the construction of the theoretical model within the open innovation funnel, with the dashed edges to characterize the permeability with the external environment representing the opening dimensions: inbound, outbound, and coupled.

Stakeholders identified in Fig. 4 represent the potential partners existing in the organization's external environment in the different stages of the innovation process. In this path, different paths and possibilities may arise until the result of innovation is obtained, such as obtaining and/or licensing patents; obtaining external technology; developing partnerships for specific project activities; and generating spin-offs.

In the innovation process, the funnel includes four main stages: ideation, research, development, and commercialization. Inside the funnel are signaled the steps of the proposed model that integrates IM and AC. Here, it is worth mentioning that each step does not necessarily begin and end at the same stage of the innovation process, and so the passage inside the funnel is also dashed to represent such a situation.

Furthermore, it is important to emphasize that the widest part of the funnel represents the largest number of ideas and projects in the early stages of the innovation process, and that until the market is reached, the end of

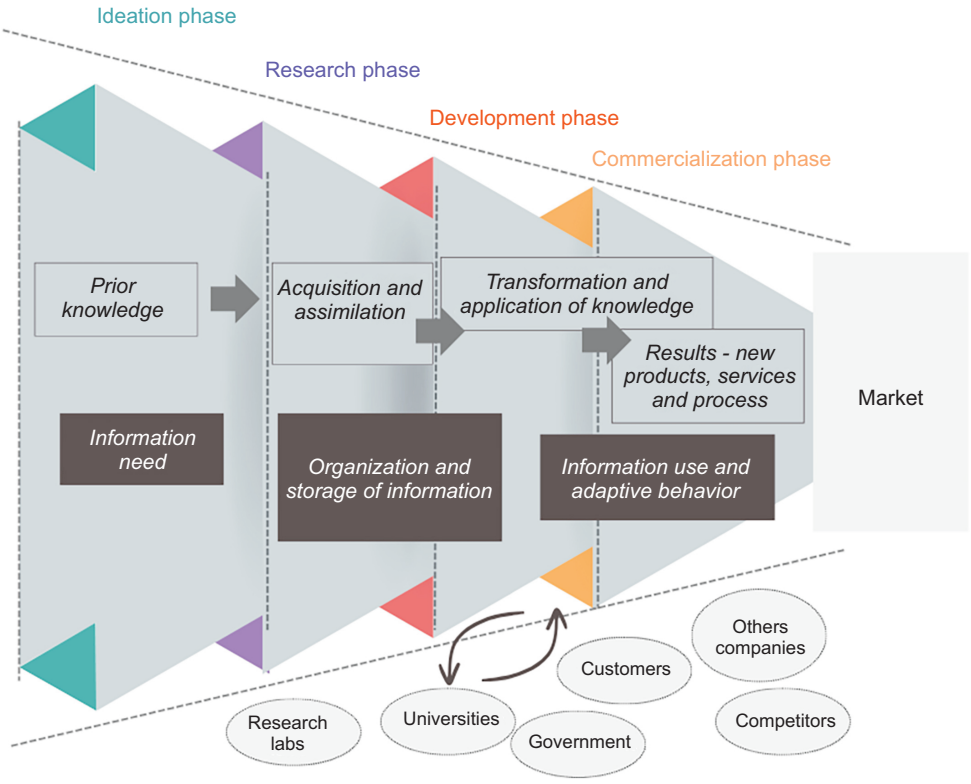


Fig. 4. Innovation funnel and integrated model of information & absorptive capacity.

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the funnel is smaller, also representing that not all ideas become innovations, for the most diverse reasons. Therefore, from left to right, the projects start in the research stage, requiring exclusively internal R&D efforts, and/or, with the collaboration of external partners, advance to the development phase that already denotes a greater maturity and consistency of the project. The arrival at the commercialization stage implies that many filters (screening) have already been applied internally. Only the most promising innovations are ultimately brought to the market, as they are initially perceived to have greater chances of success. During the ideation stage, prior knowledge and the identification of needs strengthen the activities inherent to the creative process of formulating new ideas. Considering the interaction with the external environment, it is important to recognize that ideas can originate from both internal and external sources. It is crucial to keep on the radar for new trends and consumer/user behaviors that may indicate needs to be met. Similarly, prior knowledge of the organization can be harnessed to generate insights from new projects. Knowledge about a market in which the organization already operates can generate new insights for adaptation in new markets.

The research stage is also characterized by the organization's strong relationship with its stakeholders and external environment. The participation of universities through scientific research that generates results for the initial stages of product/service development and innovative processes to be implemented by organizations stands out. At this stage, potential AC is evidenced through the acquisition and assimilation of knowledge. These are essential factors for initiating the project, verifying its technical feasibility, and assessing whether the organization's existing conditions are adequate. This process requires analyzing the knowledge to be acquired and generating new knowledge resulting from its assimilation. The organization and storage of information are supported in this activity by allowing timely access to useful and appropriate information at the project stage. Information support, in this case, may or may not be through its own systems or contracted by the organization, but it also includes all support in basic formats that the organization already uses, such as free platforms.

In the development stage, the acquisition and assimilation of knowledge still occurs and may also be associated with a moment of greater maturity of the project in technical terms, with a bias of approximation to the market potential. At this stage, fundamental activities include analyzing and assessing the business's potential and viability. This characterizes the phase of potential AC, in which knowledge is transformed and applied to support a practical understanding. Activities such as prototyping and testing with potential customers or users typically come into focus during this phase. Additionally, the use of information and the adoption of adaptive behaviors are closely related to the sharing of knowledge.

The inter-organizational sharing of information is necessary in the context of working in partnerships. As Davenport and Prusak (2000) points out, the best exploitation environment is one in which everyone performs data collection and then shares the information obtained. Collaboratively defining an organization's informational requirements helps raise awareness that information is valuable; the correct format makes it easier to distribute.

Therefore, this task is also important for exchanging knowledge between partner organizations. The exchange of ideas and information promotes a dynamic process of information flow. To the extent that organizations establish partnerships to develop new products and services, their partners' knowledge is incorporated in the same context. From this connection, new knowledge can be generated.

It is expected that new products, services, and/or processes will result after the development stage, following the natural course of a project that has followed the intended stage. It should also be considered that some projects, even those in a more advanced stage, may not proceed to the commercialization stage of the market. In this case, the organization may obtain other results, such as learning from the project development cycle, the realization of partnerships that may be continued or intended in other projects, the development of patents that although not being used at that time may be commercialized and/or used later, or learning about new markets and consumer profiles.

When analyzing the proposed model, it is important to highlight that the IM process and the stages of AC are enhanced while enhancing the development of the open innovation environment in organizations. It is also possible to affirm that the concepts of IM, AC, and prior knowledge investigated here can be considered multidimensional constructs and that the different stages of IM and AC can generate innovation results.

6. CONCLUSION

The theoretical model that integrates IM and AC in open innovation results from a cyclical and non-linear

process. That means IM → ACAP → Open Innovation. It was found that the different stages of IM and the routines created for developing AC need constant dialogue and access to the external environment to promote the proper functioning of open innovation practices, which can also be affected by other external factors. The stages of IM and ACAP can occur at different stages of the open innovation process.

Thus, this study contributes to the existing theories initially conceived for their linear characteristic. In this article, we propose that IM flows and the stages of acquisition, assimilation, transformation, and application of knowledge can occur recursively and not necessarily following the order previously defined when it comes to open innovation processes.

This study also reinforces the understanding of managers who adopt and implement open innovation practices, bringing ways to systematize the innovation process with attention to the 'information' resource as support for AC. We understand that many routine actions are performed nowadays without a systematization that prevents better results or even inhibits the continuity of partnerships and collaborations in the face of experiences that will not occur as expected.

The importance of this conceptual model lies in its ability to bridge gaps between the fields of IM, AC, and open innovation, providing a structured approach to understanding how these elements interact within innovation projects. By integrating the procedural model of information and the AC framework, the model offers a comprehensive perspective on how organizations can effectively manage information flows and enhance their ability to recognize, assimilate, and apply new knowledge. This synthesis not only supports the theoretical understanding of these concepts but also has practical implications, helping organizations optimize their innovation processes, improve decision-making, and ultimately enhance their competitiveness in an increasingly knowledge-driven economy.

In summary, the practical implications of the conceptual model presented in this study emphasize its potential to serve as a systematic framework for organizations implementing open innovation. By combining IM and AC, the model supports organizations in managing information flow more effectively, enhancing their ability to acquire, assimilate, transform, and apply new knowledge considering open innovation practices. This structured approach could facilitate better decision-making, boosts innovation outcomes, and aids in developing sustained competitive advantages.

Considering the plan to instrumentalize the theoretical model, some referrals are foreseen in the continuity of this study and can be mentioned here: 1. Validate the conceptual model proposed here from empirical studies; 2. Empirically assess the importance of IM, AC, and the impact on the innovative performance of organizations; 3. Investigate in more depth the nonlinearity of IM and AC in the context of open innovation with organizations from different areas of activity; and 4. Establish partnerships with companies interested in participating in the pilot development of the applicable instruments.

CONFLICTS OF INTEREST

No potential conflict of interest relevant to this article was reported.

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Cross-Platform Content Distribution Behavior: A Qualitative Analysis of YouTube Creators' Video Content on the Chinese Video Streaming Service Bilibili

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ABSTRACT

This study investigates the practices of Western YouTube content creators' cross-posting behavior, i.e., uploading their content on Bilibili—a Chinese video-sharing platform. A qualitative content analysis is employed to analyze videos of 14 popular YouTubers to compare the content of videos posted on both platforms. The findings indicate that the content differs for both platforms, possibly to accommodate Chinese viewers. The results show that Western YouTubers have made multiple changes to their original content before reuploading them to Bilibili, including the addition of Chinese subtitles, cut-out sponsorship content, shorter and translated descriptions, altered thumbnails, and exclusive content for Bilibili. The results also show a less frequent uploading schedule on Bilibili than on YouTube. While existing studies have explored content creators' cross-posting behavior within the same social media ecosystem, the study significantly contributes to advancing our understanding of online creators' content distribution practices across platforms in different cultural domains, especially in a Chinese-Western context.

Keywords: Bilibili, China, cross-platform, video content, Western, YouTubers

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1. INTRODUCTION

Due to cultural, legislative, and regulatory differences, widely used Western websites—i.e., in North America and Europe (Rieder et al., 2023)—such as YouTube and Facebook are not universally accessible, with China being a notable example. On the other hand, China has developed their own social media platforms that are equivalent to ones in the West, such as Bilibili. Bilibili is the largest video-sharing platform in China, with content generated and shared mainly by Chinese content creators across various categories such as games, news, music, and animation (Zheng et al., 2023), similar to those uploaded on the video-sharing platform YouTube. While video sharing is Bilibili's main function, it also has unique technical functions for user engagement compared to YouTube. For example, "Danmaku" allows users to input comments at specific timestamps on a video and let them move across the screen for other viewers to see asynchronously or synchronously, making those comments part of the video viewing experience (Zhang & Scheibe, 2023). As of the second quarter of 2024, Bilibili has gained over 102 million average daily active users in China (Thomala, 2025).

1.1. Cross-Posting as a Growing Trend

While Bilibili is the main video platform in China, content creators producing videos (professionally) for YouTube, called YouTubers, have recently also started to post their content on Bilibili. This practice of distributing (user-generated) content is called cross-posting, e.g., the same videos can be separately uploaded on TikTok, Instagram Reels, and YouTube Shorts (Abidin, 2020; Thomas et al., 2022). Cross-posting has become frequent, and professional users such as major companies, politicians, celebrities, or public institutions apply these practices for varying purposes, e.g., on Facebook and Twitter (Farahbakhsh et al., 2016). One of the goals of cross-posting is to significantly increase audience engagement. For instance, audience feedback varies widely depending on the platform, indicating that even identical content from the same brand will receive different reactions based on the platform used, which was discovered in studies involving YouTube, Facebook, and Twitter (Roma & Aloini, 2019; Smith et al., 2012). Smith et al. (2012) noted that the audience of a popular brand's YouTube account generally exhibits a more positive sentiment than compared to its respective Facebook and Twitter accounts. This difference may be attributed to the distinct features of the platforms, where Facebook and Twitter encourage conversation and link-sharing more than YouTube.

1.2. Creator Ecology and Platform Adaptation

Cross-posting on several platforms is an important aspect of the "creator ecology." Posting user-generated content, prioritizing platforms, synchronizing content across various platforms, and managing the audience are crucial practices of this ecology (Ma et al., 2023). However, producing content for several platforms can be time intensive, where the content needs to be adapted to various features, also keeping in mind creator tools, recommendations, and monetization algorithms. Ma et al. (2023)'s findings indicate that adapting strategies for the right platform is important in order to find a balance between selective labor and excessive labor. Levina and Arriaga (2014)'s argument supports the idea that different social media platforms offer various forms of capital, influencing creators' behaviors when cross-posting.

Considering this for our study, given the disparities between YouTube and Bilibili in terms of user base and interface elements, it is conceivable that YouTubers adapt their content and strategies for cross-posting on Bilibili. For example, Zhang and Scheibe (2023) noted that YouTubers often edit textual elements and video outros to suit the Bilibili audience, though their study was limited to two creators.

1.3. Regional Differences in Platform Features

Not only might the behavior of users differ between the platforms, but the functionalities of the platforms vary as well. The literature indicates that even social media platforms within the same category may be implemented very differently depending on the region of the world. For example, live streaming services illustrate this regional divergence well. In Western markets, live streaming services generally employ fewer gamification elements, such as leaderboards and virtual gifts, compared to their counterparts in China. In China, live streaming services widely utilize a broad array of gamification features to cater to the diverse tastes of their cultural market (Zimmer et al., 2020). Even though the content disparity between the two markets of live streaming services was not analyzed, it is striking that different cultures might prefer distinct aspects within specific services.

However, the literature does not investigate cross-cultural cross-posting activities in greater detail yet, which our study aims to do. Where the content is posted to platforms accessible in the West, such as from Facebook to Twitter, cross-posting content from YouTube to platforms

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such as Bilibili in China remains mainly unexplored. The first research approaches note adjustments made by Chinese creators when cross-posting from Chinese to Western platforms to enhance visibility (Meng & Nansen, 2022), but the specifics of these adjustments were not identified.

1.4. Research Objectives and Contributions

Given this research gap, the current study builds on Zhang and Scheibe (2023)'s work by examining a broader range of YouTubers. Zhang and Scheibe (2023) found that YouTubers adapted their content for Bilibili, including editing textual elements and the video "outro." However, the research only drew results from two YouTubers, which resulted in narrow outcomes. Therefore, building upon Zhang and Scheibe (2023), this new research aims to investigate a wider range of YouTubers, paying special attention to the content that has been cross-posted as well as the uploading schedules of the creators, keeping in mind the creators' workload (Ma et al., 2023).

Considering the significant differences between Bilibili and YouTube in platform features and primary viewer bases, this study seeks to deepen our understanding of the interplay between culture and platforms. Specifically, it focuses on the challenges and dynamics of distributing content across multiple platforms, with an emphasis on the Chinese-Western perspective. This study adheres to the categorization of "Western" similar to Rieder et al. (2023), focusing on the creator economy in regions including North America, Europe, and Oceania.

Owing to these observations and considerations, the research question (RQ) is:

RQ: What differences can be observed between the content cross-posted by YouTubers from YouTube on Bilibili?

This study makes multiple original and significant contributions to knowledge and practices. First, the study contributes to the existing literature on multi-platform content creation and a new understanding of online content creators' evolving practices to adapt to platforms of multiple ecosystems. Second, the findings can be developed into new practical guides for Western YouTubers or other content creators who wish to cross-post their content to BiliBili as a platform in a different social media system domain to reach Chinese audiences and broaden their viewer bases. Third, the findings could also provide significant and valuable insight for Bilibili, with the potential to develop guidance and support for content creators outside China to build their channels or cross-post their content on the platform.

In the following section, the methods for the analysis of comparing YouTubers' cross-posting behaviors are explained in detail. This is followed by the qualitative results and finishes with a discussion of the results.

2. METHODS

A qualitative content analysis, a method commonly used for in-depth analysis of visual media content (Baxter et al., 1985; Bell, 2004; Griffith & Papacharissi, 2009), including YouTube content (Tarnovskaya, 2017; Zhang & Lee, 2023), was conducted. This approach enabled a detailed comparison of cross-posted content on YouTube and Bilibili to identify consistent patterns and common themes (Patton, 2002; Zhang & Wildemuth, 2016) related to content differences. Content analysis is a suitable method to compare the similarity of video content in such detail. To select the YouTube content creators, two rigorous steps were implemented. First, a list of top content creators was identified based on various rankings, top lists, and related news reports (Borak, 2020; Chi, 2023; Pan, 2023; Thakran, 2023). Second, the YouTubers on that list who also have official Bilibili channels were identified by searching the same YouTubers' channel names on Bilibili. For the analysis, the videos of YouTube content creators who have set their YouTube location to a country in the Western region and also have an official account on both platforms, YouTube and Bilibili, were considered. All identified YouTubers who also have a Bilibili account were included in the analysis, resulting in a number of 14 Western YouTubers in total. We were not able to identify other Western YouTubers who also upload their content to Bilibili.

A combination of a directed and conventional approach was carefully applied for the qualitative content analysis. The directed approach allows us to code YouTubers' content using a pre-developed coding scheme based on the findings of our earlier research (Zhang & Scheibe, 2023). Here, the content categories were developed by viewing different cross-platform videos on YouTube and Bilibili and comparing their differences and similarities, respectively. The conventional research method allows us to further identify potential differences and patterns between the YouTube and Bilibili uploads beyond the pre-existing codes that may not have been captured in prior studies (Hsieh & Shannon, 2005). Table 1 shows all the

Table 1. Overview of categories and descriptions for content analysis of YouTubers' cross-posting behavior

Category	Description
On-screen texts	Textual elements appearing directly on the video screen including captions, labels, titles, and other pertinent information displayed within the video
Subtitles	These are text-based translations or transcriptions of spoken dialogue in videos, assisting viewers in understanding the content, particularly if it is in a foreign language or if there are audio challenges
Thumbnail design	Thumbnails are small images representing the video, serving as previews before viewers click to watch
Intro design	The video intro, the opening segment, establishes the content's tone, often featuring branding elements, music, and visuals that introduce the channel or topic
Outro design	The video outro, appearing at the end of the content, typically includes calls to action (like subscribing or visiting a website) and may feature related videos, end screens, and contributors
Advertisements	Advertisements within the video content can be pre-roll (before the video starts), mid-roll (during the video), or post-roll (after the video ends)
Video content	This refers to the main body of the video—the actual content being shared with the viewers
Watermarking	Watermarks, which are semi-transparent logos or text, are placed on the video to identify the creator or brand and help deter unauthorized content use
Video description	The video description, located below the video, provides additional context, links, and relevant information about the content

codes and categories generated from the analysis. Concerning the subtitle category, in China there are groups of *subtitlers* who are usually responsible for providing translations and subtitles for content posted on online platforms but in foreign languages. This is also true for Bilibili videos, where these communities or groups collaborate with YouTube creators to translate their work and add their names to the video outro as a form of credit and recognition.

The data collection of videos was carried out on November 14, 2023. The content of the same videos uploaded by YouTube creators on YouTube and Bilibili was thoroughly watched and analyzed by two researchers (coders) independently during a period of about five weeks, starting November 15, 2023, until December 23, 2023. The researchers were trained with a small dataset beforehand. The videos considered for this analysis are the creators' most viewed ones on Bilibili that were available on YouTube, the first videos that were uploaded to Bilibili and were available on YouTube, and the latest ones on Bilibili that were also available on YouTube. Analyzing the most-viewed videos offers insights into popular content, while the first and latest uploads capture changes in cross-platform posting behavior over time. In total, the content of 14 YouTube creators and 82 videos were evaluated (Table 2). All in all, six videos were analyzed per content creator, with three videos on each platform, excepting the channel *Rachel's English*, as its first video and most watched video on Bilibili are the same. Additionally, the video uploading schedule was reviewed by monitoring the uploading date of the same videos on both platforms. This allowed us to get an impression of the YouTube creators' video-uploading behavior. Furthermore, the channels were checked for content that has solely been uploaded to one of the platforms (exclusive content). The data of the observation were noted in a checklist and table for coders; however, the coders have always added further details about the video content changes and similarities observed. The results of the analysis were discussed and agreed on during meetings of the two coders after each coder decided on the applicable categories independently.

3. RESULTS

3.1. On-Screen Texts

On-screen texts refer to text incorporated into the video by YouTubers as part of their video content (Table 3). We observed that when cross-posting YouTube content to Bilibili, some YouTubers tend to add Chinese on-screen texts to their videos. There are two forms of Chinese on-screen texts. The first type is Chinese text used as a translation of the original English text. For example, in *Pamela Reif*'s workout videos, she replaced the workout movement names with Chinese translations from the original English text (Fig. 1). Instead of replacing English with Chinese, *Life of Boris* directly adds Chinese translation alongside

Table 2. Overview of YouTube creators channel names, the creator's location, video genre(s), and number of exclusive videos on Bilibili

YouTube name	Bilibili name	Location	Genre	Exclusive videos on Bilibili
PattyCake Productions	PattyCake官方频道	USA	Entertainment, music	3
Alan Becker	火柴人AlanBecker	USA	Animation, comedy	1
Viva La Dirt League	土团联盟VLDL	New Zealand	Entertainment	1
Pamela Reif	帕梅拉PamelaReif	Germany	Fitness	12
Life of Boris	鲍里斯的日常	Estonia	Life, gaming, comedy	1
Rob Landes	RobLandesMusic	USA	Music	6
Veritasium	Veritasium真理元素	USA	Science	0
CaptainSparklez	MC火花队长_官方账号[a)]	USA	Gaming	1
Donut	Donut_Media	USA	Automotive	2
Rachel's English	瑞秋英语Rachel	USA	Education	3
GaryVee	GaryVee加里维纳查克	USA	Motivation, entrepreneurship	1
BRIGHT SIDE	BrightSide亮生活	Cyprus	Knowledge	0
Linus Tech Tips	LinusTechTips	Canada	Technology	0
NikkieTutorials	NikkieTutorials	The Netherlands	Beauty	3

[a)]As of publication, the Bilibili channel ID of *Campain Sparklez* has been canceled, although the videos are still available on the site.

Table 3. Overview of the differences between cross-posted video content on Bilibili and originals on YouTube

Category	Cross-posted content on Bilibili	YouTube originals
On-screen texts	Chinese on-screen texts	Original English on-screen texts
Subtitles	Embedded Chinese subtitles	English or multi-language captions
Thumbnail design	Original/altered images and Chinese texts	Original images and English texts
Intro design	Cut or shortened intro from the originals Chinese intro replacing the original intro Intro made by subtitler groups	Uncut original intros
Outro design	Bilibili engagement metrics-oriented outro design Cut or shortened original outros Subtitler added outro for credits	YouTube engagement metrics-oriented outro design Uncut original outros
Advertisements	No interruptive ads	Interruptive ads
Video content	Adjusted original content (cut or shortened) Revamped/replaced original content	Original content
Watermarking	Embedded with consistent Bilibili-branded watermarking	Diverse/personalized watermarking or no watermarking
Video description	Chinese video description Shorter or no video description Chinese/Bilibili viewer-oriented video description	English video description Long video description YouTube viewer-oriented video description

the English on-screen text. Apart from translation, there are also additional Chinese on-screen texts added to the video; these texts are normally added by Chinese subtitler groups. They partner with YouTubers to translate their videos, add subtitles, and include their group members' usernames on the video as a form of promotion and credit for their work, separate from the main video.

