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Examining Social Networking Sites Users' Benefits Using the DeLone and McLean Information System Success Model

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ABSTRACT

In the modern era of technological and communication amelioration, social networking sites (SNSs) open the door, not only in industrial sectors but also as a platform which mostly aims attention at easing the formation of social correspondence among people. On the basis of the DeLone and McLean model of information system success (2003), this study develops a modified IS model to examine the individual merits (i.e., enjoyment, expected relationships, and reputation) obtained from using SNSs. Structural equation modeling is used to investigate the above issues, and an online survey questionnaire technique is conducted with 421 respondents from the United States, and several interesting results are observed. System quality significantly affects both satisfaction and use intention, whereas information and service quality have a large impact on satisfaction but not on use intention. Individual benefits (such as enjoyment, expected relationships, reputation, and use intention) are all positively impacted by satisfaction. In addition, use intention acts as an intermediate construct and has positive effects on individual benefits. SNS practitioners should focus on awareness-raising initiatives regarding the personal benefits enabled by SNS use, as well as educational programs to encourage SNS usage at the user level, by identifying and addressing the specific individual benefits.

Keywords: information system success model, social networking sites, service quality, enjoyment, expected relationships, reputation

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1. INTRODUCTION

Social networking sites (SNSs) such as Twitter, Instagram, Facebook, Google+, and Myspace permit individuals to create profiles in view of sharing photographs, personal information, and joining friends' groups (Hew, 2011; Ortiz et al., 2023), and can be viewed as a place of acquiring social benefit (Hoque & Hossain, 2023; Lee, 2024). According to Ibáñez-Sánchez et al. (2022), SNSs are utilized not only for transmitting messages and creating content but also for leisure, communication, and people-finding purposes. They are emerging as one of the most popular media of online social interaction and emotion sharing (Hoadley et al., 2010), and managing friendships as well. Mainly, the design of SNSs is to simplify communication and content sharing within networks of users, who via an individual network share ideas, interests, activities, or events on a virtual platform (Chen et al., 2012).

Statista (2024) report that SNS usage worldwide has surpassed 60%, and the highest penetration rates were found in 2023 in Northern and Western Europe, followed by Eastern Asia and Southern Europe. Globally, there were over 4.6 billion SNSs users in 2022, and that number is expected to rise to over 5.8 billion by 2027, a 26% growth in only five years. Facebook, which has the largest market size, had 2.96 billion active monthly users as of 2023, and its parent company, Meta, recorded 116.6 billion US dollars in revenue in 2022, which is more than double that of 2018 (Statista, 2024). Due to the critical function that these websites serve in increasing global communication, removing barriers between people, and facilitating conversation on a public platform, SNSs are currently the most popular communication route among educated youngsters. These websites serve as a conduit for these people to connect with friends and widen their social network (Dong et al., 2014).

Internet services such as social networking services, emailing, portal services, or other groundbreaking Internet services, are effortlessly available, providing various benefits in ubiquitous environments, and van der Heijden (2004) argue that there is a strong relationship between services and new information technologies. In addition, understanding the reasons behind people's actions and their level of engagement and stickiness with SNSs requires an understanding of the gratification that users of these platforms derive from their use (Silveira et al., 2022). Yet, despite the increasing necessity to understand the specific individual benefits a person can obtain using a certain SNS at a more insightful level, research in this facet still remains less studied. Prior research review reveals that several studies were conducted in the SNS area regarding post adoption (Chang & Zhu, 2012; Lin & Lu, 2011), and continuance usage (Mouakket, 2015), with even less research in the setting of net individual benefits. It is worth noting that teenagers love SNSs, and cases of cyberbullying frequently occur on these sites as well.

Hence, the primary objectives of this research are to offer a thorough understanding of the benefits that individuals can derive from using SNSs and how to utilize them responsibly. The authors feel that there is a growing need to comprehend the unique advantages that each user of a SNS may derive from using it, as these platforms have become popular means of connection with the intention of receiving reciprocal favors. Over the past ten years or so, the global netizen population, especially of social media, has grown geometrically due to the rising popularity of the Internet among youths. Every day, new people for a variety of reasons from all ages enter cyberspace. In light of this, the topic of comprehending the personal net benefits of utilizing SNSs has garnered interest and is logically sound.

Therefore, to fill the research gap, this current study develops a research framework applying the modified DeLone & McLean information system (D&M IS) success model (DeLone & McLean, 2003) to investigate specific individual impacts obtained using SNSs. The DeLone and McLean (2003) model focuses mainly on measuring the success of e-commerce and net paybacks achieved from using IS. Thus, the model is considered one of the most well-known frameworks for explaining individual net benefit expectations of IS (DeLone & McLean, 2003). It is becoming popular among researchers adopting it for IS success scenarios such as knowledge management systems (Kulkarni et al., 2006), online learning systems (Lin, 2007), e-commerce (DeLone & McLean, 2004), and e-government systems (Wang & Liao, 2007) by specifying different constructs aiming to make the D&M model more comprehensive and usable in different contexts. This model also acts as the underpinning for investigation in the domain of SNS contexts. However, limited research has applied the D&M IS success model within an individual benefits setting. As a result, the current study primarily builds upon D&M's IS model with some extensions, suggesting that when the quality is sufficient, users become content and increase their intention to use, which in turn influences how much they believe they have gained (e.g., enjoyment, expected relationship, and reputation). Thus, we contribute a theoretical extension of D&M's IS success

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model to examine empirically the effect of computer systems on use and satisfaction, and how continuance usage and user satisfaction can create net benefits represented by relationship formation, information sharing, and social presence.

The overall purpose of the study is to examine the net benefits users can obtain from using SNSs by applying the updated DeLone and McLean updated model (2003) in the SNS context. Particular attention is paid to the following research questions (RQs) in this paper.

RQ1: What elements will have an impact on individual net benefits in the IS success model?

RQ2: What notable individual net benefits do SNS users experience?

The current study makes the following contributions. Firstly, by illuminating the distinct dynamics of users' relationships with social media, it will offer insights into the various aspects of SNS quality that influence users' satisfaction and intention to use the platform. Secondly, this study will contribute to a deeper comprehension of the fundamental benefits and advantages that support users' intentions to