There are also cases where YouTubers did not translate



Fig. 1. Screenshot of one analyzed *Pamela Reif* video from (A) Bilibili vs. (B) YouTube.

or add additional on-screen texts to their videos. Some are due to the original videos not having on-screen texts in the first place, while others may do so based on the nature of their video. For example, *Rachel's English* tends to show various English words on-screen for the English learners in her original video, but there is no Chinese translation added to these words in the BiliBili version of the video since there are already Chinese subtitles added to it. Some videos do not initially have on-screen text, like *Alan Becker*'s animation videos. Overall, a variety of practices regarding on-screen text when cross-posting to Bilibili were found, but adding Chinese texts is among them when YouTubers cross-post their content to Bilibili.

3.2. Subtitles

There is a common pattern across the practices of YouTubers in which they added Chinese subtitles (Table 3) to the cross-posted videos on Bilibili. Some of these subtitles are Chinese-only, but others are a combination of Chinese and English subtitles on top of each other to make the videos more accessible to Chinese viewers. Although some YouTubers include Chinese and other languages as YouTube captions, on Bilibili these subtitles are embedded into the video content and cannot be turned off through the platform's interface. Not only subtitles are added, but YouTubers also change their video titles from English to Chinese or add Chinese titles in addition to English titles. Only a few YouTubers in our analysis did not add Chinese subtitles. For example, the latest video by *CaptainSparklez* does not have Chinese subtitles, but has Chinese captions generated by the artificial intelligence (AI) function on Bilibili. However, this video has significantly fewer views on Bilibili (over 1,000 views) compared to the original YouTube version (over 80,000 views). Some videos do not have subtitles in their original format, such as animation videos by *Alan Becker*. However, overwhelmingly in our analysis, when YouTubers cross-post their video to Bilibili, if there are dialogs in the originals, Chinese subtitles are added to the cross-posted content.

3.3. Thumbnail Design

Two types of differences were spotted in the thumbnail design (Table 3) between the original YouTube videos and the ones cross-posted to Bilibili. The first difference involves changes to the text on the thumbnails. If the original YouTube thumbnail is a combination of a premade image and English text, the thumbnail for the cross-posted video on Bilibili consists of the same image but replaces the English text with Chinese text. The second difference is the alternation of the image design and sometimes the text, meaning that in addition to changing English texts to Chinese, the image used for the thumbnail is also changed. For example, *Pattycake* simplified one of their original YouTube music video thumbnails when posting it on Bilibili. *Viva La Dirt League*, while switching their thumbnail texts from English to Chinese, also changed the thumbnail image. *Rachel's English* also followed a similar practice, with a different design and color scheme used for her Bilibili cross-posted video in comparison to the YouTube original. YouTubers who do not make any changes to the thumbnail design were also spotted.

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3.4. Intro Design

Most of the videos that were analyzed either do not have an intro or have no changes in the intro (Table 3) between Bilibili and YouTube. However, a few YouTubers did alter their intro design for their Bilibili versions. These changes fall into three categories. The first is cutting out part of the original video intro in the Bilibili version. This has happened on two occasions. One is when there is information about the sponsors added to the intro, which may not be available for Chinese viewers. For example, the videos from *Rob Landes* and *Linus Tech Tips* both have sponsor messages cut out from the original video when posted to Bilibili. Another alteration is a shortened version of the intro, which happens in some of the *Bright Side* videos. The second kind of change is similar to subtitling and on-screen texts, which is replacing English texts in the YouTube intro with Chinese text for accessibility, which is specifically present in *Pamela Reif*'s workout videos. The final kind of change is usually made by the subtitlers when translating the cross-posted videos for YouTubers, who add the group members' names to the intro as a form of credit.

3.5. Outro Design

Similar to the intro design, changes made to the outro design (Table 3) were also detected. Some YouTubers replace the YouTube-style outro with a more Bilibili-oriented one. YouTube-style outros are designed to accommodate the interface of YouTube and its engagement metrics. For example, creators use graphics and text at the end of the video to encourage viewers to subscribe to the YouTube channel or like the video. When cross-posting the videos, YouTubers tend to replace the ending with one that accommodates more to the Bilibili platform design. For instance, instead of asking viewers to subscribe to their YouTube channel like in the original video, *Viva La Dirt League* asks viewers to "give coins," "add the video to favorites," and "give thumbs up" to the video, which are all part of the engagement metrics design on Bilibili. Similarly, *GaryVee* shared his Chinese social media site logos at the end of his video on Bilibili, instead of asking for YouTube subscribers as shown in his original YouTube video. As with the intro design, some YouTubers also cut out sponsorship information or promotional content from the outro in the Bilibili version if it does not apply to Chinese viewers. For example, the YouTube channel *Donut* cut out the part where they are promoting merchandise in the outro of the Bilibili video version. The final difference made is the addition of the subtitlers' information. Sometimes on Bilibili, the subtitler groups who are responsible for translating YouTubers' content on Bilibili will add their name to the video outro as a form of credit and recognition. In addition, just like with the intro, there are also YouTubers who made no changes to the outro.

3.6. Advertisements

There are two types of advertisements (ads) (Table 3) that were found in this analysis: Those added by the platform and the ads incorporated by the YouTubers. When it comes to ads included by the platforms, all of the YouTubers' original videos on YouTube have ads (unless with Premium subscription), which interrupt the video during video consumption, except for "YouTube Shorts." However, in the videos cross-posted on Bilibili, there are no interruptive ads. This may be due to the design differences between the two platforms. The ads added by YouTubers as part of their videos are mainly sponsorship and merchandise promotion. In this analysis, YouTubers tend to cut out the sponsorship and self-branding content from the original video when they cross-post it on Bilibili, e.g., if the promotion is not available in China. At the end of *Pamela Reif*'s YouTube workout videos, she usually promotes her workout music playlist available on the music streaming service "Spotify." However, in the Bilibili video versions, such a promotion is removed, perhaps because Spotify is not available in China, along with some other social media sites.

3.7. Video Content

Video content refers to the main content delivered to the audience (Table 3). The results show that when cross-posting the original videos to Bilibili, sometimes a few minutes of the content in the original YouTube video will be adjusted for the Bilibili version. The first kind of adjustment is cutting out original content, especially the related promotions and sponsorship content that may not be meant to target Chinese audiences. YouTuber *Veritasium* also goes further by replacing the original sponsorship part of the video with a promotional video filmed by one of the Chinese subtitler group members, in which she recommends different YouTubers that they are collaborating with on Bilibili. As for other promotions, *NikkieTutorials* removed the giveaway and rewards promotion about her self-branded makeup palette, *Donut* has cut out their merchandise content, and *Pamela Reif* removed her Spotify playlist promotion from the original YouTube video. The second kind of content change is a larger-scale revamp of the cross-posted version, which is specifically done by

Bright Side and *GaryVee*. All the *Bright Side* videos uploaded on Bilibili are fully converted to Chinese, which includes audio voice-over and Chinese text, different from their original YouTube videos, which are all in English. As for *GaryVee*, one of his short videos was turned into an animation on Bilibili with the original audio from the YouTube version. While the practice of removing content may be more related to avoiding confusion and misunderstanding, the revamped practice seems to be more tailored towards Chinese viewers. However, there are videos with no content changes at all.

3.8. Watermarking

Watermarking is a feature on Bilibili as a form of copyright protection that creators can add directly when uploading videos (Table 3). The watermark usually consists of the Bilibili logo and the Bilibili channel name (Fig. 1). Only a few YouTubers' videos on Bilibili do not have this kind of watermarking. In terms of the original video, the practice varies. Some YouTubers have their own watermark on their YouTube videos while others do not, although YouTube also offers the watermark feature. The consistent use of watermarks on Bilibili may be because Bilibili users tend to pirate and re-upload YouTubers' videos on Bilibili without consent and permission. This has been mentioned by *Linus Tech Tips* in one of their streams (Linus Tech Tips, 2019). Overall, watermarking on Bilibili is a common practice for most YouTubers in comparison to their content on YouTube.

3.9. Video Descriptions

As for video descriptions (Table 3), there are prominent differences between the descriptions under the original video and the ones on Bilibili. The first difference is related to language, where the YouTube video descriptions are in English (with some appearing to be in other languages based on the YouTube region), and the Bilibili descriptions are in Chinese (Fig. 1) or both, English and Chinese combined. When it comes to the content of the description, YouTube descriptions are usually longer, with not only descriptions of the main content of the video but also with more promotion added, such as the YouTubers' social media links, other streaming platforms, and merchandise shops. The descriptions on Bilibili, however, are generally short. This sometimes may be because Chinese sentences and paragraphs may appear shorter than English texts, due to the nature of the language, but the analysis showed that those descriptions usually only contain information about the video content, with occasional inclusion of some credits such as production teams and subtitle groups.

Some YouTubers on Bilibili also have unique interactions with Bilibili viewers which YouTube descriptions do not have. For example, *Pamela Reif* indicates she hopes her Chinese is okay for the Bilibili viewers. *Rachel's English* especially addresses viewers in Chinese in one of her video descriptions on Bilibili, indicating how she is pleased that so many Chinese students like her English learning videos. Some YouTubers, such as *Life of Boris*, also include a link to the original YouTube video in the Bilibili description, possibly as copyright protection. The subtitler group that helped to translate some YouTubers' videos also included their information in some descriptions as well, either as credits or for promotion. In addition, some of the videos on Bilibili do not have any descriptions, which is specifically observable in, for example, *Viva La Dirt League*'s newer videos.

3.10. Exclusive Content

As shown in Table 2, out of 14 YouTubers, 11 of them offer exclusive content that is only available on Bilibili. One common format is introduction videos in which YouTubers introduce themselves to the Bilibili viewers and welcome the viewers to their Bilibili channels. These videos can be purely introductory, such as the one produced by *Viva La Dirt League* and *NikkieTutorials*, with the sole purpose of introducing themselves to viewers (Fig. 2). Alternatively, the videos can combine introductions with cross-posted YouTube content. For example, *Alan Becker*'s introduction video starts with him saying "hello" to the viewers in Chinese, with a few self-introductions in English, followed by an animation he uploaded on You-



Fig. 2. Screenshot of the exclusive *Viva La Dirt League* video about them joining Bilibili.

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Tube before. Another form of exclusive content is videos specifically made for Chinese viewers. *Rachel's English* uploaded videos of her reacting to Chinese celebrities speaking English. *Donut* made a video for "520" day, which is a day that is similar to Valentine's Day in China due to the Chinese pronunciation of "520" being similar to "I love you" in Chinese. *NikkieTutorials* created question-and-answer (Q&A) videos for Bilibili viewers to answer fan questions, along with her Chinese New Year video. *Rob Landes* created an AI-generated Chinese voice-over video, along with some newly created videos made from old YouTube videos for the Bilibili channel. He also shared videos from the official Bilibili channel in which he performed at Bilibili music festivals.

However, among all the YouTubers, *Pamela Reif* has the largest number of exclusive videos on Bilibili (12 videos). These videos are tied to her visit to China in 2023 and her various partnerships with Chinese brands. For example, she has videos collaborating with Chinese celebrities; workout videos integrating Chinese music, martial arts, and workout therapy concepts; videos sponsored by Chinese brands "Huawei" and "Jingdone"; and her food and beauty brand promotions. In comparison to other YouTubers, it seems *Pamela Reif*'s exclusive practice on Bilibili is beyond cross-posting, but forms a deeper integration within the Chinese streaming and online influencer economy ("wanghong" 网红 economy) and ecosystem. Another exception is *Linus Tech Tips*. While they do not have content that is only available on Bilibili, several of their technology reviews involve Chinese products. On YouTube, they also live streamed their opening of the Bilibili "play button," a reward like the YouTube "play button," acknowledging the accumulation of a certain number of subscribers or fan base on YouTube and Bilibili. The recording of the stream is also available on their Bilibili channel. Overall, the results showed that most of the analyzed YouTubers create exclusive content on Bilibili.

3.11. Uploading Schedule

Finally, when it comes to uploading schedules, a general pattern emerged in which the uploading schedule of the Bilibili video version is usually behind the original YouTube video. This may be due to the amount of post-production and editing that needs to be done before the content is cross-posted to Bilibili. Two videos from *Alan Becker* are on the same schedule as the Bilibili upload, maybe because they are animation videos, only having moving images and sound without dialog, therefore not needing further post-production for Bilibili.

4. DISCUSSION

This is one of the first studies that explored the cross-cultural cross-content posting of Western YouTubers on the Chinese video-sharing platform Bilibili. A content analysis was employed, investigating the behavior of 14 famous YouTubers, based on the number of subscribers. The results overall are in line with and consolidate a previous analysis of two YouTubers (Zhang & Scheibe, 2023). With more video samples analyzed and focusing on the video content as well as the uploading schedule of the creators, extensive and new findings have emerged.

Concerning the research question of what differences can be observed between the content cross-posted by YouTubers from YouTube on Bilibili, the analysis reveals multiple differences in the cross-posted content (Table 3). Most of these changes involve YouTubers adding Chinese translations and expressions to their videos, including on-screen text, subtitles, text within the thumbnail design, video descriptions, intro and outro text, and Chinese voiceovers. Reasons for this might include an intention to adapt the content for Chinese viewers by overcoming language and communication barriers.

The YouTubers studied made their content more accessible to Bilibili audiences, including Bilibili platform features and China's overall social media landscape. This includes cutting out sponsorship content and relevant promotions that may not be available in China; replacing YouTube-style promotions (e.g., "like and subscribe") with the ones that accommodate Bilibili's features (e.g., "give coins," and "thumbs up"); and promoting their Chinese social media platforms like "Weibo."

The Chinese subtitler groups that collaborated with YouTubers to translate the videos have played an important role in the shaping of YouTubers' cross-posted content. This includes adding their promotional details (e.g., credits, descriptions) to YouTubers' videos, or even adding their own content on top of the original video.

In addition, due to the platform design, there seem to be no interruptive ads on Bilibili in comparison to ads on YouTube (without Premium subscription). Finally, we found watermarking as a form of copyright protection as a common practice for YouTubers who cross-post to Bilibili.

Our results have the following significant contributions and implications.

We have significantly expanded the literature concerning cross-platform distribution of user-generated content. Previous researchers (Roma & Aloini, 2019; Smith et al., 2012) unveiled that due to the feature differences across

multiple platforms including Facebook, Twitter, and YouTube, user-generated brand-related content and audience response to that content are diverse. Our study further unveils that when users cross-post their content to platforms in different cultural domains including from YouTube to Bilibili, creators tend to alter the original video content to make it conform to the platforms' viewer bases, or remove certain content that may be irrelevant.

The results also expand our understanding of the creator-ecology. Previous research has stated that content synchronization based on platform features by cross-posting content to multiple social media platforms through proper editing is an important practice in establishing a creator ecology (Ma et al., 2023). While our study indicates that certain editing has been done by YouTubers when cross-posting, it reveals that creators are aware of how adapting the content to Bilibili's Chinese viewers is an important aspect. By adding Chinese translations, expressions (e.g., subtitles, on-screen texts, descriptions) and exclusive content (Table 2, Fig. 2), YouTubers are not only attempting to make the content accessible for Chinese viewers but also form a connection with them.

Some YouTubers may also go further to form a deeper connection with their Chinese viewer bases with extensive strategies beyond merely cross-posting. This is specifically visible in *Pamela Reif*'s case (Fig. 1). In our findings, she not only posted YouTube and exclusive content on Bilibili but also held her China tour in 2023, with fan meet-up events and visits to top Chinese platform companies, including RedNote (XiaoHongShu) (Pan, 2023). She also formed partnerships with various top Chinese brands to produce more sponsored content. As of May 2024, her Bilibili followers (over 12 million in China) even surpassed her YouTuber subscribers (over 9 million worldwide), making her one of the most successful YouTubers on Bilibili in our analysis.

We argue this goes beyond merely synchronizing content between YouTube and Bilibili to maintain the creator ecology. Instead, this might be an attempt at "platform migration," which was a term used by Meng and Nansen (2022) when they explored Chinese video creators' cross-posting activities between Chinese (e.g., Bilibili) and Western platforms (e.g., YouTube). They found that platform migration of Chinese creators involves not only sharing content across multiple social media platforms, but also intent to "adopt multiple platforms and make tailored content for each platform with considerations of targeted audience, platform features, and cultures" (p. 31). While Meng and Nansen (2022) mainly explored the platform migration practices of Chinese creators, our study argues that such a practice also occurs with Western YouTubers who are cross-posting to Chinese platforms, with tailored content creation strategies for Chinese platform audiences, features, and cultural landscapes.

Finally, YouTubers' extensive use of watermarks on Bilibili and the absence of interruptive ads were due to Bilibili's features, including its watermarking function, its copyright issues, and its way of approaching advertising. The platform's features play an important role in affecting YouTubers' cross-posting behaviors to maintain their capital gain (Levina & Arriaga, 2014), even when they post to a different cultural domain.

The above results combined suggest that platforms in diverse cultural contexts are not only designed with varying (gamification) elements tailored to their respective user demographics (Zimmer et al., 2020), but also create distinctions in the cross-posting behavior of content creators and the content they deliver to their audiences as well.

5. CONCLUSION AND OUTLOOK

Overall, the results offer new insights suggesting that YouTubers need cultural adaptation, platform-specific customization, and copyright protection when cross-posting content for a global audience. This is particularly important for platforms like Bilibili, which operates in a distinct cultural domain and serves viewers with limited or no access to YouTube due to regional restrictions.

The research significantly contributes to the existing literature on multi-platform content creation by focusing on YouTubers' cross-posting practices in a Western and Chinese context. The research also contributes to further understanding of online content creators' evolving practices to adapt to platforms of multiple ecosystems for maximized audience reach in a globally connected world.

Our findings can be further developed into new practical recommendations for YouTubers or other content creators who wish to cross-post their content to Bilibili to reach Chinese viewers. For instance, the findings illustrate the importance of cultural and linguistic adaptation in fostering cross-cultural communication. Western YouTubers use Chinese translations, expressions, and culturally relevant content to connect with Chinese audiences by further uploading exclusive content, bridging linguistic and cultural gaps. Therefore, Western content creators looking to expand into culturally distinct markets must employ strategies that go beyond mere translation, tailor-

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ing their content to resonate with the audience's cultural expectations. Content creators and marketers should also analyze platform-specific features and user preferences when designing strategies for cross-platform distribution to ensure relevance and effectiveness.

Furthermore, the findings could also potentially help Bilibili to develop guidance for content creators outside China to build their channels or cross-post their content on the platform and offer related support. For example, using Chinese subtitling was found to be a common practice by the YouTubers analyzed to add to the accessibility of their videos among Chinese viewers. While we found those YouTubers commonly hire Chinese subtitling groups or use the AI translating function on Bilibili, Bilibili could further implement personalized support or guidance on translating videos for those content creators to suit Chinese viewers' needs and contribute to the accessibility of their videos. Finally, future research on the creator ecology should consider cross-platform and cross-cultural dynamics as key factors in the evolution of creators' strategies.

However, this research has some limitations. First, some of the YouTubers we analyzed have stopped uploading on Bilibili, e.g., *NikkieTutorial*'s last upload was in 2020. While those YouTubers' practices on Bilibili are still valid during the time they were active, future research can look at YouTubers who are more consistently active on the Bilibili platform. Second, the research has used content analysis to investigate YouTubers' behaviors on Bilibili, and while the method allows us to observe them in their natural state, future research can implement interviews to investigate in detail the reasons behind their practices on Bilibili, for example how they approach the translation of videos with subtitler groups.

CONFLICTS OF INTEREST

No potential conflict of interest relevant to this article was reported.

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Scientometric Evaluation of Research Institutions: Identifying the Appropriate Dimensions and Attributes for Assessment

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ABSTRACT

Many descriptions and evaluations of research institutions apply publication and citation indicators, which can also be found in most of the popular rankings of universities all over the world. When comparing different institutions, the question arises whether scientometric indicators, and institutional rankings derived from them, are really valid. In our paper we discuss various dimensions of scientometric analyses which have a more or less strong impact on the results of research evaluations on the scientometric meso-level (e.g., department or university level). Concerning research output (based upon publications), we found nine different dimensions, namely time period, size of the institution, representatives of the institution, data source, language, document types and their weighting, co-authorship, document length, and access option. Concerning research impact (based upon citations), there are 14 different dimensions. Using the simple example of two university departments, we present different rankings while varying a few attributes of the suggested dimensions. As the results show, there are large differences between the performed rankings. Each ranking stresses a different aspect; hence there is not the one and only valid ranking. All the popular global university rankings work with arbitrary selections of indicator combinations, making the results more or less arbitrary. The greatest issues are the rankings' incomplete empirical bases, the non-consideration of fractional counting of authors, and – most importantly – the disregarding of the institutions' sizes.

Keywords: research evaluation, scientometrics, rankings, multi-dimensional evaluation, university departments

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1. INTRODUCTION

Many evaluations of research institutions apply purely quantitative scientometric indicators, which are based upon publication and citation counts (Yang & Lee, 2013). The challenge of scientometrics is to quantify quality (Yang & Lee, 2018) as well as possible. Often, research evaluations use only a few indicators or even just one. In practice, problems with the ranking of research institutions often become apparent in the course of university rankings, since these are carried out frequently. In particular, worldwide university rankings are very popular (Kochetkov, 2024) and sometimes even lead to reports in newspapers. Some examples of such rankings with different approaches include:

- the *Academic Ranking of World Universities* (*ARWU*) (established in 2003), initially published by the Shanghai Jiao Tong University, and since 2009 distributed by the Shanghai Ranking Consultancy, located in China,
- the *Quacquarelli Symonds World University Rankings* (QS) (founded in 2004 together with *THE*), which has its headquarter in London (UK) and has numerous offices in many countries of the world,
- the *Times Higher Education World University Ranking* (THE) (established in 2004, independent from QS since 2010), published by TSL Education and located in London, UK,
- the *Webometric University Ranking* (since 2004) by the Cybermetrics Lab of the Spanish National Research Council in Madrid,
- the *Leiden Ranking*, existing since 2006, compiled by the Centrum voor Wetenschap en Technologische Studies at Leiden University in the Netherlands, and, finally,
- the *U.S. News Best Global Universities*, produced by U.S. News & World Report with headquarters in Washington, DC, and New York, NY (established in 2014 for the international ranking, while the national American ranking started in 1983).

ARWU, also known as *Shanghai Ranking*, considers research awards (e.g., Nobel prizes), field-specific and highly cited researchers (from Clarivate), articles published in top journals (such as *Nature* or *Science*) and indexed by multidisciplinary bibliographic information services (here Web of Science [WoS]), and performance per capita (Liu & Cheng, 2005). Very important aspects of *ARWU* are overall research output and top-notch researchers (Dehon et al., 2010). In contrast, *THE Ranking* applies data from opinion surveys on university reputation, the faculty per student ratio, the number of citations per faculty, the extent of international faculty, and the number of international students (Baty, 2013); furthermore, *THE* changes their selection of concrete indicators from time to time. It covers mainly the university's perceived reputation, its research impact (based upon data from WoS), its resources for teaching, and its internationality. *QS Ranking* is similar to *THE* (both institutions originally cooperated). *QS* works with surveys on research activity, employers' surveys, citations per faculty, the faculty-student ratio, and the numbers of international faculty and students (Huang, 2012). In *THE Ranking*, survey data is weighted at 30%, while *QS* is more dependent on surveys (50%). *Leiden Ranking* is based on publication output, citation impact, and scientific collaboration; all data are retrieved from Clarivate's Science Citation Index and Social Sciences Citation Index (Waltman et al., 2012). The *U.S. News Best Global Universities Ranking* uses survey data on research reputation by Clarivate (weighted at 25%) and the number of publications, as well as the number and percentage of the most cited publications (data from Clarivate's InCites), and international collaboration (Morse & Wellington, 2024). The *Webometric University Ranking* analyses the universities' web presence performance, such as the number of web pages, "rich" files (e.g., PDFs), and external links to the university's websites (Aguillo et al., 2008). This may be an indicator for the size of online published information and of the access to this information, but is by no means a research or teaching indicator.

Each approach brings its own ranking into being frequently inconsistent with the other rankings. For example, *THE* ranks the Universities of Oxford (UK) and Cambridge (UK) in the first two places, while *QS* ranks Massachusetts Institute of Technology (US) and Stanford University (US) at the top. The California Institute of Technology is no. 3 in *THE* and no. 4 in *QS*, but no. 193 in the *Leiden Ranking* (all data as of 2018; Fauzi et al., 2020, p. 89). However, Aguillo et al. (2010) found also some similarities between certain pairs of rankings (e.g., between *ARWU* and a ranking from Taiwan). But for most rankings, "correlations highlight the significant differences among some indexes even in measuring the same criterion such as teaching or research" (Olcay & Bulu, 2017, p. 153).

All this has led the majority of researchers to view worldwide university rankings extremely critically (Bel-

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lantuono et al., 2022; Billaut et al., 2010; Chirikov, 2023; Gadd, 2021; Kochetkov, 2024; Lim, 2018; Moed, 2017; Selten et al., 2020). For example, Altbach (2006) concludes, "they (university rankings) often measure the wrong things, and they use flawed metrics to do the measurements." If rankings try to measure "reputation" using surveys—and such reputation indicators play an important role in the rankings of *QS* and *THE* (Hou & Jacob, 2017)—problems arise with the "reputational bias derived from the anchoring, echo, halo and Matthew effects" (Safón, 2019, p. 910). University rankings clearly exhibit shortcomings such as "adjustment for institutional size, differences between average and extreme, defining the institutions, measurement of time frame, credit allocation, excellency factors as well as adjustment for scientific fields" (Anowar et al., 2015, p. 559). In a review of articles on university rankings, Vernon et al. (2018, p. 13) conclude that "current indicators are inadequate to accurately evaluate research outcomes and should be supplemented and expanded to meet standardized criteria." For van Raan (2005, p. 140) some university rankings can be considered as "quasi-evaluations," which is "absolutely unacceptable."

In view of these criticisms, the question arises as to how a meaningful ranking could be carried out at the institutional level. It is obvious that there is no universally valid research ranking. Rather, it seems more sensible to take various aspects into account in order to avoid an overly narrow view and possible misjudgments. And this is precisely where our study comes in, which on the one hand attempts to identify the dimensions (and their attributes) that affect the results of research evaluations at the institutional level, such as at the level of departments, faculties, or universities. In addition, a case study will be carried out to examine whether identical data but modified indicators and attributes lead to different rankings of two specific research institutions. If this is the case, a combined consideration of various aspects could provide a more complete picture of the research performance of the two exemplary institutions.

For resource-economic reasons, our study focuses on the research performance of institutions in the form of publications (publication output and publication impact), as we believe these are of central importance for assessing the overall performance of institutions. Therefore, we focus on the inconsistencies of rankings that make use only of quantitative scientometric data and indicators. From the literature (e.g., Reichmann & Schlögl, 2021; 2022; Reichmann et al., 2022), we identified several dimensions of research output and of research impact, which may influence the results of a quantitative research evaluation more or less strongly. "Output" ("production") means an institution's publications and "impact" the citations these publications attracted (Abramo, 2018; Stock, 2001; 2010).

For our case study, we focused on two university departments that we know very well (those where we are currently working or have previously worked), as this was the only way to fully capture the required data. Departments, like universities, are also located at the meso-level, and so the dimensions and attributes we identified in the first step are fully relevant.

Overall, in our study we want to answer the following two research questions (RQs):

RQ1. Based on a purely theoretical consideration: Which dimensions and which attributes of the dimensions are useful for the description and subsequent ranking of research institutions? (Section 2)

RQ2. Based on a case study of two research institutions: Is it useful to produce different rankings concerning their research output and research impact? (Sections 3 and 4)

2. DIMENSIONS OF SCIENTOMETRIC RESEARCH EVALUATION

In the following section (2.1.) we present the dimensions having an impact on the results of research evaluations in more detail (RQ1). As is e xhibited in Table 1, they differ partly depending on whether they refer to research output via publications (P) or research impact via citations (C). Concerning research output we found nine, and for research impact we identified 14 relevant dimensions. In Table 1 we list each dimension and its possible attributes to provide guidance for a "fair ranking" of institutions (Vavryčuk, 2018), if something like that is ever possible.

We did not consider compound indicators, which are derived from two or more raw indicators. Examples are normalization approaches for research fields, such as the Leiden crown indicator (Abramo & D'Angelo, 2016; Opthof & Leydesdorff, 2010; van Raan et al., 2010), and the H-Index combining publication and citation counts (Hirsch, 2005; 2023; Kamrani et al., 2021). We also did not consider indicators from altmetrics, e.g., mentions of an institution's research activities on social media services (Stock et al., 2023b, pp. 46-48).

Table 1. Scientometric dimensions of research output and research impact and their attributes

Dimensions	Attributes
Research output - publications	
P1. Time period	1 year | multi-year periods | institution's lifetime
P2. Size of the institution	a) Size-dependent: no consideration of size b) Size-independent: production per capita | labor productivity (production per full-time equivalent) | productivity (production per complete input costs)
P3. Representatives of the institution	Only full professors | all professors | professors and postdocs | all faculty | all research staff
P4. Data source	Web of Science (WoS) | Scopus | Dimensions | Google Scholar | discipline-specific information services | combinations of information services | personal publication lists/institutional research databases
P5. Language	Only English | only national language | combinations of individual languages | all languages (no consideration)
P6. Document types and their weighting	a) Without weighting: books | journal articles | articles in proceedings | articles in other edited books | granted patents | other publications | combinations of individual document types | all document types (all publications) b) With weighting: document-type-specific weights (single document types, combinations, all document types) | weighting with impact factor or source-normalized impact per paper (only for journal articles) | only highly-cited articles (only for journal articles)
P7. Co-authorship	Whole counting (micro-level=individual level) (no consideration) | whole counting (meso-level) | fractional counting (*1/n*) | other adjusted counting methods
P8. Document length	Exclusion of very short publications | weighting by page or character numbers | no consideration
P9. Access status	Share of full text documents online | not considering access status
Research impact - citations	
C1. Time period of citing documents (citations)	Short-term citation impact | long-term citation impact
C2. Time period of cited documents (publications)	See research output, dimension 1 (P1)
C3. Size of the institution	See dimension P2
C4. Representatives of the institution	See dimension P3
C5. Data source of citing documents	WoS | Scopus | Dimensions | Google Scholar | combinations of information services
C6. Data source of cited documents	See dimension P4
C7. Language of citing documents	Only English | all languages (no consideration)
C8. Language of cited documents	Only English | all languages (no consideration)
C9. Document types and their weighting (citing documents)	a) Without weighting: journal articles | all document types (all publications) b) With weighting: weighting with the importance of the citing article (e.g., PageRank) | weighting with the importance of the journal of the citing article (e.g., impact factor)
C10. Document types and their weighting (cited documents)	a) Without weighting: journal articles | all document types (all publications) b) With weighting: document-type-specific weights | weighting with, e.g., impact factor (only journal articles) | only highly-cited articles
C11. Citations to co-authored publications	See dimension P7
C12. Document length of cited documents	See dimension P8
C13. Dealing with self-citations	Consideration of all citations (no consideration of self-citations) | weighting of self-citations | exclusion of author self-citations | exclusion of institutional self-citations
C14. Citations by access status of cited documents	Citations by access status of cited documents | not considering access status

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2.1. Research Output

2.1.1. (P1) Time Period

A fundamental dimension of any research evaluation is the determination of the appropriate analysis period (Ioannidis et al., 2007), which depends partly on the purpose of an evaluation. When analyzing smaller evaluation units like subunits of universities or individual researchers, it must be considered that small-term fluctuations may have some impact on the evaluation results. In their analysis, Reichmann and Schlögl (2022) show that the extent of fluctuations in the publication output of a university department can be particularly strong in the short-term.

There are many possibilities to find the best-fitting time frame. International university rankings prefer a time period of one year. Similar to the 5-year impact factor, one can work with a time frame of 5 years; also, shorter or longer multi-year periods can make sense. Finally, it is possible to describe and evaluate the entire lifetime of an institution—as did Reichmann and Schlögl (2022) or Stock (2022). Periods of less than a year seem clearly too short for a research evaluation. In addition, the data are usually only available on a yearly basis.

Regarding this dimension, we identified three advisable attributes (Table 1).

2.1.2. (P2) Size of the Institution

After having defined a proper unit of evaluation (chair, department, institute, school, or university), the extent to which its size should be considered must be fixed. There are both size-dependent (ignoring the size) and size-independent (considering the size) indicators (Anninos, 2014; Docampo & Bessoule, 2019). If evaluators apply size-independent indicators, a research evaluation on the meso-level faces the challenge of capturing the number of an institution's staff members (employees) over the considered time period (Toutkoushian et al., 2003) as the "underlying production capability" (Thelwall & Fairclough, 2017, p. 1142). For the consideration of size, there are three different approaches in research evaluation, namely the production per capita (Abramo & D'Angelo, 2014; Akbash et al., 2021), the labor productivity, i.e. the production per full-time equivalent (FTE) (Stock et al., 2023a), and the productivity relating production to the complete input costs (Abramo et al., 2010).

When assessing research performance at the meso-level, it seems fairest to us to consider the size of the institution under consideration. Accordingly, it is quite surprising that this is not the case in many university rankings (Olcay & Bulu, 2017; van Raan, 2005). One reason for this might be that it is often quite difficult to get the relevant data on the research staff employed and their costs.

In summary, the dimension of "size of the institution" can have four attributes (Table 1).

2.1.3. (P3) Representatives of the Institution

Closely related to the size of an institution is the question of who actually represents the research staff (Bornmann & Marx, 2013). A wide definition (all research staff) would also include staff which runs the technical infrastructure; a narrower definition would only consider faculty. Considering only professors and postdocs takes into account that predocs are preliminarily concerned with their doctoral theses and, as a consequence, do not publish so much. The narrowest definition would only consider full professors, since they represent the core of the research staff. Studies have shown that full professors are more productive than other categories of professors: Abramo et al. (2011) studied the performance differences between full, associate, and assistant professors in Italy; Ventura and Mombrú (2006) published a similar study on full and associate professors in Uruguay.

All in all, we found five options to define an institution's representatives (Table 1).

2.1.4. (P4) Data Source

The great impact of the data source on the results of a research evaluation has already been shown in many other studies (see, e.g., Harzing & Alakangas, 2016). In most evaluations, research publications are retrieved from public databases. Multidisciplinary information services such as WoS (Birkle et al., 2020; Stock & Stock, 2003), Scopus (Baas et al., 2020), Dimensions (Herzog et al., 2020), and Google Scholar (Aguillo, 2012) offer the great advantage that they also provide citation data. However, across all multidisciplinary information services, there is a pronounced unequal coverage of certain disciplines (Mongeon & Paul-Hus, 2016) and many languages (except English) (Vera-Baceta et al., 2019). Google Scholar is by far the most complete service (Martín-Martín et al., 2018). However, the use of Google Scholar for research evaluation is discussed critically in general (Halevi et al., 2017). The quality of WoS seems to be rather high, though it is far from being top. For example, Tüür-Fröhlich (2016) was able to show that there are many spelling and typing errors, "mutations" of author names, and data field confusions, all leading to wrong evaluation results.

It must also be considered that all the mentioned mul-

tidisciplinary information services are more or less incomplete (Hilbert et al., 2015). Their coverage is particularly low for most non-English languages as well as in the social sciences and humanities (Dorsch, 2017). In these cases, discipline-specific information services could be an alternative. Additionally, it is possible to merge data from different information services to get a more complete picture. However, in order to have a full coverage of research output, personal publication lists of the researchers would be necessary (Dorsch et al., 2017). An alternative would be institutional research databases which contain, among other data, the publications of the scientific staff.

Overall, there are seven alternatives concerning the selection of the data source (Table 1).

2.1.5. (P5) Language

While the publication language is primarily English in most of the natural sciences, this is different in the social sciences and humanities (Stockemer & Wigginton, 2019). Therefore, it is very useful to also retrieve publications in the national language of the institutions (Pölönen et al., 2018). Furthermore, a differentiation by publication language could be useful in order to investigate the international orientation. Such a study was, for instance, conducted by Schlögl (2013) who analyzed the international visibility of European and in particular German language information science.

We see four options for dealing with publication languages in research evaluations (Table 1).

2.1.6. (P6) Document Types and Their Weighting

Even in disciplines where scholarly communication takes place primarily in journals, an editorial or book review, for example, cannot be treated in the same way as a research article (Stock, 2001; 2010; Stock et al., 2023b). Moreover, it is possible to consider different quality levels for journal articles, for example by using the (problematic) impact factor for journal ratings (Martyn, 2005; Seglen, 1992; 1997; Van Noorden, 2010).

In the social sciences and humanities, document types are more heterogeneous than in the natural sciences. A possible rough categorization of all document types would be books, journal articles, articles in proceedings or other edited books, patents, and other types (meeting reports, project reports, etc.). In order to consider the different efforts involved in composing these publication types, it is possible to either carry out separated rankings by each document type or to assign different weights (Kladroba et al., 2021). In a rather arbitrary way, some authors have introduced different weights, for instance, 50 for a monograph, 10 for an article, and 1 for a book review (e.g., Finkenstaedt, 1986). Following a completely different idea by Abramo and D'Angelo (2015), one can restrict a ranking on counting the number of highly-cited publications by the institution's employees using data from WoS or Scopus.

Concerning document types and their weightings, we would at least consider the following eleven options, a) eight of them without weighting and b) three of them with weighting (Table 1).

2.1.7. (P7) Co-Authorship

How can publications with more than one author (Gauffriau, 2017) be dealt with? Whole counting, meaning to count "1" for each of the co-authors, is still a common way to treat co-authored work (Sivertsen et al., 2019). However, it does not reflect the real contribution of an author. If we aggregate data from the individual researcher level (micro-level) to higher levels (meso- and macro-levels), whole counting may lead to a serious statistical problem: If two authors from the same institution co-publish an article, this article would be counted as 2 for the institution (Schloegl et al., 2022; Stock et al., 2023b). Since co-authorship by researchers from the same institution is always possible, the addition of the individual values would lead to values that are too high at the aggregation level. This error can be avoided by relating whole counting directly to the aggregation level, i.e., the meso-level (Reichmann & Schlögl, 2021).

A fairer approach for attributing research effort to an individual author or to a university department is adjusted counting, for which there are different possibilities. According to the most common formula $1/n$ (Waltman, 2016, pp. 378 ff.), each of the n co-authors receives the same share for a publication. The fact that co-authored publications require additional coordination and discussion is better expressed by the formula $2/(n+1)$ (Schneijderberg, 2017, p. 343). All in all, Gauffriau (2021) identified 32 different counting methods for an author's share of a multi-authored research publication. One disadvantage of adjusted counting is that in a few disciplines it is common to list all persons who were somehow involved in the creation of a publication; sometimes even some hundreds of co-authors are mentioned. As a consequence, the individual share of each co-author is very small. It is precisely in these cases that it would be desirable for each author's contribution to be stated as it really was (Rahman et al., 2017).

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We can distinguish four approaches for treating co-authorships (Table 1).

2.1.8. (P8) Document Length

To some degree the length of the publications can also be considered in a research evaluation. However, the following issues must be regarded: Papers can be very long (e.g., more than 50 or even 100 pages) or very short (e.g., letters with a length less than one page of the journal *Science*), and this may be completely independent of the quality of the documents. When using page numbers, the length of publications can vary greatly depending on different aspects such as layout or font size. An alternative could be to count single characters. When considering the document length at all, it is even more problematic if different document types (e.g., books and proceedings papers) are involved. But most importantly, there is hardly any correlation between quantity and quality. Possibly, if at all, it is therefore primarily useful to use the length of a publication as a filter criterion (e.g., only publications with at least 500 or 1,000 words are taken into account). However, also this can be problematic as well since some high-quality journals like *Science* and *Nature* actually publish very short articles.

With regard to the length of publications, we ultimately differentiate between three variants (Table 1).

2.1.9. (P9) Access Status

It is known for decades that research articles published online in their full lengths – maybe as open access documents or otherwise – have the chance to gather higher visibility and even higher citation counts, compared with articles in which only the bibliographic data are known, e.g., articles behind a paywall (Gargouri et al., 2010). Wentz (2002) called this effect the Full Text On the Net bias.

In evaluative scientometrics we can recognize this effect and differentiate between the number of full-text articles and non-full-text articles, or ignore it (Table 1).

2.2. Research Impact

Besides the nine dimensions of research output, 14 dimensions concerning citing and cited documents have an influence on an institution's research impact.

2.2.1. (C1) Time Period of Citing Documents

The chosen time period is also important with regard to citations (Wang, 2013). Short-term citation impact indicators (e.g., considering the last two years in analogy to the impact factor) do not work well, especially in research fields with a long citation history such as history and philology. Since in other fields it takes also some time until citations evolve, long-term citation impact provides a more meaningful description (Wang & Zhang, 2020). Regarding this dimension, we have identified two attributes (Table 1).

2.2.2. (C2) Time Period of Cited Documents

In the context of a citation analysis, the period of the publications whose citations are relevant must be determined in addition to the period of the citations (see dimension P1).

2.2.3. (C3) Size of the Institution

Here, we refer to the explanations on dimension P2. The only difference is that the size-independent attributes refer to citations instead of publications (e.g., impact per FTE instead of production per FTE).

2.2.4. (C4) Representatives of the Institution

See dimension P3.

2.2.5. (C5) Data Source of Citing Documents

In contrast to the use of the data source for publication counts, for citations we can only apply information services that provide citations, such as WoS, Scopus, Dimensions, or Google Scholar. Therefore, many field-specific databases and personal as well as institutional publication lists drop out and only five variants remain (Table 1).

2.2.6. (C6) Data Source of Cited Documents

Theoretically, in the context of a citation analysis, one could refer to publications contained in any data source (see dimension P4) and then retrieve the citations for that subset of documents which is also included in the citations database. In practice, however, the same database (e.g., WoS) is usually used for retrieving the publications and the citations to them.

2.2.7. (C7) Language of Citing Documents

Since the citation databases currently available are largely limited to English-language sources, only two variants make sense from our point of view (Table 1).

2.2.8. (C8) Language of Cited Documents

In some rare cases, it could be of interest to differentiate between the publication language of the citing and the cited documents. In contrast to the publication analysis, we consider only two variants (the same as in C7) for the language of the cited documents to be useful in the con-

text of a citation analysis (Table 1).

2.2.9. (C9) Document Types and Their Weighting (Citing Documents)

Since citation databases more frequently contain articles in journals, in contrast to the publication analysis, we would only differentiate between two variants with regard to the document types: journal articles and all publications.

When counting the citations of an institution's publications, one can count every citing article equally with 1. If not all citing sources are of similar quality, one can weight a citation according to the importance of the citing publication. It might be critical to work with, e.g., the journal impact factor of a citing article, as this is the same dead end as when weighting an individual article with the journal's impact factor. A more suited approach is weighting with the importance of the citing article through the use of network analysis. Many scientometric studies work with PageRank-like measures (Brin & Page, 1998) or similar eigenvector-based calculations of the citing documents (Cai et al., 2019).

Finally, we can distinguish between four attributes for this dimension, a) two without weighting and b) two with weighting (Table 1).

2.2.10. (C10) Document Types and Their Weighting (Cited Documents)

The discussion on dimension P6 applies here with the following deviation: Regarding the dominance of journal articles in citation databases, a restriction to only two document types seems to be useful: journal articles and all document types. Since a weighting of the cited documents could also be of interest in a few cases, we would suggest a total of five attributes for this dimension, a) two without weighting and b) three with weighting (Table 1).

2.2.11. (C11) Citations of Co-Authored Publications

Citations of publications with more than one author can be counted as 1 for each co-author of the cited publication (whole citation counting) or in analogy to fractional counting of publications, as *1/n* for each co-author (fractional citation counting) (Leydesdorff & Shin, 2011)—or using any other counting method described by Gauffriau (2021). As a consequence, there remain the same variants as for dimension P7.

2.2.12. (C12) Document Length of Cited Documents

See dimension P8.

2.2.13. (C13) Dealing with Self-Citations

Self-citations play a special role in research evaluation, as researchers can inflate their citation rate through massive self-citations, both at the author level (author self-citations) and at the institutional level (citations from other authors of the same institution). It is not useful to ignore self-citation, as it may be very informative when an author uses his or her own insights in a later publication. Accordingly, self-citations may signal continuity and competence in a particular research field. However, external citations may be more relevant for evaluation purposes (Costas et al., 2010). Schubert et al. (2006, p. 505) introduced weightings for self-citations. Accordingly, a self-citation link between two single-authored papers by the same author is "stronger" than one between two multi-authored papers in which the former is cited by a joint co-author. From the above, four approaches can be distinguished (Table 1).

2.2.14. (C14) Citations by Access Status of Cited Documents

In continuation of dimension P9 we differentiate twofoldly concerning the description of the access status of the cited documents (Table 1).

At this point we can answer our first RQ: Relating the attributes of all dimensions to each other accounts for about 440,000 theoretically possible publication rankings, and for more than 32 million citation rankings. Exactly, there are 443,520 possible publication rankings which result from the following multiplication (the factors represent the number of attributes of each dimension): 3×4×5×7×4×11×4×3×2. The 32,256,000 possible citation rankings are calculated as follows: 2×3×4×5×5×7×2×2×4×5×4×3×4×2. Definitely, many of these rankings do not make sense. However, there are also many suitable rankings, each of which stresses particular aspects more or less strongly. If university rankings such as *ARWU* and *THE* have chosen any dimensions and any attributes for their rankings without evidence-based justifications, their ranking methods will seem rather arbitrary.

3. CASE STUDY METHODOLOGY

Based on our second RQ, we want to investigate what impact follows on research performance if we vary some attributes of the scientometric dimensions discussed before. In order to do this, we are following a case study approach and compare the research performance of two similar information science departments: the Department of Information Science at the University of Düsseldorf,

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which was part of the Institute of Language and Information, and the former Department of Information Science and Information Systems at the University of Graz. The main reason for the selection of these two research institutions was that they are comparable to some degree. Partly they do research on similar topics, in particular scientometrics and information literacy, and partly they work in different research areas: Düsseldorf on smart cities and social media services, and Graz on topics related to information systems. Another reason was that the authors were staff members of the two institutions, which facilitated both data collection and interpretation of the results.

One major difference between the two organizational units relates to the staff structure. While the department in Düsseldorf consisted of one professor and more than ten predocs and postdocs, the department in Graz had one full and three associate professors as well as one predoc researcher. As a consequence, the department in Düsseldorf had slightly more than two times the research staff compared to that in Graz. The department in Düsseldorf is shut since the beginning of 2024, while that in Graz was merged with two other departments in 2020, forming the Department of Operations and Information Systems. Due to data availability, we chose an evaluation period from 2009 to 2018 (i.e., 10 years). Publication data was collected for all research staff employed (at some point of time) between 2009 and 2018. It should be noted that obtaining the appropriately detailed employment data took some effort. This shows how difficult it is, even for relatively small research units, to determine the research output per FTE, in particular for longer evaluation periods.

For Düsseldorf, the data of all personal publication lists was cumulated. For Graz, there exists an institutional research database in which researchers have to enter their research activities, including their publications. All publication data was entered into a MS Access database (Microsoft, Redmond, WA, USA) developed for this study. Besides the most important bibliographic data, the number of co-authors, the publication type (books, journal articles, articles in proceedings, articles in other edited books, and other publications), the publication language, and the length (in pages) were also recorded for each publication. Finally, we recorded whether a publication was included in WoS Core Collection (without consideration of the Book and the Proceedings Citation Index), Scopus, or Google Scholar, and how often it was cited in these databases. Data collection took place in December 2020 for WoS and in March 2021 for Scopus and Google Scholar. The Access database comprises a total of 345 publications by authors from Düsseldorf and 228 publications by authors from Graz. Fig. 1 shows the publication output during the observation period by document type for Düsseldorf and Graz.

As can be seen, journal articles constitute only slightly more than one quarter of the total publication output at both institutions. Therefore, we decided not to base our publication analyses solely on journal articles (dimension P6). Variant 1 covers all document types, which were arbitrarily weighted as follows: books – 10 points, journal articles – 5 points, articles in proceedings – 3 points, articles in other edited books – 2 points, other publications – 1 point. Variant 2 only considers journal articles. This means that in variant 2 there is no weighting of publication types. For each of these two variants, we used the following attributes for the various dimensions to calculate the so-called base of operations:

- Time period: multi-year period, namely 10 years (2009-2018) (dimension P1).
- Size of the institution: size-dependent (ignoring the size) and size-independent using labor productivity (production per FTE) (dimension P2). Since we believe that this dimension is a key influencing factor on the results of research evaluations on the meso-level, all of the following variations are always calculated and presented in a size-dependent and a size-independent manner.
- Representatives of the institution: all research staff (dimension P3).
- Data source: personal publication lists (Düsseldorf) / institutional research database (Graz) (dimension P4).
- Language: all languages (dimension P5).
- Document types and their weighting: variant 1:

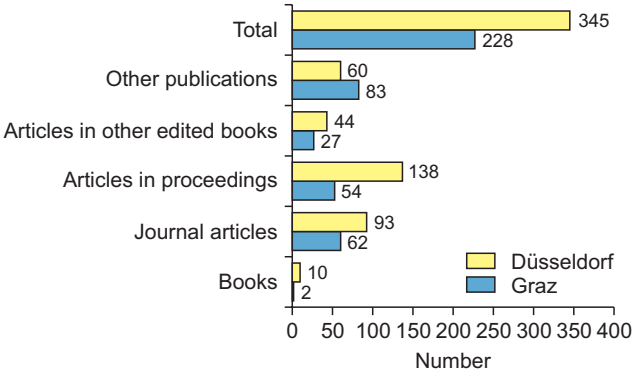


Fig. 1. Publication output by document type for Düsseldorf and Graz (2009-2018).

all document types, using document-type-specific weights (see above); variant 2: journal articles without weighting (dimension P6).
- Co-authorship: fractional counting (*1/n* given *n* co-authors) (dimension P7).
- Document length: no consideration (dimension P8).
- Access status: not considered (dimension P9).

Starting from the base of operations, we then calculated alternative research rankings (in our case study, they consisted only of a comparison of the values for the two compared institutions), in which only one attribute of one dimension was changed compared to the base of operations (e.g., dimension P4 – data source: WoS instead of personal publication lists/institutional research database). In this way, we calculated 12 (9) alternatives with regard to variant 1 (2), the results of which are displayed in the following two tables, both size-dependent and size-independent. Each of the tables also shows for each ranking by what percentage Düsseldorf is better or worse than Graz (Graz=100% in each case).

We chose the same procedure for the citation analysis as for the publication analysis, i.e., there are variants 1 and 2 with regard to the cited documents (dimension C10: all document types without weighting vs. journal articles), as well as a size-dependent and a size-independent presentation of the results (dimension C3). For both variants, we again calculated a base of operations, on the basis of which we then calculated seven alternatives according to the procedure described regarding the publication analysis. We used the following attributes for the various dimensions to calculate the base of operations for the citation analysis:

- Time period of citing documents: long-term citation impact, namely 2009-2020/2021 (dimension C1).
- Time period of cited documents: multi-year period, namely 10 years (2009-2018) (dimension C2).
- Size of the institution: size-dependent (ignoring the size) and size-independent using labor productivity (impact per FTE) (dimension C3).
- Representatives of the institution: all research staff (dimension C4).
- Data source of citing documents: WoS Core Collection (dimension C5).
- Data source of cited documents: personal publication lists (Düsseldorf) / institutional research database (Graz) (dimension C6).
- Language of citing documents: all languages (dimension C7).
- Language of cited documents: all languages (dimension C8).
- Document types and their weighting (citing documents): all document types without weighting (dimension C9).
- Document types and their weighting (cited documents): variant 1: all document types without weighting; variant 2: journal articles without weighting (dimension C10).
- Citations of co-authored papers: fractional counting (*1/n*) (dimension C11).
- Document length of cited documents: no consideration (dimension C12).
- Dealing with self-citations: consideration of all citations (dimension C13).
- Access status of cited documents: no consideration (dimension C14).

4. CASE STUDY RESULTS

4.1. Publication Analysis

Tables 2 and 3, which are related to the publication analysis, reveal that Düsseldorf performs significantly better in nearly all size-dependent indicators. The simple reason is that Düsseldorf has more than twice the research staff of Graz (11.32 vs. 5.125 FTE). Graz solely comes first if the professors are seen as the representatives of an institution (variation 3). Since Graz has 4 professors and Düsseldorf only 1, it is not surprising that the total publication output of Graz is higher than that of Düsseldorf in this ranking.

Since in our view the consideration of the institution's size is much fairer, we only refer to size-independent indicators (dimension P2, see right-hand parts of Tables 2, 3) in the following discussions. In variant 1 (dimension P6), which includes all document types, Graz is ahead in six cases and Düsseldorf in seven cases. According to the base of operations, a researcher from Graz achieves an average of 90 (publication) points, while a researcher from Düsseldorf only achieves 79.2 points. Here, Düsseldorf is 12% behind Graz.

As Table 2 shows, each attribute has a greater or lesser impact on the research output of the two institutions. Interestingly, Düsseldorf is 28% ahead if only the research output of the last 5 years of the observation period (variation 2) is considered, which results in a difference of 40%-points compared to the base of operations with an observation period of 10 years. In fact, from 2014 to 2018 Graz only achieved slightly more than one third of its

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Table 2. Rankings of the two institutions – effects of changing attributes in a publication analysis – variant 1 (all document types)

Variations of single attributes	Total publications (points)[a] (dim. P2)		Δ (%)	Publications (points)[a] per FTE[b] (dim. P2)		Δ (%)
	Graz	Düsseldorf		Graz	Düsseldorf	
1. Base of operations[c]	461.2	896.5	94	90.0	79.2	-12
2. Dim. P1: 2014-2018	167.8	475.4	183	32.7	42.0	28
3. Dim. P3: only all professors[d]	346.7	193.2	-44	86.7	193.2	123
4. Dim. P4: WoS	65.1	160.7	147	12.7	14.2	12
5. Dim. P4: Scopus	141.3	439.7	211	27.6	38.8	41
6. Dim. P4: Google Scholar	299.0	763.7	155	58.3	67.5	16
7. Dim. P5: only English publications	202.1	581.1	188	39.4	51.3	30
8. Dim. P6: without other publications	388.7	841.0	116	75.8	74.3	-2
9. Dim. P6: only articles in proceedings	102.7	306.2	198	20.0	27.1	35
10. Dim. P6: different weighting[e]	391.4	752.4	92	76.4	66.5	-13
11. Dim. P7: co-authorship: *2/(1+n)*	538.0	1,159.6	116	105.0	102.4	-2
12. Dim. P7: full counting	656.0	1,171.0	79	128.0	103.5	-19
13. Dim. P8: publication length ≥5 pages	370.8	740.6	100	72.4	65.4	-10

dim., dimension; WoS, Web of Science.
[a]The figures in the table are not publication numbers but publication points (see dim. P6); book=10, journal article=5, article in proceedings=3, article in other edited book=2, other publication=1. [b]Graz: 5.125 FTE, Düsseldorf: 11.32 FTE. [c]Dim. P1: 2009-2018; dim. P3: all research staff; dim. P4: publication lists/inst. research database; dim. P5: all languages; dim. P6: weighting: book=10, journal article=5, article in proceedings=3, article in other edited book=2, other publication=1; dim P7: *1/n*; dim. P8: no consideration of document length – see section 3, variant 1. [d]Graz: 4 professors, Düsseldorf: 1 professor. [e]Weighting: book=5, journal article=4, article in proceedings=3, article in other edited book=2, other publication=1.

Table 3. Ranking of the two institutions – effects of changing attributes in a publication analysis – variant 2 (only journal articles)

Variations of single attributes	Total journal articles (dim. P2)		Δ (%)	Journal articles per FTE[a] (dim. P2)		Δ (%)
	Graz	Düsseldorf		Graz	Düsseldorf	
1. Base of operations[b]	40.3	70.0	74	7.9	6.2	-21
2. Dim. P1: 2014-2018	14.8	40.6	174	2.9	3.6	24
3. Dim. P3: only all professors[c]	28.1	20.0	-29	7.0	20.0	185
4. Dim. P4: WoS	12.3	31.0	152	2.4	2.7	14
5. Dim. P4: Scopus	17.0	47.7	181	3.3	4.2	27
6. Dim. P4: Google Scholar	33.2	63.3	91	6.5	5.6	-14
7. Dim. P5: only English papers	13.9	38.4	176	2.7	3.4	25
8. Dim. P7: co-authorship: *2/(1+n)*	48.6	88.6	82	9.5	7.8	-17
9. Dim. P7: full counting	62.0	93.0	50	12.1	8.2	-32
10. Dim. P8: paper length ≥5 pages	39.3	61.7	57	7.7	5.5	-29

dim., dimension; WoS, Web of Science.
[a]Graz: 5.125 FTE, Düsseldorf: 11.32 FTE. [b]Dim. P1: 2009-2018; dim. P3: all research staff; dim. P4: publication lists/inst. research database; dim. P5: all languages; dim. P6: journal articles; dim. P7: *1/n*; dim. P8: no consideration of document length. [c]Graz: 4 professors, Düsseldorf: 1 professor.

whole research output per FTE (based on 2009 to 2018), with Düsseldorf reaching slightly more than half.

As can be seen in Fig. 1, the structure of the publication output differs between Graz and Düsseldorf. This is reflected in the rankings based on different document types and their weighting (variations 8-10). For instance, Düsseldorf has published more books and 35% more articles in proceedings per FTE but fewer other publications. Without taking the latter into account, the research performance of Graz is only slightly above that of Düsseldorf (variation 8). If only articles in conference proceedings are taken into account, Düsseldorf performs significantly better than Graz (variation 9). The structure of the publication output is, of course, also reflected in the weightings. If a different weighting is used in which books are weighted less (variation 10: weighting factor 5 for books instead of 10), Düsseldorf performs slightly worse compared to the base of operations (-13% vs. -12%).

In contrast to the researchers from Düsseldorf, the researchers from Graz have a high proportion of German-language publications (56% vs. 37%). Therefore, if only English-language publications are considered (variation 7), Düsseldorf is 30% ahead of Graz. Document type and language also have a great impact on coverage in various data sources (variations 4-6). According to Table 2, Düsseldorf has a significantly higher publication output than Graz based on the three information services considered: WoS (+12%), Scopus (+41%), and Google Scholar (+16%). The high values of Düsseldorf's institution on Scopus are also due to the high number of articles in proceedings, which are not included in the subscriptions of WoS by the university libraries of Düsseldorf and Graz.

When considering only articles with a length of at least 5 pages (variation 13), Düsseldorf has a 10% lower research output than Graz. The (small) difference to the base of operations is due to the fact that Graz has a higher proportion of other publications, which are usually relatively short. If the ranking is based on full counting (variation 12), the lead of Graz is greater compared to the base of operations: Düsseldorf is 19% behind Graz here. This is due to different collaboration habits. Accordingly, the fractional publication counts are usually higher for Düsseldorf than for Graz since Düsseldorf has a higher amount of internal co-authorships. In the case of a higher weighting of a larger number of co-authors, as is the case with the formula $2/(n+1)$ (variation 11), Düsseldorf is preferred even more and is then only 2% behind Graz.

Not only do the above-mentioned collaboration habits differ, but the structure of the research staff also differs between the two institutions. Düsseldorf has one professor and several pre- and postdocs (some of them employed in projects), whereas in Graz the research staff consists of four professors and one predoc. So, if only the research output of the professors is taken into account (variation 3), the absolute value for Graz is significantly higher. When relating the research output to one FTE, Düsseldorf is clearly ahead (+123%), as the professor from Düsseldorf has a very high research output. However, this is partly also due to joint work with other Düsseldorf research staff members.

In variant 2, only journal articles are considered (dimension P6), which account for a little more than one quarter of the publications at the two institutions. Here, Graz and Düsseldorf head the rankings per FTE in five cases each. As is shown in Table 3, one FTE from Graz published an average of 7.9 journal articles, and one FTE from Düsseldorf published 6.2 journal articles according to the base of operations. Here the difference of 21% is significantly higher than in variant 1 since Graz has a higher proportion of journal articles than Düsseldorf. The variations of the attributes lead to similar results as in variant 1 – with a few exceptions: One is that more journal articles from Graz can be found in Google Scholar than from Düsseldorf (variation 6). This might be due to the fact that more German-language journals are indexed in Google Scholar compared to WoS and Scopus, and because many journal articles from Graz are in German (see variation 7). Furthermore, Graz has a higher proportion of journal articles with a length of at least five pages (variation 10). The lower percentage differences in favor of Düsseldorf when using Scopus (variation 5) compared to variant 1 can be explained by the fact that books and articles in proceedings (where Düsseldorf has a lead over Graz) are not considered in variant 2.

4.2. Citation Analysis

When considering citations, Düsseldorf is clearly ahead in all rankings. As before, we differentiated between two kinds of rankings: one in which citations to all document types were covered (variant 1 – Table 4) and one in which citations to only journal articles were regarded (dimension C10) (variant 2 – Table 5). The comparison of the two variants shows that the citation numbers between the two variants are relatively close with regard to the WoS-based rankings. This is due to the fact that the used WoS Core Collection is predominantly based on journal publications. When comparing the base of operations of the two variants, Düsseldorf receives approximately double as

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Table 4. Ranking of the two institutions – effects of changing attributes in a citation analysis – variant 1 (cited documents: all document types)

Variations of single attributes	Total citations (dim. C3)		Δ (%)	Citations per FTE[a] (dim. C3)		Δ (%)
	Graz	Düsseldorf		Graz	Düsseldorf	
1. Base of operations[b]	86.0	384.0	347	16.8	33.9	102
2. Dim. C2: 2014-2018 (dim. 1: 2014-2020)	22.0	156.4	652	4.3	14.6	240
3. Dim. C1: 2022[c]	5.1	36.2	710	1.0	3.2	320
4. Dim. C8: only English cited documents	79.6	369.0	364	15.5	32.6	110
5. Dim. C11: full counting	204.0	705.0	246	39.8	62.3	56
6. Dim. C5: Scopus (dim. C1: 2004-2021)	131.0	928.2	609	25.6	82.0	221
7. Dim. C5: Google Scholar (dim. C1: 2004-2021)	468.5	3,471.5	641	91.4	306.7	236
8. #6+Dim. C8: German cited documents	90.3	286.8	218	17.6	25.3	44

Citations were retrieved in December 2020 for WoS and in March 2021 for Scopus and Google Scholar.
FTE, full-time equivalent; dim., dimension.
[a]Graz: 5.125 FTE, Düsseldorf: 11.32 FTE. [b] Dim. C1: 2009-2020/21; dim. C2: 2009-2018; dim. C4: all research staff; dim. C5: WOS; dim. C6: publication lists/inst. research database; dim. C7: all languages; dim. C8: all languages; dim. C9: all doc. types without weighting; dim. C10: all doc. types without weighting; dim. C11: *1/n*; dim. C12: -; dim. C13: all citations. [c]The citations in 2022 were retrieved end of February 2023.

Table 5. Ranking of the two institutions – effects of changing attributes in a citation analysis – variant 2 (cited documents: only journal articles)

Variations of single attributes	Total citations (dim. C3)		Δ (%)	Citations per FTE[a] (dim. C3)		Δ (%)
	Graz	Düsseldorf		Graz	Düsseldorf	
1. Base of operations[b]	86.0	341.3	297	16.8	30.2	80
2. Dim. C2: 2014-2018 (dim. C1: 2014-2020)	22.0	121.7	453	4.3	10.8	150
3. Dim. C1: 2022[c]	5.1	32.2	631	1.0	2.8	280
4. Dim. C8: only English cited documents	79.6	326.3	310	15.5	28.8	86
5. Dim. C11: full counting	204.0	570.0	179	39.8	50.4	27
6. Dim. C5: Scopus (dim. 1: 2004-2021)	99.7	513.4	415	19.5	45.4	133
7. Dim. C5: Google Scholar (dim. 1: 2004-2021)	272.2	1291.9	375	53.1	114.1	115
8. #6+Dim. C8: German cited documents	46.8	145.5	211	9.1	12.9	41

Citations were retrieved in December 2020 for WoS and in March 2021 for Scopus and Google Scholar.
FTE, full-time equivalent; dim., dimension.
[a]Graz: 5.125 FTE, Düsseldorf: 11.32 FTE. [b] Dim. C1: 2009-2020/21; dim. C2: 2009-2018; dim. C4: all research staff; dim. C5: WOS; dim. C6: publication lists/inst. research database; dim. C7: all languages; dim. C8: all languages; dim. C9: all doc. types without weighting; dim. C10: journal articles without weighting; dim. C11: *1/n*; dim. C12: -; dim. C13: all citations. [c] The citations in 2022 were retrieved end of February 2023.

many citations (+102% for variant 1, +80% for variant 2). These values are similar if only English language publications are considered (variation 4), which is why WoS considers primarily English language journals.

The difference is clearly greater if a shorter time window is chosen for the cited documents (variation 2; 2014-2018). Here the lead of Düsseldorf over Graz is +240% for variant 1 and +150% for variant 2. Düsseldorf has not only a higher publication output in the second half of the observation period, but its publications are also much more cited recently. This is also confirmed by variation 3 where only citations from the year 2022 are considered (+320% more citations for variant 1 and +280% more for variant 2). When full counting is used (which is common practice; see variation 5), the gap between Düsseldorf and Graz is not that large anymore: +56% for variant 1 (62.3 vs. 39.8 cites per FTE) and +27% for variant 2 (50.4 vs. 39.8 cites per FTE). Rather sizeable differences between Düsseldorf

and Graz occur for Scopus (+221%; see variation 6) and Google Scholar (+236%; see variation 7) with regard to variant 1. When only German-language publications are taken into account in Google Scholar (variation 8), the lead of Düsseldorf is much smaller: slightly more than 40% for both variants. Though Graz publishes more in German, its publications are less cited compared to Düsseldorf.

5. DISCUSSION AND CONCLUSION

Our first RQ tried to identify the dimensions which have an impact on the results of research evaluations at the institutional level. Since each of the identified dimensions consists of several attributes, there are hundreds of thousands (regarding publications) or even millions (regarding citations) of possible combinations to rank institutions. Definitely, many of these combinations do not make sense. However, a greater number of them can be relevant in research evaluations.

In practice, when evaluating research institutions, for example in the context of university rankings, only a fraction of these variants can of course be used. However, some variants are used that we would never recommend for reasons of fairness (Anowar et al., 2015; Fauzi et al., 2020; Moed, 2017). For example, many international university rankings are entirely size-dependent or use only individual size-independent indicators. This is probably primarily because in many cases it could be difficult to obtain reliable data on size. If, as in our case, a study is restricted to the area of research, the average number of researchers at a university during the observation period would be needed; ideally in the form of FTE. As our study has shown, obtaining this data is already quite complex for two departments. But international university rankings usually refer to an observation period of just one year (Selten et al., 2020), which in turn makes it much easier to collect size-relevant data, as a single data collection point seems sufficient (all relevant data, such as the number of employees, are only shown on an annual basis anyway), which is why we strongly recommend collecting and taking such data into account as part of research evaluation at the institutional level.

In our study, we chose a ten-year observation period due to possible annual fluctuations in the publication output of individual researchers, as we only considered a relatively small number of researchers due to the restriction to two departments. Due to the much larger number of researchers at entire universities, annual fluctuations in performance by individual researchers should not play a role in university rankings even when looking at the data on an annual basis.

Another dimension that, in our view, is often not given enough attention in international university rankings is the handling of multiple authorships. Full counting is often used with regard to publication output, and this is even the standard in terms of research impact. This seems rather unfair to us, as it puts single authorships at a great disadvantage. However, it should be stressed that the use of fractional counting would mean a considerable additional effort. In the case of fractional counting, we would recommend using the formula $1/n$, which is also the most important in practice, as our literature study has shown (see Section 2).

Based on the second RQ, we wanted to explore whether modified indicators and attributes lead to different rankings and how large the differences in the rankings can be. Hence, we have selected several combinations from the options elaborated theoretically (see Section 2) that we consider useful for research evaluation at the meso-level. As the results show, the rankings can vary greatly.

In addition to the two dimensions already mentioned above (size of the institution and handling of co-authorship), the following dimensions also had a major influence on the results of our case study: a) the representatives, whereby we recommend that the entire research staff should be taken into account in a research evaluation. This is the only way to capture the entire research performance of an institution; and b) the data source, whereby the use of personal publication lists or institutional research databases would be optimal for reasons of completeness. However, such data sources sometimes do not even exist and their use in the context of international university rankings would be extremely complex. In practice, such rankings usually rely on a single one of the common information services (Billaut et al., 2010), which can lead to considerable distortions, as our case study has shown. It would therefore be desirable if these information services were used in combination. One consequence of using these information services as a data source is that the attributes with regard to the dimensions "language" and "document types" are practically fixed, since these information services mainly contain papers in English.

Table 6 summarizes the largest differences depending on the chosen procedure (attributes). As can be seen from our case study, Düsseldorf is clearly ahead in all citation rankings, while the results of the publication rankings are more diverse. Depending on the particular underlying

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Table 6. Dimensions and their attributes having a strong impact on size-independent research rankings either in favor of Graz or Düsseldorf

	Relevant dimension (in favor of Graz)	Relevant attributes (in favor of Düsseldorf)
Publication rankings		
Time period (dim. P1)	2009-2013	2014-2018
Representatives of the institution (dim. P3)	All research staff	Professors[a)]
Data source (dim. P4)	Publication lists/institutional research database	WoS, Scopus[a)], Google Scholar
Language of publications (dim. P5)	German	English
Document types and their weighting (dim. P6)	Higher weights for "journal articles" and "other pubs"	Higher weights for "books" and "articles in proceedings"
Co-authorship (dim. P7)	Full counting	Fractional counting: *1/n*, *2/(n+1)*
Document length (dim. P8)	Journal articles ≥5 pages	
Citation rankings		
Time period of citing documents (dim. C1)		2014-2020/21[a)] 2022[a)]
Time period of cited documents (dim. C2)		2014-2018
Data sources of citing documents (dim. C5)		Scopus[a)] and Google Scholar[a)]
Document types of cited documents (dim. C10)		All document types
Citations to co-authored publications (dim. C11)		Fractional counting: *1/n*

dim., dimension.
[a)]Notably large differences.

"research reality," the selection of a certain attribute of a research dimension is in favor of either the one or the other department.

The large differences between the results of the publication analysis and those of the citation analysis revealed in our case study illustrate the great importance of using both analyses together. In our view, too much emphasis is often placed on citation analyses in international university rankings (Baty, 2013; Huang, 2012). This is critical because, due to the limited data sources for citation analyses, there is little scope for design with regard to other dimensions, such as language.

However, the results of our case study also show that an institution that is significantly better in one area, such as Düsseldorf in terms of citations, performs better in all related rankings, regardless of which (somewhat meaningful) attributes are used. This seems very reassuring to us with regard to the selection of these attributes.

One major limitation of our case study is that it lacks generalization. Therefore, it cannot be taken for granted that other studies also reveal similarly significant differences in their rankings – or even greater differences. Overall, we assume that the variability of the rankings does not only depend on the particular circumstances of the institutions under consideration (for instance, more project staff vs. more long-term employed staff) but also on the discipline. In some natural sciences disciplines it might, for instance, be sufficient to concentrate on journal articles and citations to them. In contrast, in many social sciences and humanities disciplines this would be a much too narrow view, as is also confirmed in our case study. Here, it definitely makes sense to follow a broader approach. However, it must be pointed out that if an institution designated for a research evaluation is invited to participate in the determination of the indicators, it could be "attempted" to suggest those dimensions and attributes which are in favor of it.

Scientometric indicators are not "good" or "bad" per se. However, as our case study shows, a wise use of different indicators can reflect research reality much more adequately. Therefore, rankings of institutions such as the rankings of the world's universities with only one composite indicator are in no way purposeful. As there are numerous possible combinations of quantitative dimensions and their attributes, there is never a "true" measurement and all indicator selection is more or less arbitrary.

Therefore, all mentioned rankings of universities are suboptimal. The research literature on global rankings of

universities is very critical. But the producers of the rankings have failed to adjust their methods. After all, if the publishing institutions insist on producing their rankings in the future, following the literature and the results of our study, we have some serious recommendations:

- Justify your indicators! Tell your customers why you choose some indicators and ignore others! Our list of dimensions and their possible attributes may be helpful.
- Consider the university's size! It is by no means fair to compare a small higher education institution with a university with many researchers, institutes, and larger budgets.
- Justify your selection of authors (all staff, only full professors, with or without postdocs, etc.)!
- Use fractional publication and citation counting (*1/n* given *n* co-authors)! As it is more and more common to work in teams leading to enhanced co-authorships, whole counting (counting all authors as "1") is both statistically problematic and unrealistic.
- Try to compile a complete list of publications of all mentioned universities! Relying only on WoS, Scopus, or Dimensions is a great jeopardy as all multidisciplinary bibliographic information services are biased and incomplete. It would be better to try to find personal or institutional publication lists in addition.

If evaluators fail to follow these hints because the necessary activities are too complex or too costly to realize, the Austrian philosopher Wittgenstein (n.d., ch. 7) should be remembered: "Whereof one cannot speak thereof one must be silent."

CONFLICTS OF INTEREST

No potential conflict of interest relevant to this article was reported.

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Exploring Inclusive Design in Augmented Reality: Enhancing Information Accessibility and Collaborative Play

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ABSTRACT

Augmented reality (AR) offers significant potential for inclusive design by merging virtual and physical environments to support equitable interaction and engagement. This study explores the role of AR in facilitating inclusive play, focusing on how it can enhance information accessibility and collaboration among children with and without disabilities. Using participatory design methodologies, we engaged 21 children aged 8-13, including children with and without disabilities, in co-design sessions to identify barriers and opportunities within AR-based activities. The study included both online and offline sessions, ensuring diverse participation and perspectives. We employed a thematic analysis approach to examine patterns in children's interactions with AR, focusing on engagement, accessibility, and collaborative play. Findings reveal that AR can blur social and physical barriers, foster engagement through interest-driven interaction, and provide adaptive tools to support diverse user needs. The study also highlights the importance of autonomy, tailored technological support, and the role of facilitators in designing equitable AR environments. By positioning AR as a tool for inclusivity, this research contributes to the broader field of information science, offering insights into designing systems that prioritize information accessibility, user engagement, and collaborative interaction. Practical implications for developing AR-based information systems and environments are discussed.

Keywords: augmented reality, inclusive design, information accessibility, co-design, participatory design, user-centered design

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1. INTRODUCTION

The design of inclusive environments that promote equitable access to information and interaction has become an important focus in information science and human-computer interaction. Inclusive design for creating these environments aims to create systems and experiences that can accommodate all human diversity (Sobel et al., 2015). In particular, inclusive environments for children play an essential role in promoting their information accessibility and socialization (Brennan et al., 2016). Play is fundamental to childhood development, serving as a medium for socialization, emotional growth, and learning (Youell, 2008). In the context of play, inclusive environments can foster collaboration and mutual understanding between children with and without disabilities (Lynch et al., 2018). However, children with disabilities often face barriers that limit their participation in traditional play activities. Research has shown that children with disabilities often face challenges in accessing both physical and digital play environments due to design limitations (Kumar & Sanaman, 2013). While existing research continues to show the importance of communication in digital environments and the effectiveness of learning through smart devices, the question remains whether these environments are sufficiently inclusive (Lee, 2016; Stock et al., 2022). Understanding their specific needs and experiences is essential for developing AR systems that foster equitable participation.

As digital environments become more embedded in everyday experiences, access to digital information and knowledge remains a critical factor in ensuring equitable participation. Augmented reality (AR), as a technology that connects physical and digital spaces, offers potential for improving access to digital information, particularly for marginalized user groups, by assisting them to overcome traditional physical barriers (Wu et al., 2013). AR overlays digital content onto the real world, allowing users to experience immersive experiences that can be customized to their needs and preferences (Dick, 2021). These unique characteristics make AR a promising tool for addressing accessibility and inclusion issues, especially for diverse user groups such as children with disabilities (Macdonald & Clayton, 2013). While previous studies have explored AR's potential for learning and engagement, there remains a gap in understanding how AR can be leveraged to address accessibility and inclusion in digital play environments. Existing research has primarily focused on usability and experience (Koumpouros, 2024), but limited work has examined how AR can bridge social and physical barriers for children with diverse needs. Our study investigates how AR can support information accessibility, collaboration, and equitable interaction for children with diverse needs.

This study examines how AR-based environments can serve as inclusive digital spaces that promote information accessibility and collaborative interaction. Using participatory design methodologies, we engaged children in co-design sessions to explore the affordances and limitations of AR in inclusive play environments. Thematic analysis was employed to analyze insights from these sessions and identify key design considerations for inclusive AR systems. By bringing children's voices and experiences to the forefront, this research contributes to our understanding of how AR environments can be designed to support diverse user needs, foster collaboration, and enhance participation.

A key issue is how AR may both support and hinder accessibility and collaboration for children with diverse needs, particularly in play-based interactions. Additionally, there is a need to identify design elements that facilitate equitable user engagement and ensure that AR systems promote meaningful interaction rather than reinforcing barriers. Therefore, this study explores how AR can be leveraged to create inclusive play experiences by examining its role in accessibility, engagement, and co-design with children. It addresses the following research questions:

1. How does AR support or hinder accessibility and collaboration in inclusive play environments for children with diverse needs?
2. What are the design elements required to enhance equitable interaction and user engagement in AR-based systems?
3. How can participatory design methodologies involving children inform the development of inclusive AR environments that promote information accessibility?

The findings of this study have broader implications for information science, particularly in the design of digital systems that prioritize accessibility and inclusion. By examining the interplay between technology, user needs, and social interaction, this research provides valuable insights into the development of AR-based environments that support equitable access to information and interaction for diverse user groups. Through a focus on co-design with children, we aim to address the fundamental gap in play experiences for children with diverse needs.

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2. RELATED WORK

In this section, we aim to explore what 1) "inclusive play in advancing accessibility" is, 2) how children with and without disabilities have collaborated to co-design together, and lastly 3) the current research in AR and children's content within AR, in order to understand the possibilities in creating inclusive play with children within an AR environment.

2.1. Inclusive Play in Advancing Accessibility

Inclusive play refers to play programs that allow children with and without disabilities to participate equally and equitably (Sobel et al., 2015). Children's play environments are often designed for the developing child without much consideration for children who have special needs because of physical and sensory limitations, therefore often leading to a harder time being included in certain activities (Movahedazarhouligh, 2018). Addressing these barriers is a critical issue because play has a profound impact on children's development, both socially and emotionally (Youell, 2008). Inclusive play builds on this need, ensuring that all children with diverse needs can learn vital social and emotional skills. It also provides a place to learn to recognize, empathize, and respect human diversity and differences (Odom & Diamond, 1998).

Especially within the context of information exploration, inclusive play provides children with opportunities to engage in a wider range of collaborative information seeking (CIS) behaviors (Motti, 2019). CIS is an information seeking process that is clearly defined, interactive, and mutually beneficial among participants, where children work individually and in groups during play to experience a variety of information processing processes (Sangari & Zerehsaz, 2020; Shah & Marchionini, 2010). When children engage in CIS in an inclusive environment, they gain experience in understanding each other's perspectives and abilities (Talja, 2002). Drawing on CIS behaviors in inclusive play environments, our study focuses on designing AR experiences that promote equitable interactions among children with and without disabilities.

Research on inclusive play has been conducted in diverse academic settings. First, in education, the learning benefits of inclusive play and different approaches to creating inclusive classrooms have been analyzed. Danniels and Pyle (2023) investigated preschool teachers' perspectives and approaches to inclusive play. They found that teachers adopted a variety of approaches to successful inclusive play, including being visually and socially supportive, child-centered, and respectful of children's opinions. Scholars in the field of human computer interaction (HCI) have focused on the design of assistive technology to help children with disabilities participate equitably in play (Boyd et al., 2019; Currin, 2022; Sobel et al., 2016). Metatla et al. (2020) designed a robot-based educational game that allows children with visual impairments to participate. Within these studies, many scholars have stated that there is an additional need to investigate children's perspectives and thoughts about technology. In this study, we aim to investigate how AR-based interactions impact inclusive play principles and make improvements based on children's perspectives.

2.2. Co-Designs with Diverse User Groups for Inclusive Digital Systems

Children with disabilities have their own unique physical and emotional challenges. As opposed to the mindset of experts of technology design for the user, the co-design method adapts a mindset of including the end-user in the process of design (Druin, 2002; Walsh et al., 2012; Yip et al., 2013). Traditionally, co-design has been often used to include historically marginalized groups in the process of design, and scholars have explored new methods and techniques for their inclusion (Fails et al., 2013; Hiniker et al., 2016; Walsh et al., 2010). Co-design allows end-users the flexibility to participate in the development of a product or technology that they will use as researchers, and their perspectives and opinions can contribute to a more user-centered and inclusive design. Therefore, in designing new technology for children with disabilities, co-design has often been used as a methodology as it actively considers new forms and methods for participation in making design decisions. Frauenberger et al. (2017), for instance, conducted co-design with autistic children for two years to design their own smart objects. During their research, they empowered autistic children to generate ideas, develop prototypes, and select materials. Their visual aid was developed to assist designers with gathering input and to understand the perspectives of children with disabilities. Sobel et al. (2015) identified factors that facilitate and hinder inclusive play through co-design sessions with neurologically disabled children. They found that direct and embedded support, transparency, adaptability, use of new technology, and emphasizing children's interests and strengths facilitated inclusive play. On the other hand, the effort required for play, children's preferences, and parents' lack of experience functioned as barriers to inclusive play.

There have also been attempts to design technology for inclusive education (Pires et al., 2022) and develop technology to facilitate the participation of a broader range of disabled children (Robb et al., 2017). Most of these studies acknowledged that there are still limitations in involving children with disabilities and without disabilities in co-designing. Despite its limitations, the method of co-design still strives to maximize collaboration and participation by understanding the group dynamics and the role of the facilitator. In our study, we focused on participatory design methodologies for co-design, allowing children with diverse needs to directly explore their preferences for AR experiences. In participatory design, engaging children in decision-making processes requires methods that are both interactive and accessible. "Would You Rather" (WYR) has been used to help children express preferences and navigate complex design choices in an intuitive manner (Simko et al., 2021). Similarly, "Comic Boarding" enables children to visualize and narrate their design ideas through storytelling, making it particularly valuable for users with varying communication abilities (Moraveji et al., 2007). In this study, we employ these methods to facilitate meaningful participation from children with diverse needs, ensuring that their voices are effectively captured in the co-design process.

2.3. Augmented Reality as a Tool for Accessibility and Engagement

AR is a technology that augments virtual, digital information onto the real world to create an interactive experience (Craig, 2013). AR has been increasingly recognized as a tool for enhancing access to digital information, particularly for individuals who face barriers in traditional digital environments. Unlike conventional screen-based interfaces, AR integrates digital information into real-world interactions, offering new opportunities for engagement and accessibility (Qiao et al., 2019). Recent market analyses predict that the AR industry will continue its rapid expansion, with projections indicating a market value exceeding US $13 billion by 2024 (Statista, 2024). This growth underscores AR's increasing integration into various domains, including education, accessibility, and assistive technologies. While the prediction of AR devices replacing all conventional displays did not come as predicted, still there has been active research in creating novel and effective visualization for AR (Maio et al., 2024; Shaghaghian et al., 2024).

However, AR utilizes a variety of sensors and devices, not just digital outputs, and allows users to exist partially in a virtual environment. Prior research with children has shown that blending artificial and real worlds fosters children's imaginations, providing them with fictional, fantastical experiences beyond what they can experience in the real world (Alali & Al-Barakat, 2024; Dengel et al., 2022) and enabling them to understand abstract concepts easier (Mansor et al., 2023). Research has also shown that virtual reality (VR) and AR-based learning is effective in improving student learning performance (Yoo et al., 2018). These benefits have prompted educational institutions, such as libraries and schools, to adopt a variety of VR devices for their users' information seeking (Elahi, 2016; Lim, 2021). Based on these positive possibilities, research continues on how to use AR in a more inclusive way. Currently, AR contents for children are being developed in various fields such as school education (Abdullah et al., 2024), content development training (Cash et al., 2020), and media use education (Hiniker et al., 2017).

At the same time, AR for children with disabilities is centered on more specific needs that require more consideration, such as self-assessment (Torrado et al., 2019) and language learning (El Shemy, 2022). For children with disabilities, AR can serve as a bridge between physical and digital spaces, providing interactive and adaptive learning experiences tailored to their needs (Mokmin & Rassy, 2024). This study examines how AR functions within digital environments to promote equitable access to information and knowledge, particularly in play-based learning contexts. Mokmin and Rassy (2024) reviewed studies of AR technology in physical education for children with learning disabilities. In their analysis, they found that AR had a positive impact on children's physical activity and motivation, and that it was more adaptable for people with and without disabilities to play sports together because it did not require special equipment. This allowed children with disabilities to learn more safely and inclusively without the need for special assistance or technology. We have expanded our discussion to specify how AR's unique affordances are examined in this study to assess their potential in supporting information accessibility and user engagement.

3. METHODS

To collectively identify children's views on inclusive play, we used two techniques from the participatory design methodology: WYR (Simko et al., 2021) and "Comic Boarding" (Moraveji et al., 2007). Participatory design methodology is a collaborative design methodology that

involves end-users in the design of a product or activity to include their opinions and perspectives (Spinuzzi, 2005). WYR is a technique in participatory design methodology in which two alternatives are presented and participants are asked to choose between them. In the process, the participants' perspectives and values are revealed (Simko et al., 2021). "Comic Boarding" is another technique in co-design where participants fill in the blanks of a given comic scenario in various settings. Comic boarding allows us to understand the designer's intent and context through the comic's organization and elements. This technique is particularly useful because it helps to intuitively illustrate elements that are difficult or ambiguous to express in writing (Walsh et al., 2013). These participatory design techniques aim for children to participate equally with adult designers in the design process and effectively validate their ideas and insights. It can also reveal underlying values and worldviews beyond words (Muller & Kuhn, 1993). Using these techniques, we sought to engage children in the design of an inclusive play process and explore their opinions about AR.

3.1. Participants

The study consisted of one adult researcher and 21 children aged 8-13 years old. We held three sessions, four times between August and September 2023. The first session, WYR was held online with 10 children, and twice with five children each time to ensure active participation, and the second session, "Comic Boarding," was held offline with 12 children. In the final session, the first author observed children interacting with AR content. Participants were recruited through a church physical education program, ensuring familiarity among participants to facilitate smoother interactions during participatory design sessions. Selection criteria included: (1) age range of 8-13 years to ensure cognitive and social engagement in design discussions, (2) willingness to participate in interactive AR-related activities, and (3) representation of children

Table 1. Participants' information

Child pseudonym	Gender	Age (yr)	Note	Participated session
Aiden	Boy	8	Diagnosed language disorder	Session 1
Jackson	Boy	8	Diagnosed language disorder	Session 1
Lily	Girl	8	-	Session 2
Sophia	Girl	9	Siblings	Session 2
Olivia	Girl	12	Siblings	Session 2
Lucas	Boy	10	Siblings	Session 1, 3
Liam	Boy	12	Siblings	Session 1, 3
Emma	Girl	10	Siblings	Session 1, 3
Ethan	Boy	12	Siblings	Session 1, 3
Ava	Girl	10	Siblings	Session 2
Mia	Girl	13	Siblings	Session 2
Noah	Boy	10	-	Session 2
Abigail	Girl	11	Siblings (twins)	Session 1, 2
Amelia	Girl	11	Siblings (twins)	Session 1, 2
Scarlett	Girl	11	-	Session 1
Grace	Girl	11	-	Session 2
Chloe	Girl	11	-	Session 2
Aria	Girl	11	-	Session 2
Harper	Girl	12	-	Session 1
Evelyn	Girl	12	-	Session 2
Caleb	Boy	12	-	Session 3

with and without disabilities to understand diverse perspectives on inclusive play. There were also four pairs of family participants. The families all participated within the same session, and most of them participated in the same group. In the first session, two children who were diagnosed with language disorder participated in the activity. These two children participated in different rounds of the same session (Table 1).

Although the first author had prior relationships with the parents of children with disabilities, the research design and data analysis process were structured to mitigate potential biases. All data collection and coding were conducted following established qualitative research protocols, and findings were validated by independent researchers who had no prior relationship with the participants. The division into online and offline groups was based on logistical constraints and participant availability. While we recognize the uneven distribution, our priority was maintaining a setting where participants had pre-established relationships, as familiarity facilitated more natural discussions and collaboration during the sessions. This study was conducted following ethical guidelines for research with children. Parental consent and child assent were obtained before participation. To ensure participant privacy, all names were anonymized or pseudonymized in transcripts and reports. Children were informed of their right to withdraw from the study at any time without consequences.

3.2. Data Collection

3.2.1. Session 1: Would You Rather?

The first session consisted of two online activities. The online sessions were held via the Zoom meeting program (Zoom Video Communications, San Jose, CA, USA) and lasted about an hour per session. The sessions consisted of an introduction and practice (10 minutes), a WYR activity (45 minutes), and a wrap-up and reflection (5 minutes). The children were asked to answer and discuss 12 questions prepared by the researcher, which were based on their values and preferences for AR and technology. Throughout the activity, the children had to choose between two difficult choices and explain why. They were encouraged to ask each other questions or discuss if they

Table 2. Would You Rather (WYR) questionnaires

No.	Topic	Methodological variations	Scenario
1	Exploring children's values	Practice options	WYR choose midsummer or midwinter?
2		Preferences for group activities	WYR always study alone or study with someone else?
3		Perception of competition	WYR be first on the last place team or last on the first-place team?
4		Writing and speaking preferences	WYR just call or just text?
5		Recognizing and responding to negative situations	WYR be in a situation where no one listens to you, or be in an embarrassing situation where you have to introduce yourself in front of a group of strangers?
6	Perceptions of AR technology	Researching VR and AR preferences	WYR be in a fairy tale or have a fairy tale character come out into your world?
7		Preferences between AR and digital content	WYR play Pokémon Go or Nintendo Pokémon?
8		Researching preferences between pre-made characters to self-made characters	WYR have the pictures in the book come to life or the character you drew come to life?
9	Preferred content	Preferences for linguistic scaffolding assistants in content	WYR have a friend who says everything you want to say, or a friend who always listens to you when you talk?
10		Preference for passive and active content	WYR imitate a character or the character imitate you?
11		How to solve problems when you encounter them	(If you're working on a problem and don't know the answer) WYR work through it with a friend or ask your teacher for the answer right away?
12		Preference for presented vs. authorized content	WYR explain your favorite things to your friends or have them explain them to you?

VR, virtual reality; AR, augmented reality.

did not understand the reasons, and the researcher's role was to facilitate the discussion without intervening with opinions. The questions used in the sessions were organized and edited based on prior research (Simko et al., 2021). We aimed to identify children's value-based preferences regarding AR and inclusive play in this session (Table 2).

During the session, the questions were displayed on the screen through PowerPoint slides. Children expressed their decisions by raising one or two fingers. All data, including video, audio, and chat, was recorded online using Zoom (Fig. 1).

3.2.2. Session 2: Comic Boarding

The second session was an in-person activity. The activity lasted about an hour and consisted of an orientation and explanation (15 minutes), a comic boarding activity (30 minutes), and a presentation and wrap-up (15 minutes). We presented the children with an example of a problematic scenario and asked them to generate a solution. They had to fill in the third blank of four comics depicting the problem situation. The cartoons were as follows: First cut, you see your friends being teased because they cannot speak well; second cut, as you are thinking about how to help your friend, your cell phone suddenly glows and something popped up on it; third cut, left blank for children to fill in; final cut, your friend was able to get along with her other friends, but what was it that popped up and helped her (Fig. 2)?

The problem context implies that the participant child is helping a child with a speech impediment. In particular, the setting of something appearing on a phone device implies a use of AR. Therefore, by thinking of a solution that includes the concept of 'augmentation,' the children naturally think about the elements necessary for interacting with children with disabilities.

The activity was divided into four groups of three. After identifying the problem situation, the groups were first asked to exchange opinions through the sticky note technique. The sticky note technique is one of the most used techniques in co-design and helps gather and synthesize different ideas from participants (Fails et al., 2013). Each participant was asked to write their opinion on a Post-It note, and then stick it on a large piece of construction paper and write an explanation of their opinion. Next, they were asked to synthesize and discuss the contents shared on the sticky notes and draw cartoons on a large-sized paper sheet. To ensure that no child was left out of the process, the researcher participated in each group's discussion and tracked time to ensure that everyone had a chance to explain their opinions. The researcher also acted as a mediator, helping the other children understand the content by asking additional questions if they were unable to explain well. All discussions and decisions were made by the children themselves. The process was recorded and captured on camera (Fig. 3).

After the discussion and drawing process, they were asked to come forward with their drawings and explain their team's intentions and meanings. This process allowed us to see the children's intentions and values that were not evident from the drawings alone. We allowed children to express design ideas for inclusive AR environments and highlighted key considerations for AR-based interactions through a scenario setting.

3.2.3. Session 3: Participant Observation

The third session consisted of one offline activity. The activity lasted about 30 minutes, with each child taking



Fig. 1. A screenshot of Session 1 where children are voting.



Fig. 2. Comic boarding scenario.



Fig. 3. Children working in groups to fill in blank space and afterward presenting.

turns to use the AR app for about 5 minutes per person. The activity was conducted using one iPad device (Apple Inc., Cupertino, CA, USA), and only a basic explanation of what AR is and how to use the app was provided beforehand. The children were allowed to use the device autonomously without any order or rules. The researcher's intervention was limited to mediating excessive conflicts between children or organizing the situation so that the activity could proceed smoothly. The activity was captured and recorded on camera. We wanted to identify how children in different conditions utilize AR and what factors influence their autonomous use of AR. In the process of observing children interacting with AR content, we were able to provide insights into how children interact with AR autonomously, revealing factors that foster or hinder inclusive play.

The used application was Math Ninja AR (Fantamstick, Ltd., Tokyo, Japan), which allows children to view displayed math questions and find the correct answer within the augmented AR content. To find apps for the sessions, the second author searched for AR content in the Google App store (Google LLC., Mountain View, CA, USA) and Apple App store (Apple Inc., Cupertino, CA, USA), and compiled a list of AR apps for children that allowed for actual interaction rather than just viewing. The first and second authors then had a meeting to select the apps based on three criteria: 1) interaction more than just touch; 2) low barrier to entry; and 3) capability for multiple users.

In the end, the Math Ninja AR app was chosen because first, it required children to be physically active, such as squatting or moving around to find answers, as opposed to merely touching the screen. Second, when we did a test run, all the researchers found the concept easy to understand but challenging enough for the children to be engaged. Lastly, the application allowed multiple children to solve problems at the same time. These features were thought to be sufficiently representative of the kinds of problems and situations children might encounter when using AR for inclusive play.

3.3. Data Analysis

The first author of the paper content logged all the

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recorded videos that totaled approximately 360 minutes for the three sessions. After logging the recorded videos, additional observational and analytical notes were written in a separate document. Codes were developed using a grounded theory approach with constant comparative analysis (Corbin & Strauss, 1990). Initial open coding was conducted to identify recurring patterns related to inclusive play in AR environments. Through iterative discussions, the research team refined the coding scheme based on thematic relevance to the study's objectives. Criteria for code creation included: (1) relevance to AR's role in fostering or hindering inclusion, (2) observable behaviors or statements related to engagement and accessibility, and (3) emerging themes that reflected children's design perspectives. By using the researcher's analytical memos, discussion notes with parents, and video data, we made sure all data supported each other. We generated the following codes: hinder/foster inclusion, active/disengaged participation, interest and confidence, technological support, facilitator role, and rules. For validity, we presented the findings to two researchers who did not have any prior relationship with the children in the study but had an understanding of "inclusive play" through prior research experience, and refined the final coding scheme.

4. FINDINGS

We sought to discover how children engage in inclusive play with the technology of AR. To achieve this goal, we conducted four sessions. Each session explored children's AR awareness, content needs, and inclusive play behaviors. From this, we were able to identify several factors that facilitate and hinder inclusive play with AR, which can be summarized into three main categories: 1) interest and confidence; 2) technology in inclusive play; and 3) support and guidelines.

4.1. Interest and Confidence

Children were more engaged in play when they shared a common interest with other children, recognizing each other's strengths and working together. In this process, children became confident in their abilities and actively participated in play. In our sessions, we observed children focusing on their own interests. Among the codes we generated, the children's behavior classified and collected through the codes 'hinder/foster inclusion,' 'active/disengaged participation,' and 'interest and confidence' revealed that children's interest and confidence are key factors in their participation in play activities and information seeking groups. A common theme across all the sessions was that children were engaged in activities once an element that they were interested in was added, despite the fact that the topic itself (mathematics) was not favorable for most children. In Session 3, the participants played a game using AR to solve math problems. Most of the children did not like math and were not confident in their ability to answer the questions. However, they were intrigued by the AR activity and actively participated. The game, which was played on an iPad, required a great deal of physical activity such as walking around, squatting, and standing up. Even the children who were initially confused by the math problems were soon intrigued by the AR graphics and spontaneously moved beyond the initial required physical activity. Liam said that his interest in the physical activity that the technology required led to an interest in math: "It's fun to do math problems like this!" In addition, there was Caleb, who struggled to socialize with other children outside of the session, but his strength was math. When he showed interest in the AR math game that the other children were playing during the session and tried to join in, they were all reluctant. But as he quickly worked through the problems and found the answers, children from other teams came up to him and asked to play with him. The initially interested but hesitant child gradually gained confidence in his strengths and led the play.

All of the children risked getting frustrated or losing interest during the sessions. This was especially noticeable with the children who were diagnosed with language impairment, which included two children in Session 1. These children showed a lack of confidence, stating that others did not like them or did not play with them because they were speaking slowly, so they were often disengaged during discussions or presentations. Even though the activity required them to answer and explain the reasoning for the alternative questions in the WYR activity, they often answered the questions with short answers or chatted to themselves. This was distinct from the other participants, who provided their own answers and specific rationale for almost every question. Aiden and Jackson, who both have language disorders, were particularly enthusiastic when questions were about topics they were interested in, such as games or friends. However, their interests quickly shifted when another friend asked them additional questions and they either did not answer or gave different answers.

This tendency to engage in interest-driven play also highlighted the importance of proactivity and self-confidence in children. In Session 2, children were asked to consider how they would help a friend who was struggling

to socialize with children and had relationship problems due to her inability to speak. Most of the children argued that the cause of the problem was not a disability, but a lack of proactivity, and suggested solutions such as "going back to the beginning of the relationship and rebuilding it with confidence," or "using assistive technology to find confidence and competence." The relationship problem that children perceived was less about the fact that the child does not speak well, and more about the fact that they did not feel confident or have not reached out to others first. When asked why they thought approaching first mattered more, the children said they could interpret it as an indicator of interest. They valued participating in the activity rather than the method or format. Some children interpreted others not participating as a lack of interest in the activity, or they were not interested themselves. This suggests that children's cooperative play requires a high level of activeness, and that children may interpret expressions of interest as a willingness to cooperate. Additionally, the children showed a tendency to be more active in searching for and sharing information when their interest and confidence were fostered. In all sessions, children were observed to demonstrate the most active CIS behavior when discussing topics that aligned with their interests. Conversely, when they lacked interest or confidence, they were hesitant to share information or participate in the information-sharing group. These observations suggest that children's information accessibility could be primarily influenced by their interests.

4.2. Technology in Inclusive Play

Technology can be used both positively and negatively for inclusive play. In Sessions 1 and 2, the concept of augmentation was presented as "something that pops out of the phone." Children naturally accepted the concept of augmentation and had no difficulty describing a situation that involved something appearing on their phone. The children's familiarity with smartphones and tablets was evident, as they were already part of their daily routine, and their wariness was low. When the questions in Session 1 asked for examples of other unfamiliar devices, such as a Nintendo, some children expressed discomfort with the device before applying it to a specific situation: "[a] Nintendo is uncomfortable and heavy to carry around" (Abigail). However, when a device such as a smartphone was presented as an example, there were complaints and suggestions about the augmented content, but no questions about the device itself. In the real-world experience of AR content in Session 3, children were excited to be able to enjoy a completely new virtual environment and activity on a familiar device in a church space where they had limited options for play.

However, in some cases, the limitations of the devices made activities difficult. In Session 3, five children played a multiplayer game using a single tablet device to solve math problems and moved the device around to find the answers. The children quickly adapted to the AR on the tablet screen. Without much instruction, they easily figured out how to play the game and proceeded to play the activity as if they already knew how to utilize the device. However, because there was only one tablet device available, many children had to wait, and some expressed frustration that they could not see the screen well or that they had less opportunity to play. Participants holding their own tablets also complained that the screen was too small, and that the augmented objects were hard to see (Fig. 4).

Through the children's behavior that emerged during the sessions, especially those classified as "technological support," we observed that AR can play an essential role in creating an "equitable environment." While children were mostly excited about the question of creating AR content elements, they were less enthusiastic about the idea of seeing someone else's drawings come to life. The lack of trust in others manifested itself in fear and exclusion. For instance, in response to the question in Session 1, "WYR have the pictures in the book come to life or the character you drew come to life?", the children worried about poorly drawn pictures coming to life that can threaten the world they live in. However, in the process, who drew the picture



Fig. 4. Children playing with augmented reality apps in Session 3.

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and who owns the picture was considered less important. Given that the question refers to the picture as the AR content and the person who drew it as the AR player, we can assume that the user receives relatively little attention in the process of children's use of AR. Differences and characteristics between users are less important because they are focused on the new and unfamiliar AR content itself.

In this context, in Session 3, children paid less attention to who they were playing with when they focused on the AR activity. Since there was only one device, most of the attention was focused on the child holding the tablet. These children were so focused on enjoying the AR content that they were often unaware of who else was around them. As a result, when using AR, the children frequently found themselves playing with children with whom they were not normally close, and they even reached out to children with whom they were not familiar but who were good at using AR, showing communication that extended beyond their existing relationships. The sessions included children with a variety of characteristics—difference in height, age, children who were more focused or those more easily distracted, children who were talkative or quiet, etc. Regardless of these differences, the children simply found someone to use AR with quickly and did not consider other factors in their interactions. Differences between children were not considered, which automatically created a situation of inclusion. These findings indicate that AR can serve as an accessible tool for children with diverse needs by providing adaptive and interest-driven engagement opportunities. AR's ability to integrate digital and physical play environments fosters equitable access to information through interactive and immersive experiences. This reinforces the role of AR as an information-accessible medium in digital environments.

4.3. Support and Guidelines

Adult assistance is essential in most inclusive play environments. Classified under the codes 'Facilitator Role' and 'Rules,' the children's behavior demonstrated their need for the presence of a facilitator in the play and the way children learn norms and rules through AR experience. In Session 2, children expressed a preference for a facilitator figure, often imagined as a fairy, goddess, or wizard from fairy tales, who would consistently support them within the AR content. They wanted a facilitator who was "familiar and comfortable" and who could provide tangible support for their situation. However, they did not want a facilitator to directly participate in the activity with them or do it for them. For instance, children wanted a fairy from a cartoon to pop up and help them in their adventures or relationships. Children insisted that they were responsible for what happened after the facilitator helped them through the situation. Similarly, they wanted a comforting presence, such as a family member, to give them a boost of courage. In this case, they did not ask for more than comfort, desiring only support for their work and relationship building. When asked about their preference for an active or passive facilitator in Session 1, children also rejected more than a certain amount of intervention, asking why a facilitator should do something for them that they could do themselves. This was contrary to our expectation that in the context of AR or digital content, children would want more active intervention because anything they imagined could appear. Because this was an AR environment rather than a real-world play environment, they wanted more autonomy, and they wanted to be able to control the situation themselves.

Children were able to play autonomously, even when they were actually trying out AR. During the actual AR game in Session 3, most of the gameplay did not require any special explanation or assistance, as the instructions for the activity were already well-described within the AR environment. The children quickly picked up on the inherent activity rules and adapted easily. Problems arose outside of the games. Liam fell while fighting over a device or pushing Ethan to get a better view of the screen. There were also complaints about one child monopolizing the device, but after a few initial teacher interventions, the children established some order, such as answering three questions themselves before passing it to another child. Once the rule was established, the children were able to play relatively fairly. At the same time, however, there were problems such as children who lost interest in the game after their turn and went to other activities, which lowered the interest and morale of the remaining children, or children who did not follow the rules who were unduly criticized by others. When the researcher intervened to encourage the children and set additional rules, the immediate problem was solved, but some children quickly lost interest in the game because they felt they had lost their autonomy. This shows that the AR environment is relatively effective in ensuring children's autonomy, and the inherent rules can be acquired through technical elements, so that external intervention by adults is less necessary than in real-life play.

Overall, our findings suggest that effective AR design for accessible and inclusive play should incorporate the

following elements: (1) interest-driven engagement, (2) intuitive and adaptive interfaces, (3) multi-user collaboration features, and (4) minimal but supportive facilitator intervention. These insights provide concrete guidelines for developing AR technologies that enhance both play and information accessibility for diverse user groups.

5. DISCUSSION

In this study, we investigated the elements within AR for inclusive play that children wanted through co-design sessions. We propose suggestions for developing inclusive play activities within AR.

5.1. Designing for AR Activities: Renewal of Content and Self-Encouraging Features

The children in this study showed considerable interest in the AR activities, but when they lost interest, they quickly left or became uncooperative. This behavior was demoralizing to the other children involved in the activity and made them think that the children who left were not interested in the relationship. As children tend to follow the interests of their peer group, the impact of this behavior extends beyond the play activity and into the relationships between children (Jitsaeng & Chaikhambung, 2022). This also affects the information accessibility that children experience in play, as children may refuse to participate or lose interest in the CIS process (Motti, 2019). In this regard, Kangas et al. (2023) suggests that for inclusive play to occur, the content should provide new activities and interactions on a regular basis to keep children interested. In our observation, children with disabilities often show a rapid change of interest and a lack of response to questions that do not interest them. Therefore, understanding children's interest cycles and providing new content is an important issue in designing for inclusive play using AR.

AR has many aspects that make it attractive to children. Through AR, children can experience the perspective of another person and have an immersive VR experience (Dick, 2021). Considering that much current AR content is designed to be short and intuitive with educational or therapeutic purposes, there is a need to develop AR content with a wider range of engaging elements. AR allows us to experience traditional play in a completely new perspective through digitally augmented elements. In an unfamiliar and rapidly changing play process, children can feel the necessity of cooperation and learn the sense of teamwork. Especially for children with disabilities, such content can be more comfortable, as everyone is initially unfamiliar with the play process and needs time to adapt to the play process. However, confidence is the necessary precondition for this.

In our observations across the sessions, we found that children commonly interpreted disengagement as a lack of interest in play. Many of the children were disengaged in play due to lack of interest or exhaustion. However, in the sessions it was noticeable that the children with disabilities, before expressing their interest, were afraid that they would delay the play activity or bore everyone else. They showed a lack of confidence in their own abilities, valuing the reactions of other children over their own preferences in play activities. These fears not only prevented them from participating in play but can also have a negative impact on their relationships with other children (Mshali & Al-Azawei, 2022). It can also prevent children with disabilities from taking a leading role in inclusive play, where cooperation is essential. To overcome this, AR's feature of being able to experience both real and virtual environments simultaneously can help.

AR works by overlaying virtual elements that users want on top of a real-world background, but the ability requirements for activities vary greatly depending on the specific content. AR can be used to provide an inclusive play environment by limiting the required abilities such as physical, educational, and emotional skills, based on the characteristics of the participating children. In the case of the AR app utilized in the activity in Session 3, the physical ability to find answers was important, but the ability to solve math problems quickly was more important. Therefore, the children decided to form teams based on mathematical skills rather than on relationships or personalities, and focused on roles that could utilize their strengths. Children showed the most confidence when their strengths were recognized. As such, inclusive play content using AR should be designed in a way that allows children with a variety of conditions to express their strengths. It should offer a wide range of interaction options so that children who are not confident in some areas can utilize other strengths. This content design approach is better suited to AR, which allows for multiple ways to engage with the same content in a wider range of contexts, compared to other technologies that often restrict users to a limited set of interactions within predetermined contexts. In this process, AR environments can serve as "invisible equalizers," reducing the salience of physical and social differences among children. Our findings align with prior research on information behavior in digital environments (Dick, 2021), extending these theories to the context of

collaborative play. Additionally, our findings suggest that AR facilitates CIS behaviors, reinforcing theories of co-learning and participatory design in HCI.

5.2. Creating Spaces for Children to Play in Equal Basis

Inclusive play is heavily influenced by environmental factors. Children with and without disabilities need to participate in activities together, requiring a wider range of physical and emotional factors to be considered. These environmental factors need to be considered when creating inclusive play content using AR. Children were familiar with devices such as smartphones and tablets but were frustrated with additional devices like Nintendo Switch. In Session 3, when we tried AR in action, we found that the inconvenience of having to share a single device and the technical limitations, such as poor camera recognition, hindered the immersion of the play. These challenges were similar to those encountered in many previous studies using digital devices (Balbin & Dolendo, 2023). Yet at the same time, AR gives children an expanded play space and allows them to try new things they have never experienced before. Our findings indicate that AR enhances information accessibility by providing children with interactive and adaptive ways to engage with content that accommodates diverse needs. By blending physical and digital spaces, AR reduces traditional barriers to information access—such as physical mobility limitations or language constraints—enabling children with disabilities to participate on a more equal footing with their peers.

A major advantage of AR is that it blurs the boundaries between children. When we asked children in Session 1 what elements of AR they wanted, they focused more on the content of the activity rather than the AR user they were interacting with. This suggests that AR experiences should prioritize engagement-driven design, where multi-sensory interaction, adaptive difficulty levels, and dynamic challenges sustain children's participation and encourage collaboration.

In Session 3, children were even unaware of who was around them because they were so focused on the AR game they were playing. Since they were more concentrated on what they were doing rather than the people around them in the expanded play space, they often played with children they were not familiar with during the session. The AR app used in the Sessions required active physical interaction. Children actively moved their bodies and operated the device to find answers.

At this point, differences between children were not a matter of concern, at least for the participating children. As such, in most AR-related sessions, the researchers noticed the children forgetting the differences between the other children they were playing with as they focused on the activity and collaboration itself. This reflects how AR can influence information behavior by encouraging collaborative activities that prioritize shared problem solving over individual differences. This may have implications for reducing children's feelings of disjunction and exclusion when physical and neurological differences exist between children. Prior research (Dick, 2021) has argued that AR experiences support equality and inclusion by removing the need to consider differences in conditions between users. In inclusive play, which is heavily influenced by the environment, AR provides a space for everyone to participate on a relatively equal basis by invisibilizing differences, and allows for dynamic experiences with minimal movement. AR also has the potential to enhance information accessibility by allowing children to engage with content in ways that minimize barriers such as physical mobility or language skills (Köse & Güner-Yildiz, 2021). This use of technology in inclusive play has both advantages and disadvantages and needs to be developed carefully. It is important to consider the different personalities and contexts in which children operate the devices they are familiar with. Inclusive play spaces can be designed so that children can focus on the AR environment and rules rather than on their differences.

5.3. Assistance and Norms in AR Content

In this study, children requested the presence of a familiar and comfortable helper. However, they refused to allow the assistant to provide direct assistance, preferring to maintain their autonomy. AR environments make it relatively easy to provide these assistants. While many inclusive plays rely heavily on adults to teach and moderate the play (Danniels & Pyle, 2023), AR environments can automate this through elements such as augmented indicators or direct introductions to activities by the main character of the augmented content. These technological methods can be used to create a play environment that engages children without controlling them directly, and that feels like it respects their autonomy as much as possible. Despite its potential for inclusion, AR still presents challenges such as device availability, usability constraints, and potential disengagement due to technical limitations (Quintero et al., 2019). Therefore, AR environments require careful content moderation and facilitation to prevent excessive autonomy from leading to confusion or conflict. Future

research should explore how to balance autonomy with structured guidance in AR-based play settings. Since AR is an extended form of digital content based on reality, it is relatively uninterrupted when children are interacting and learning embedded social norms. Children believe they are exploring a virtual environment through AR, but they are playing within the confines of reality. This illusion allows children to learn the norms and relationships of the real world that are familiar to them in a more enjoyable way. However, this requires that the presence of a human assistant in the AR content be authoritative—someone children can rely on and feel safe around in an unfamiliar virtual environment. Such assistants need to be defined as a guardian or a supportive figure so that they can easily accept the guidelines provided in the AR environment. It is also necessary to define norms to avoid confusion with the hierarchy and rules of the real world that children are accustomed to.

6. CONCLUSION

In the modern world, investments and developments in AR are increasing. AR for children with disabilities is especially challenging. The practicalities of AR for children with disabilities are much more complex than those for children without disabilities. Therefore, when developing AR as a tool for inclusive play, more research is needed to consider cooperation and harmony with other children. Through three participatory design and observation sessions, we identified the necessary elements of AR for children's inclusive play.

6.1. Enhancing Information Accessibility

We observed that children interacted with each other through AR activities and felt confident in activities that interested them. This sense of confidence and interaction reflects key aspects of children's information behavior, as it demonstrates how children actively seek, process, and share information. Through AR, children engage in problem-solving, explore digital content, and adapt their interactions based on technological affordances. It also showed how interest-driven engagement enhances knowledge acquisition and collaborative learning. This tendency has a direct impact on how children respond to inclusive play. In addition, AR environments allow children to focus on the unfamiliarity of the virtual environment rather than the real-world barriers of disability. This change in perspective shows how AR can shape children's information behavior by reducing barriers to information accessibility and promoting collaboration in shared virtual environments. This conclusion emphasizes the inclusivity and equity of inclusive play.

6.2. Collaborative Play in AR Environments

AR can also automate rules by providing augmented indicators that are unfamiliar and interesting to children instead of additional effort from adults to facilitate inclusive play. This expansion of autonomy allows children to learn social norms in a more enjoyable way and provide a sense of self-determination in a safe environment. In conclusion, based on these findings, we propose the necessary elements of AR content for inclusive play. For children to collaborate effectively, it should include a process that promotes confidence and a sense of accomplishment. The technical elements need to be based on media that children are familiar with, blurring boundaries and physical barriers between children. Designers need to consider deploying effective facilitators to help children quickly accept the rules of the AR environment and internalize social norms. The definition and authority of the facilitator can influence the level of engagement.

For practitioners developing AR for inclusive play, we suggest the following:

1. Design for Sustained Engagement: Incorporate dynamic, evolving challenges and interest-driven content to maintain children's motivation.
2. Prioritize Accessible Interactions: Ensure AR interfaces are intuitive and adaptable, minimizing barriers for children with disabilities.
3. Support Collaborative Play Features: Facilitate multi-user interactions, enabling children to engage in cooperative tasks rather than passive experiences.
4. Define the Role of Facilitators Carefully: AR should provide structured but non-intrusive guidance, allowing children autonomy while maintaining social structure.

Our study used a variety of methodologies and a wide range of participants to get a comprehensive picture of children's opinions. However, there was a lack of diversity as the participants were children from the same church program, and the number of children with disabilities was low. Furthermore, because we only had one session of direct AR use, future research should include more participants and experiments in a variety of settings. Despite these limitations, our study provides a comprehensive understanding of future design ideas within AR which can

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utilize children's inclusive play. Additionally, through the design sessions, we have directly involved children in the development process to identify what elements they prefer and how they perceive inclusive play. Based on this research, we anticipate that future studies can develop more AR content that is child-centered to enhance information accessibility and collaborative play.

CONFLICTS OF INTEREST

No potential conflict of interest relevant to this article was reported.

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Reflecting on 12 Years: Strategic Insights from *JISTaP*'s Development in the Evolving Asian LIS Publishing Ecosystem

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ABSTRACT

The current state of scholarly publishing is marked by the dominance of commercial publishers, the expansion of open access (OA) models, and the persistent challenges faced by independent, non-commercial journals. The aim of this paper is to critically examine the 12-year developmental course of the *Journal of Information Science Theory and Practice* (*JISTaP*), analyzing how an Asia-based library and information science journal with global aspirations has navigated academic publishing challenges. By tracing four distinct developmental epochs from 2013 to the present, the research explores its adaptation strategies, institutional support mechanisms, and bibliometric performance. An analysis of publication trends and citation patterns revealed significant growth, with steady increases in submissions and published articles despite systemic challenges for independent journals. A strengths–weaknesses–opportunities–threats analysis identified *JISTaP*'s key strengths, including robust institutional support from the Korea Institute of Science and Technology Information (KISTI) and an innovative OA model. However, critical challenges remain, such as limited Social Sciences Citation Index visibility and modest citation impact. The findings illuminate external pressures confronting non-commercial scholarly journals, including predatory publishing threats, technological disruptions, and the emerging complexities of AI-driven editorial systems. This research presents *JISTaP*'s 12-year trajectory as a critical case study of how a scholarly journal from an underrepresented region can strategically navigate global scholarly communication barriers, demonstrating that success lies in reimagining academic influence through institutional support, digital innovation, and a commitment to OA principles that transcend commercial publishing constraints.

Keywords: *JISTaP*, open access publishing, independent LIS journals, strategic development, SWOT analysis, bibliometric analysis

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1. INTRODUCTION

Scholarly publishing plays a crucial role in the global research ecosystem, shaping academic discourse, validating research contributions, and determining institutional prestige. However, the sustainability of non-commercial and regionally based journals remains a significant challenge, particularly given the increasing concentration of publishing power among major commercial entities such as Elsevier, Springer, and Wiley (Matthews, 2018). These publishers not only dominate indexing in Web of Science (WoS) and Scopus but also establish publishing standards that determine journal impact, creating barriers for smaller, independent journals seeking global recognition (Kim, 2024; Pranckutė, 2021; Tennant et al., 2019).

The *Journal of Information Science Theory and Practice* (*JISTaP*) offers a compelling case study for examining scholarly publishing dynamics. As Marchionini (2022) reflected at *JISTaP*'s 10-year milestone, the journal was founded in 2013 with a specific vision to "serve the expanding global information science research community and especially welcome and encourage authors from the Asia-Pacific region" while ensuring that "impact and practice were as welcome as theory" (p. 1). *JISTaP* represented a strategic development of the Korea Institute of Science and Technology Information (KISTI)'s long-standing commitment to scholarly publishing. Oh (2020) summarized this transformation from a domestic journal into an international one. From its inception, *JISTaP* was designed as a fully open access (OA) journal without commercial interests or author-facing fees, distinguishing it from many commercial OA models that shifted costs to authors through article processing charges (APCs).

As Choi (2013) documented in *JISTaP*'s inaugural issue, the journal replaced the Korean-language domestic journal *Journal of Information Management*, which had been published for over 50 years since 1963. This historical continuity provided *JISTaP* with an institutional legacy and intellectual foundation, even as it adopted new approaches to meet international publishing standards. However, challenges remain, including limited visibility in WoS, competition from well-established library and information science (LIS) journals, and ongoing financial and operational constraints. These issues reflect broader trends affecting independent journals in the Asia-Pacific region (Kim & Jeong, 2023).

The objective of this paper is to critically examine how *JISTaP*'s 12-year development illustrates the shifting dynamics between traditional commercial publishing and emerging OA models. By analyzing its strategic decisions, successes, and ongoing challenges, we show how regional journals navigate an increasingly competitive publishing landscape while striving for global relevance. Through a SWOT analysis (strengths–weaknesses–opportunities–threats), we provide insights into *JISTaP*'s strengths, weaknesses, opportunities, and threats, offering a framework to assess its sustainability and influence in scholarly publishing. The findings underscore both the structural limitations faced by independent journals and the strategic approaches that can enhance their long-term viability (Gasparyan & Kitas, 2021; Kim, 2022; Kim & Atteraya, 2023).

2. METHODOLOGY

This study employs a mixed-methods approach, combining bibliometric analysis with a strategic assessment of *JISTaP*'s development and position within the Asian LIS publishing landscape.

2.1. Bibliometric Analysis

Data on LIS journals in Asia were gathered from the SCImago Journal & Country Rank (SJR) portal (SCImago, n.d.), which provides Scopus-indexed journal metrics, including H-Index values, publication output, and quartile rankings from 2017 to 2023. The SJR database is publicly accessible and updated annually, allowing for a broad view of publishing trends and journal performance across the region. Filtering for LIS journals from Asian countries resulted in 17 journals for comparative analysis. *JISTaP*'s development was examined across four publishing periods (2013-2016, 2017-2019, 2020-2022, and 2023-present), each representing key milestones in the journal's growth.

2.2. SWOT Analysis

To complement the bibliometric analysis, a SWOT analysis was used to evaluate *JISTaP*'s internal strengths and external challenges (Pickton & Wright, 1998). The SWOT framework is a well-established tool in strategic planning and is particularly useful for assessing a journal's long-term sustainability and competitive position.

- Strengths and weaknesses were identified based on internal factors, such as editorial policies, journal indexing, institutional support, and citation trends.
- Opportunities and threats were assessed based on external factors, including changes in OA publishing, digital innovations, and competition from commercial publishers.

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The analysis incorporated bibliometric data alongside qualitative insights from internal institutional reports and editorial strategy assessments, ensuring a well-rounded evaluation of *JISTaP*'s position in the evolving LIS publishing landscape. By integrating quantitative metrics with qualitative perspectives, this mixed-methods approach provides a balanced assessment of the journal's trajectory and future outlook.

3. *JISTaP*'S STABILITY AND STRATEGIC POSITIONING IN ASIAN PUBLISHING

3.1. Scopus-Indexed Asian LIS Journals (Based on SJR Data)

The 2023 list of Scopus-indexed Asian LIS journals, extracted from SJR, represents a snapshot of the current research landscape, offering insights into the evolving scholarly communication in LIS across the region (Table 1). As shown, East Asian countries including China and Taiwan, alongside India, demonstrate dominance with three Scopus-indexed journals each. In contrast, *JISTaP* is the only journal from South Korea indexed in Scopus under the LIS subject area, while Southeast Asia has a more limited presence, reflecting variations in research infrastructure development across the region. In India, the influence of governmental and institutional backing is evident through publishers like the Defence Scientific Information & Documentation Centre, which publishes the *DESIDOC Journal of Library and Information Technology*. This suggests how national research priorities

Table 1. Asian library and information science journals listed in Scopus based on SCImago Journal & Country Rank (2023)

No.	Title	Country	Publisher	Coverage
1	*Annals of Library and Information Studies*	IN	National Institute of Science Communication and Information Resources (NISCAIR)	2011-2023
2	*DESIDOC Journal of Library and Information Technology*	IN	Defence Scientific Information & Documentation Centre (DESIDOC)	2012-2023
3	*Data Analysis and Knowledge Discovery*	CN	Chinese Academy of Sciences	2019-2023
4	*IAFOR Journal of Literature and Librarianship*	JP	International Academic Forum (IAFOR)	2019-2023
5	*Journal of Educational Media and Library Sciences*	TW	Tamkang University	2005-2023
6	*Journal of Information Science Theory and Practice (JISTaP)*	KR	Korea Institute of Science and Technology Information	2017-2023
7	*Journal of Information Science and Engineering*	TW	Institute of Information Science	1993-1994, 1996-2023
8	*Journal of Information and Knowledge Management*	SG	World Scientific	2002-2023
9	*Journal of Library Science in China*	CN	Editorial Office of Journal of Library Science in China	2019-2023
10	*Journal of Library and Information Science in Agriculture*	CN	Chinese Academy of Agricultural Sciences	2019-2023
11	*Journal of Library and Information Studies*	TW	National Taiwan University, Department of Library and Information Science	2019-2023
12	*Journal of Scientometric Research*	IN	Phcog.Net	2019-2023
13	*Library and Information Science*	JP	Mita Society for Library and Information Science	1980-2023
14	*Libres*	SG	Nanyang Technological University	1996-2022
15	*Malaysian Journal of Library and Information Science*	MY	Faculty of Computer Science and Information Technology	1996-2023
16	*Pakistan Journal of Information Management and Libraries*	PK	Department of Information Management, University of the Punjab	2014-2022
17	*Wacana*	ID	Faculty of Humanities, University of Indonesia	2015-2023

shape regional scholarship. Singson et al. (2025) showed that policies and initiatives—such as the University Grants Commission (UGC) guidelines, the National Institutional Ranking Framework (NIRF), the Internal Quality Assurance Cell (IQAC), and UGC-CARE (Consortium for Academic and Research Ethics)—have played a pivotal role in increasing top-tier journal publications and enhancing research productivity.

Furthermore, the data in Table 1 confirms that journal longevity varies dramatically across the index—established publications like *Library and Information Science* (Japan, indexed since 1980) coexist with recent entrants such as *Data Analysis and Knowledge Discovery* (China, since 2019). Gaps in indexing for journals from Singapore and Pakistan after 2022 demonstrate the tenuous nature of maintaining continuous inclusion in international databases. Perhaps most revealing is the overall coverage trend, where fluctuating indexing periods and occasional gaps (as seen with Taiwan's *Journal of Information Science and Engineering* in 1995) confirm that Asian LIS scholarship operates in a dynamic environment. These patterns suggest that academic influence continues to shift and evolve, creating an uneven but gradually expanding footprint in global information science discourse, which is consistent with previous studies such as Oh (2020) that have examined the transformation of Asian LIS journals and their increasing integration into international scholarly communication.

3.2. H-Index Performance of Asian LIS Journals

Fig. 1 presents the H-Index trends of Asian LIS journals from 2018 to 2023, indicating distinctions between high-impact, mid-range, and emerging journals. The *Journal of Information Science and Engineering* consistently leads with an H-Index of 42, reflecting its strong scholarly influence. Other well-established journals, such as the *Malaysian Journal of Library and Information Science* (H-Index 29) and *Journal of Information and Knowledge Management* (H-Index 27), maintain relatively high citation impact over time. *JISTaP* has remained stable at an H-Index of 8 since its Scopus indexing in 2017, positioning it in the mid-range category alongside *DESIDOC Journal of Library and Information Technology* (H-Index 19) and *Annals of Library and Information Studies* (H-Index 17). While *JISTaP* has maintained its standing, it has not shown the upward path seen in some regional counterparts. Meanwhile, emerging journals such as the *IAFOR Journal of Literature and Librarianship* (H-Index 2) and *Journal of Library Science in China* (H-Index 3-5) remain at lower citation levels. Fig. 1 illustrates how some journals experience slow but steady growth, while others, including *JISTaP*, have yet to gain significant citation influence, underscoring the need for increased visibility and stronger citation engagement.

3.3. Publication Output Trends in Asian LIS Journals

Fig. 2 reveals the distinctive publication dynamics of *JISTaP* within the landscape of Asian scholarly journals. While some journals show extreme publication patterns, *JISTaP* occupies a unique middle ground. The journal's document count varies dramatically from 20 in 2018 to 36 in 2019, surging to 80 in 2020, peaking at 149 in 2021, and then recalibrating to 42 in 2022. In contrast, *Data Analysis and Knowledge Discovery* exhibits an explosive growth trajectory, rocketing from minimal publications to 441 documents by 2022. The *Journal of Scientometric Re-*

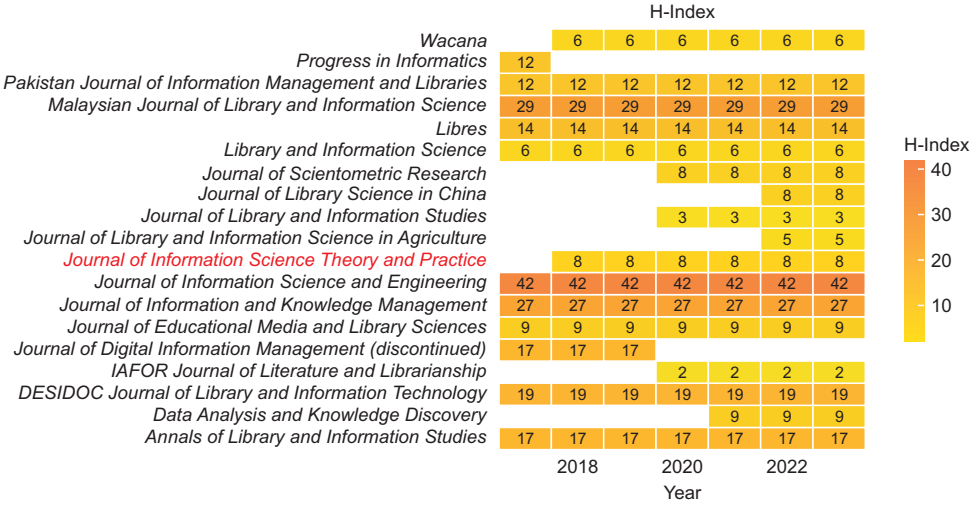


Fig. 1. H-Index of Asian library and information science journals (2017-2023).

 https://doi.org/10.1633/JISTaP.2025.13.2.6

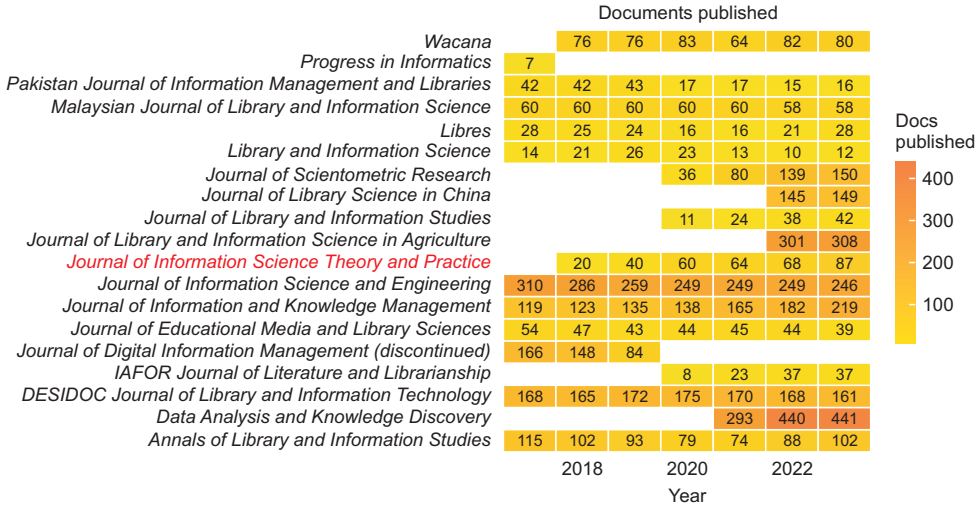


Fig. 2. Yearly documents published of Asian library and information science journals (2017-2023).

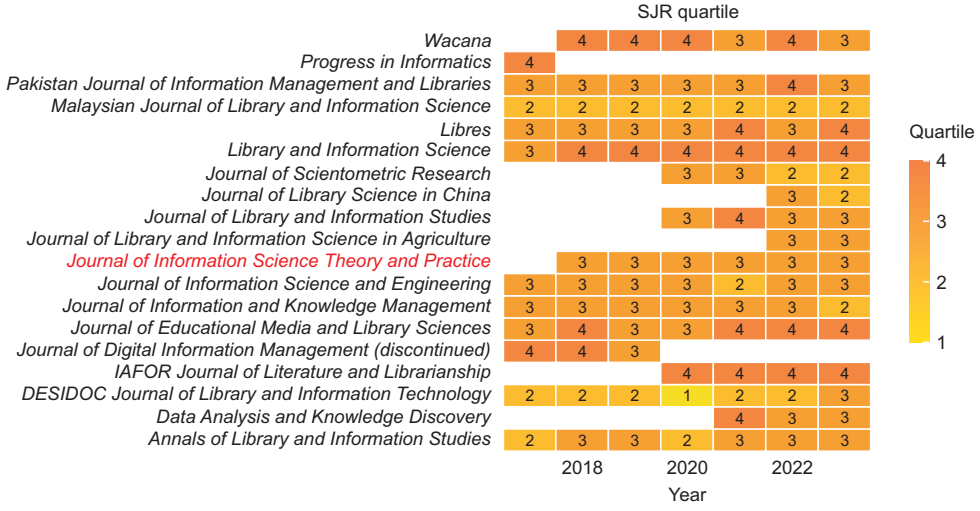


Fig. 3. SCImago Journal & Country Rank (SJR) quartile rankings of Asian library and information science journals (2017-2023).

search follows a similar rapid expansion, increasing to 150 documents. At the other end of the spectrum, journals like *Pakistan Journal of Information Management and Libraries* have contracted significantly, dropping from 42 to 16 publications. Agricultural and scientometric journals in the dataset display particularly volatile patterns, with extreme fluctuations that dwarf *JISTaP*'s variations. The *Journal of Information Science and Engineering* demonstrates a more gradual decline, reducing from 310 to 246 documents. This finding indicates that *JISTaP* has positioned itself as a moderate performer amidst the diverse and dynamic Asian scholarly communication landscape. In a broader sense, *JISTaP*'s publication pattern reflects the unpredictable nature of scholarly journal publishing.

3.4. SJR Quartile Rankings and Journal Positioning

Fig. 3 shows SJR Quartile ranking trends (2017-2023) among Asian LIS journals, with *JISTaP* maintaining a consistent Q3 position throughout this period. Quartile rankings reflect each journal's position within its field, where Q1 represents the top 25% of journals and Q4 the bottom 25%. Notably, newer entrants such as the *Journal of Library Science in China* and *Journal of Library and Information Studies* emerged around 2020 and secured Q3-Q4 rankings upon entering the index. *IAFOR Journal of Literature and Librarianship* moved from no ranking to Q4, maintaining this position thereafter. *Data Analysis and Knowledge Discovery* showed upward mobility by achieving Q3 shortly after appearing in the index. Meanwhile, the *Journal of Information Science and Engineering* fluctuated between Q3 and occasional Q2 rankings, with Q2 representing higher impact. *JISTaP*'s steady Q3 position contrasts with these variations among regional peers. Ranking patterns align with the H-Index and publication

output trends discussed earlier, illustrating the competitive environment within the Asian LIS publishing ecosystem.

4. *JISTaP*'S DEVELOPMENT AND STRATEGIC ADAPTATION IN SCHOLARLY PUBLISHING

JISTaP provides a valuable case study in scholarly publishing dynamics, evolving alongside global shifts in academic communication. Established in 2013, the journal replaced the long-standing *Journal of Information Management*, leveraging its institutional legacy and adopting international publishing standards. Since its inception, *JISTaP* has progressed through distinct development epochs, as outlined in Table 2 (Bhavsar et al., 2025; Björk, 2017; 2021; Budzinski et al., 2020; Choi, 2013; Chung et al., 2024; Fiorillo & Mehta, 2024; Gendron et al., 2022; Irawan et al., 2022; JISTaP, 2023; Kim et al., 2021; Kim & Atteraya, 2023; Larivière et al., 2015; Loaiza & Rigobon, 2024; Marchionini, 2022; Miller & Tsai, 2020; Mills & Inouye, 2024; Oh, 2020; Oh et al., 2019; Pavan & Barbosa, 2018; Rhee, 2019; Sharma & Sharma, 2021; Shen & Björk, 2015; Tennant et al., 2019; Vinay, 2023): Foundation & Establishment (2013-2016), focusing on OA expansion and peer review implementation; Global Recognition & Impact (2017-2019), marked by Scopus indexing and increasing international visibility; and Adapta-

Table 2. *JISTaP*'s development epochs and shifts in the publishing ecosystem

Time period	*JISTaP* development phases	Publishing ecosystem shifts
2013-2016	*Foundation & Establishment:* Launch as an OA journal replacing the 50-year-old *Journal of Information Management*; implementation of international peer review system; development of global editorial network (Choi, 2013; Oh et al., 2019; Oh, 2020)	*OA Expansion and Market Shifts:* Institutional mandates (Björk, 2017); rise of predatory journals raising issues of credibility and exploiting researchers in peripheral academic economies (Mills & Inouye, 2024; Shen & Björk, 2015); publisher consolidation as major firms acquire OA platforms (Larivière et al., 2015); peer review processes streamlined in megajournals while coming under increased scrutiny (Björk, 2021; Tennant et al., 2019); repercussions of APC charges (Budzinski et al., 2020; Pavan & Barbosa, 2018)
2017-2019	*Global Recognition & Impact:* Increased visibility through Scopus indexing, quarterly publication, rising international submissions with growing submission stability, and stronger institutional backing from KISTI, expanding infrastructure and reach (Rhee, 2019). Early bibliometric trends in author collaboration and citation patterns signaling academic growth (Sharma & Sharma, 2021)	
2020-2022	*Adaptation & Reflection:* Introduction of ACOMS+ submission system; 10-year anniversary milestone; maintaining consistent submission patterns despite pandemic disruptions; expanded international authorship with increasing contributions from previously underrepresented countries; increasing bibliometric visibility through authorship and research topic analysis in the LIS landscape (Chung et al., 2024; Kim et al., 2021; Marchionini, 2022)	*Pandemic Transformation:* COVID-19 accelerating digital publishing workflows; surge in preprints; open science practices gaining momentum (Irawan et al., 2022); expansion of OA and Non-OA journal output reflecting shifts in publishing models (Kim & Atteraya, 2023). Emphasis on data sharing/data interoperability (Miller & Tsai, 2020)
2023-	*Digital Innovation & Strategic Growth in Global Academic Publishing:* Addressing AI-driven changes in academic publishing within the context of *JISTaP*'s policies and ethical governance; examining AI chatbot use, transparency requirements, authorship restrictions, and ethical concerns in scholarly communication; aligning with evolving policies on AI in research, focusing on authorship qualifications, responsibility distribution, and disclosure requirements (*JISTaP* AI & Authorship Guidelines, JISTaP, 2023); exploring AI-assisted peer review, automation in editorial processes, and governance challenges in LIS research; assessing AI's impact on scholarly judgment, human agency, and workforce transformation in digital publishing	*AI and Next-Gen Publishing:* Policies on AI chatbot use in academic publishing, transparency requirements, authorship restrictions, and ethical concerns (Bhavsar et al., 2025); AI-assisted peer review, ChatGPT integration for manuscript evaluation, efficiency improvements, and potential biases (Fiorillo & Mehta, 2024); AI reshaping of digital publishing, automation in editorial processes, and ethical and governance challenges (Vinay, 2023); critical examination of AI's potential to erode scholarly judgment and human agency in publishing processes (Gendron et al., 2022); human-machine complementarities and workforce transformation (Loaiza & Rigobon, 2024)

 https://doi.org/10.1633/JISTaP.2025.13.2.6

tion & Reflection (2020-2022), navigating the disruptions of COVID-19 and expanding its global author base and digital infrastructure. Most established global LIS journals had secured presence in major indexing services during 2013-2016, but *JISTaP*'s developmental trajectory distinctly shifted in 2017-2019 following its Scopus indexing achievement, creating a different developmental pattern compared to more established journals.

Entering the Digital Innovation & Strategic Growth phase (2023-present), *JISTaP* is responding to artificial intelligence (AI)-driven transformations in scholarly publishing. As AI increasingly influences scholarly journal article creation, review processes, and distribution methods, *JISTaP* has implemented policies on AI chatbot use, authorship restrictions, and transparency in manuscript preparation, developed in consultation with its editorial board to ensure alignment with ethical publishing standards (*JISTaP* AI & Authorship Guidelines, JISTaP, 2023). These policies reflect broader industry discussions on AI's role in peer review, manuscript evaluation, and editorial automation, as well as addressing concerns about its impact on scholarly judgment and human agency. By actively engaging in governance discussions and enforcing ethical guidelines, *JISTaP* aims to balance technological innovation with academic integrity.

As reflected in the journal's decade milestone (Marchionini, 2022; Oh et al., 2024), *JISTaP* was founded with a vision to support global information science research, particularly fostering contributions from underrepresented regions while maintaining a balance between theoretical and practical impact. Through OA publishing, Scopus indexing, and continuous adaptation to industry trends, *JISTaP* has strengthened its position in the evolving scholarly communication landscape. By integrating emerging technologies and maintaining ethical standards, the journal continues to shape discussions on digital innovation, ensuring its relevance in the future of academic publishing.

5. SWOT ANALYSIS OF *JISTaP*

Fig. 4 presents a high-level SWOT framework for *JISTaP*, indicating its strengths, weaknesses, opportunities, and threats in the academic publishing ecosystem. Fig. 4 categorizes the journal's legitimacy, structural challenges, potential for expansion, and competitive pressures, providing insight into how *JISTaP* navigates global scholarly publishing hierarchies. The journal benefits from Scopus indexing, OA, and institutional support, but also faces technical inefficiencies, limited citation impact, and financial uncertainties. Additionally, growing LIS research communities and digital innovations present opportunities, whereas increasing competition and rising operational costs pose ongoing challenges. Building on our SWOT analysis framework, we can now examine each component with greater specificity to understand *JISTaP*'s strategic position. The following breakdown elaborates on these specific factors in greater detail, providing a comprehensive picture of *JISTaP*'s current position in the scholarly publishing landscape.

5.1. Strengths: Legitimacy & Visibility

JISTaP possesses significant advantages in international standing, institutional support, and its publishing model that collectively establish its position in the LIS scholarly ecosystem. As summarized in Table 3, its status as Korea's only Scopus-indexed English-language LIS journal provides a crucial bridge between Asian research and global scholarly communities. The journal's OA model with free copy-editing services and currently zero APC eliminates financial barriers for authors, promoting accessibility and diverse contributions. Institutional backing from the KISTI provides essential financial stability, technological infrastructure, and networking opportunities that support long-term sustainability. Despite challenges such as



Fig. 4. Strengths–weaknesses–opportunities–threats analysis framework for *Journal of Information Science Theory and Practice*.

Table 3. Strengths of *JISTaP*

Strengths	Description
International recognition	The only Scopus-indexed English LIS journal from Korea, enhancing global credibility
OA & free copy editing	Removes financial barriers, ensuring accessibility and attracting submissions
No APCs	No APCs required from authors at present, providing a significant advantage over commercial journals with high publication fees
Institutional support	Strong backing from KISTI provides financial stability and networking opportunities
Editorial leadership	Active participation in international LIS organizations strengthens journal credibility
Growing international reach	Increasing submissions from Asia, Europe, and beyond, expanding scholarly influence
Diverse editorial board	Enhances credibility, review quality, and potential for higher citation impact
Commitment to next-generation publishing	ACOMS+ streamlines workflows, improving accessibility for Korean and global researchers
Submission stability	Consistent submission patterns maintained despite external disruptions, demonstrating author trust and operational resilience
Ethical governance in AI & publishing standards	Established AI & authorship guidelines in consultation with the editorial board, ensuring responsible AI use, authorship transparency, and alignment with global ethical publishing practices

the COVID-19 pandemic, shifts in publishing trends, and funding uncertainties, *JISTaP* has maintained remarkable submission stability, indicating strong author trust and operational resilience.

Strong editorial leadership and global engagement further enhance *JISTaP*'s visibility and scholarly influence. The journal actively participates in international LIS networks, academic conferences, and collaborative research initiatives, extending its scholarly reach. Its diverse, internationally engaged editorial board attracts quality submissions from researchers worldwide, strengthening its academic reputation. The growing number of international submissions from across Asia, Europe, and beyond demonstrates *JISTaP*'s expanding global presence. Though still building its citation impact, the journal's commitment to next-generation publishing through ACOMS+, an advanced submission management system, streamlines workflows and improves accessibility for both Korean and global researchers, establishing *JISTaP* as an emerging contributor to the evolving LIS publishing landscape.

5.2. Weaknesses: Structural Challenges

JISTaP encounters fundamental visibility, sustainability, and operational issues that limit its competitive standing in the global LIS publishing ecosystem. As summarized in Table 4, a key limitation is the lack of indexing in Social Sciences Citation Index (SSCI) and WoS, restricting its visibility in high-impact academic circles and reducing its ability to compete with well-established LIS journals. Despite growth in submissions, its citation impact remains modest, which affects its long-term scholarly reputation. Furthermore, *JISTaP* is often perceived as an institution-driven rather than a commercially independent journal, which may limit its ability to attract a more diverse author base and compete with major LIS journals operated by multinational publishers. The publishing environment is dominated by large commercial players with strong indexing, high-impact metrics, and aggressive marketing strategies, creating significant barriers for *JISTaP* in gaining broader recognition and legitimacy. These challenges reflect the systematic inequalities in global academic publishing that consistently privilege publications from the Global North and commercial publishers (Collyer, 2016).

Another challenge is our ability to sustain financial and operational stability. Although KISTI provides crucial institutional support, *JISTaP* lacks independent revenue streams, unlike commercial journals that secure funding through APCs, subscription models, or sponsorships. This reliance on institutional backing creates uncertainty regarding long-term sustainability and the ability to scale operations, recruit top-tier editorial talent, and expand global outreach. Moreover, *JISTaP*'s transition to the ACOMS+ submission system, despite being a step forward in modernizing editorial processes, introduces a learning curve for authors and reviewers unfamiliar with non-commercial platforms. This shift may temporarily slow submission processes and peer review efficiency, potentially discouraging new contributors. To strengthen its position in an increasingly competitive LIS publishing landscape, we must address these structural challenges

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Table 4. Weaknesses of *JISTaP*

Weaknesses	Description
Lack of SSCI & Web of Science indexing	Limits ranking and visibility in high-impact academic circles, reducing competitiveness
Low citation impact	Modest citation rates restrict scholarly influence, affecting long-term reputation
Institution-driven perception	Seen as reliant on institutional support rather than an independent LIS journal, impacting credibility
Challenges competing with commercial publishers	Struggles to compete with established LIS journals backed by large commercial publishers
Uncertain long-term funding & staffing	Dependent on KISTI support without independent financial sustainability, limiting expansion
Transition to new submission system	ACOMS+ adoption introduces a learning curve, temporarily affecting submission efficiency

Table 5. Opportunities for *JISTaP*

Opportunities	Description
Growing LIS research community	Expanding global pool of authors and readers, particularly in emerging economies facing systematic publishing inequalities (Collyer, 2016), who may benefit from *JISTaP*'s no-APC model
Increased recognition of Scopus-indexed journals	Institutional emphasis on Scopus-indexed publications drives higher submissions
Editorial board's international engagement	Participation in global LIS conferences and networks enhances visibility
Editorial leadership diversification	Internationalizing leadership could distinguish *JISTaP* from regional competitors
Advancements in digital publishing	Enhanced metadata indexing, automated plagiarism detection, and digital archiving improve efficiency and quality control
Enhanced publishing infrastructure	ACOMS+ streamlines editorial workflows and supports open peer review and OA
Alignment with global LIS research trends	*JISTaP*'s mission aligns with emerging LIS topics like information overload and digital information environments

and enhance its visibility and influence within the global academic community.

5.3. Opportunities: Expansion and Innovation

JISTaP can capitalize on several strategic pathways for advancement in the evolving scholarly publishing environment. As supported by Table 1 and Figs. 1-3, the growing number of Scopus-indexed LIS journals in Asia indicates a developing research landscape that could enhance the journal's global reach. The bibliometric comparisons demonstrate increasing recognition of Scopus-indexed publications, potentially strengthening *JISTaP*'s competitive position. The journal's editorial board's active participation in international LIS conferences and professional networks raises its profile and creates opportunities for collaborations with scholars worldwide. A significant opportunity exists in further internationalizing its editorial leadership—while many LIS journals struggle with editorial diversity (Oh et al., 2019), *JISTaP* could distinguish itself by pioneering a truly global editorial approach.

The key opportunities for *JISTaP*, as illustrated in Table 5, include leveraging advancements in digital publishing to enhance operational efficiency and maintain manuscript quality. Implementing enhanced metadata indexing, automated plagiarism detection, and sophisticated digital archiving could further strengthen the journal's position. *JISTaP*'s adoption of ACOMS+ (Chung et al., 2024) represents a significant improvement in editorial infrastructure, promising long-term benefits for workflow management and user experience. As Korea's first system combining open peer review with OA publishing, ACOMS+ positions *JISTaP* as a potential model for transparency in scholarly

communication. The journal's commitment to balancing theoretical and applied LIS research aligns with emerging global research priorities—including information overload, digital information environments, and the digital exposome (Marchionini, 2022). Here, *JISTaP*'s coeditor-in-chief, Dr. Marchionini, refers to the digital exposome as the impact of ongoing exposure to digital information on human wellbeing, creating opportunities for the journal to attract submissions addressing these contemporary challenges. Furthermore, by maintaining its no-APC model, *JISTaP* can leverage its position to attract quality research from regions affected by systematic inequalities in global academic publishing (Collyer, 2016), potentially increasing both submission rates and citation impact.

5.4. Threats: Competitiveness and Financial Pressure

JISTaP confronts substantial challenges in today's competitive scholarly publishing environment. As summarized in Table 6, the dominance of major commercial publishers such as Elsevier, Springer, and Wiley in the OA market creates significant competitive pressure. These publishers leverage extensive resources, established reputations, and high-impact indexing advantages, making it difficult for independent journals like *JISTaP* to compete for author attention, citations, and visibility. The proliferation of OA LIS journals regionally and internationally intensifies competition for indexing positions, readership, and academic influence. As more journals secure Scopus and other database listings, maintaining *JISTaP*'s distinctive identity and scholarly relevance requires increasingly strategic efforts.

Financial sustainability remains a substantial challenge for *JISTaP*. As a non-commercial journal, it lacks the diversified revenue streams that commercial publishers generate through subscription models or APCs. Although institutional backing from KISTI provides critical infrastructure, the long-term financial viability of the journal remains uncertain, particularly as rising costs for editorial management, digital publishing technologies, and manuscript processing place increasing demands on available resources. The continuation of the free APC policy specifically may be at risk. Without alternative funding mechanisms, sustaining high publication standards may become increasingly difficult. Furthermore, maintaining editorial quality presents an ongoing challenge, as many experienced scholars in the LIS field balance substantial institutional responsibilities, potentially limiting their capacity to engage in editorial and peer review processes. This, in turn, may impact review timelines and academic rigor. Addressing these challenges necessitates a strategic approach to strengthening *JISTaP*'s competitive positioning, securing financial stability, and ensuring the retention of a qualified editorial network to uphold scholarly excellence.

5.5. Strategic Imperatives for *JISTaP*'s Future

For *JISTaP* to thrive in the evolving academic publishing landscape, several strategic approaches would strengthen its position and secure its future. Enhancing citation metrics and indexing, particularly through SSCI inclusion, offers pathways to greater credibility, potentially attracting high-impact submissions that could further solidify its standing. The current instability of its manuscript system presents an opportunity for improvement, with AI-driven editorial processes offering promising solutions to workflow efficiency challenges. Expanding international collaborations—through a more diverse editorial board and global research partnerships—would likely widen its reach while reinforcing its authority in LIS scholarship (Oh et al., 2024).

However, financial sustainability remains a significant challenge. To address rising costs and funding uncertainties, *JISTaP* would benefit from actively pursuing institutional sponsorships, grant-based funding, and alternative

Table 6. Threats to *JISTaP*'s sustainability

Threats	Description
Intensifying competition from commercial publishers	Major commercial publishers (Elsevier, Springer, Wiley) dominate the LIS OA space, making visibility and recognition more challenging
Rise of more OA LIS journals	Increasing competition for indexing, citations, and readership threatens *JISTaP*'s positioning within the field
Financial constraints & rising costs	Growing operational expenses, including editorial management and digital infrastructure, challenge long-term sustainability
Difficulty in retaining high-quality reviewers & editors	Increased academic workloads make it harder to secure dedicated reviewers and editorial board members, impacting peer review quality and efficiency

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financial models that align with its OA mission. Furthermore, the rapid expansion of commercial publishers and LIS journals necessitates developing a clear competitive edge—*JISTaP* stands to gain from embracing editorial innovation, digital transformation, and strategic networking to maintain influence. Beyond mere adaptation, *JISTaP* has the opportunity to redefine its role in global scholarly publishing, contributing to a more inclusive, accessible, and forward-thinking academic ecosystem. The question extends beyond whether *JISTaP* can evolve, to how boldly it will shape the future of LIS publishing.

6. DISCUSSION

We have examined the current strategic development of *JISTaP*, focusing on how it has navigated global publishing challenges, institutional backing, and bibliometric performance in comparison with other Asian LIS journals. By analyzing publication output, ranking stability, and citation impact, we identified key factors shaping the visibility, sustainability, and influence of independent journals in an evolving scholarly landscape. The trends observed in *JISTaP*'s development, alongside shifts in the global publishing ecosystem, align with distinct publishing epochs, each marked by changes in scholarly impact, research output, and ranking stability. These epochs reflect broader transformations in the region's academic publishing environment, where institutional support, indexing strategies, and evolving research priorities play a crucial role. Scholarly influence builds gradually, but journal visibility and impact remain fluid, shaped by both structural and strategic factors, underscoring the need for proactive adaptation in an increasingly competitive publishing landscape.

JISTaP's trajectory is broadly aligned with the development of other Asian LIS journals, many of which have benefited from institutional support and OA models to enhance their reach. Like the *Malaysian Journal of Library & Information Science*, *JISTaP* has leveraged an OA framework and institutional affiliation to improve visibility and attract international contributors. However, key differences in indexing status, impact metrics, and global recognition set these journals apart. Several LIS journals in Asia have successfully attained SSCI indexing, leading to increased visibility and citation impact; however, *JISTaP* is still in the process of expanding its indexing footprint. This trend underscores the critical role of WoS and SSCI inclusion in shaping a journal's credibility, as these databases serve as key indicators of research impact in the field. To bridge this gap, *JISTaP* would benefit from continuing to strengthen editorial policies, foster international collaborations, and invest in digital infrastructure—all areas where it is actively progressing.

Although certain LIS journals in Asia have achieved steady growth in citations and rankings, others have encountered challenges such as fluctuating impact factors, inconsistent publication schedules, and regional visibility constraints. The performance of LIS journals in Asia is diverse, reflecting differences in institutional backing, indexing status, and publishing strategies rather than a uniform pattern of stagnation. *JISTaP*, for instance, has maintained a stable publication output, growing international author base, and a consistent presence in Scopus, whereas other independent LIS journals have faced periodic declines in citations or difficulty sustaining indexing status. These variations suggest that although some journals successfully navigate the competitive publishing landscape, others struggle with long-term sustainability due to resource constraints and shifting indexing criteria. Unlike LIS journals affiliated with large commercial publishers, independent journals often operate within structural limitations, making targeted strategic investment crucial to their success.

Through our SWOT analysis, we identified both internal and external challenges affecting *JISTaP*'s sustainability and impact. *JISTaP* has benefited from strong institutional support, an OA model, and increasing international recognition but also faces significant hurdles, including limited WoS visibility, moderate citation impact, and competition with commercial publishers. Some of these challenges—such as improving indexing status, expanding editorial capacity, and strengthening digital infrastructure—can be addressed through targeted efforts and strategic investment. However, external challenges, such as the dominance of commercial publishers, the financial sustainability of independent journals, and the concentration of high-impact LIS scholarship in Western countries, present structural barriers that are more difficult to overcome. These challenges reflect the systematic inequalities in global academic publishing that privilege established commercial publishers and publications from the Global North (Collyer, 2016).

Even though individual journals can implement strategic improvements, broader academic communities should also play a role in sustaining non-commercial, independent journals that adhere to OA principles. Universities, research organizations, and funding agencies can enhance support by providing stable funding mechanisms, facili-

tating cross-journal collaborations, and promoting open-access initiatives. Dedicated institutional support for indexing efforts, editorial development, and digital infrastructure would improve visibility and long-term viability. Strengthening these partnerships will help independent journals compete with commercial publishers while maintaining their role in a diverse and inclusive scholarly ecosystem.

JISTaP remains committed to ethical citation practices while recognizing the challenges of increasing its scholarly impact. Although its citation influence is growing, further improvements are needed to enhance visibility and academic reach. To achieve this, the journal utilizes ACOMS+, a platform that optimizes indexing, automates dissemination, and strengthens digital infrastructure, distinguishing it from many Asian LIS journals that rely on landing pages or government-funded initiatives (Shelomi, 2014). Ethical considerations are central to *JISTaP*'s approach, as it firmly opposes coercive citation requests, excessive self-citation, and citation cartels that distort scholarly metrics. Instead, it fosters organic citation growth by promoting high-quality research, expanding dissemination through ACOMS+, encouraging impactful formats such as review papers and meta-analyses, publishing special issues on emerging LIS topics, diversifying its international editorial board, mentoring authors to improve article quality, forming cross-journal partnerships with higher-ranked LIS publications, and systematically tracking citations to assess impact. *JISTaP* acknowledges the realities of citation dynamics in academia. However, it remains dedicated to ethical scholarship and is mindful of the skepticism surrounding citation-based metrics, which, despite their widespread use, often fail to reflect true research quality. Expanding ACOMS+ could further support regional journals by enhancing international discoverability and fostering responsible citation practices in the Asian LIS publishing ecosystem.

In sum, this analysis of *JISTaP* reinforces the importance of sustained institutional backing, digital innovation, and strategic indexing efforts in securing long-term growth for independent journals. Its trajectory through distinct publishing epochs demonstrates how regional journals can adapt to shifting scholarly communication landscapes. *JISTaP* has benefited from KISTI's commitment to scholarly publishing and its OA model; yet its continued success depends on leveraging technological solutions like ACOMS+ to enhance global visibility and academic impact. Although inclusion in prestigious databases remains a priority for improving credibility and attracting high-quality submissions, sustainable development requires more than just meeting indexing criteria. The journal's experience illustrates how independent publications can navigate global publishing hierarchies by balancing institutional support with strategic innovation. These insights provide context for understanding the broader challenges faced by journals from underrepresented regions in the international scholarly ecosystem.

7. CONCLUSION AND FUTURE DIRECTIONS

JISTaP's 12-year development illustrates how regional journals can build legitimacy in global scholarly publishing amid structural inequalities. Our bibliometric analysis revealed that while *JISTaP* has maintained stable metrics and consistent Scopus presence, comparable Asian LIS journals with SSCI indexing achieved significantly higher citation impact. The SWOT analysis identified key strengths in institutional backing from KISTI and the OA model, alongside challenges in WoS visibility and competition from commercial publishers. Despite these challenges in non-Western publishing environments, *JISTaP* has effectively leveraged institutional support and OA frameworks to increase visibility, establishing an international author base and consistent quarterly publication schedule. Its experience demonstrates that successful journals do not simply follow Western publishing models but develop approaches suited to their specific contexts, balancing global accessibility with regional perspectives. For independent OA journals from underrepresented regions, sustainable growth requires both tactical adaptation to evolving scholarly metrics and consistent institutional support for digital infrastructure and editorial development. As scholarly publishing continues to transform, these findings suggest that independent OA journals can establish distinctive value through specialized content, ethical publishing practices, and strategic partnerships that enhance their global reach while maintaining their regional identity.

CONFLICTS OF INTEREST

The first author currently serves as Co-Editor-in-Chief and the second author as Managing Editor of JISTaP. To ensure objectivity and transparency, the peer review process for this article was overseen by an independent editor, and the final editorial decision was made based solely on that editor's recommendation, without any involvement from the authors.

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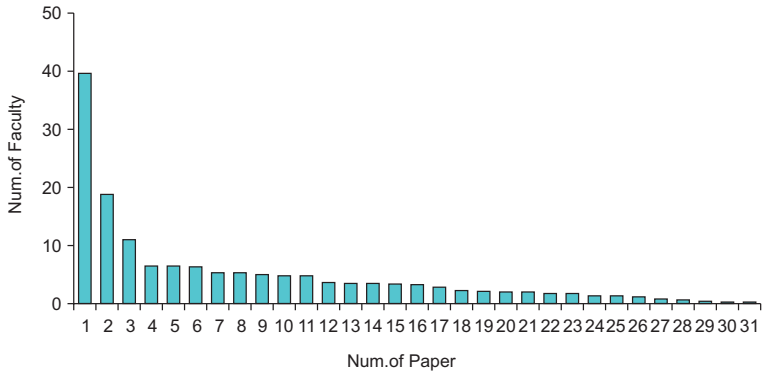


Fig. 1. Distribution of authors over publication count.

Table

Table 1. The title of table goes here

Study	Time period study	Data
Smith Wesson (1996)	1970 - 1995	684 papers in 4 SSCI journals
Reeves [a (2002)	1997 - 2001	597 papers in 3 SSCI journals
Jones Wilson [b (2011)	2000 - 2009	2,166 papers in 4 SSCI journals

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Journal article

- Author, A., Author, B. & Author, C. (Year). Article title. *Journal Title*, volume(issue), start page-end page.
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Book

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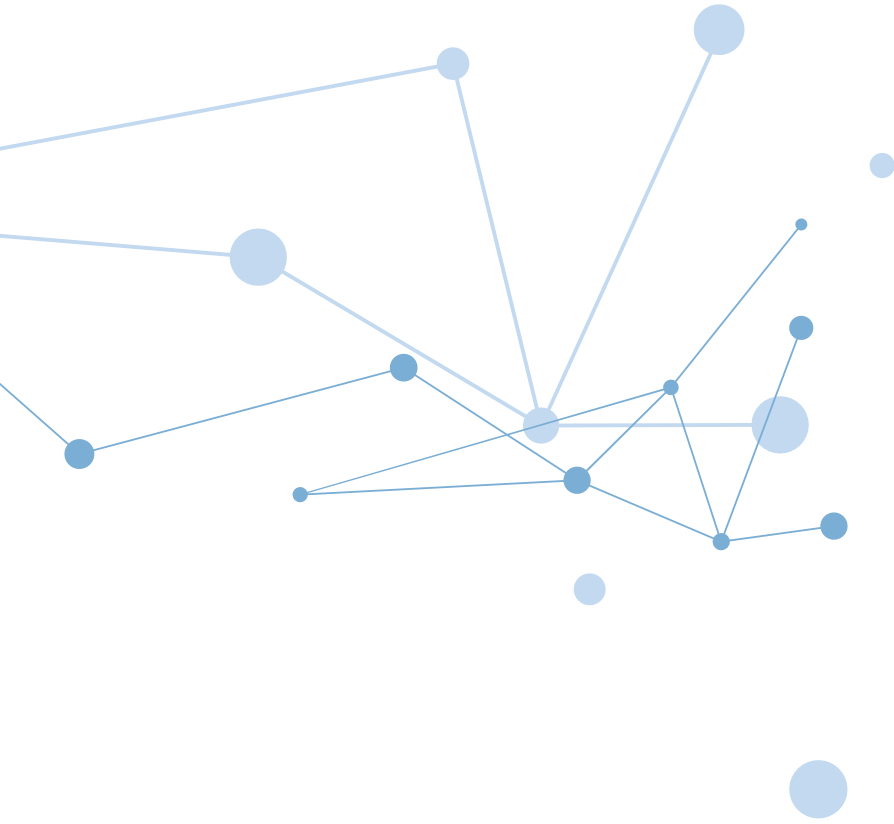
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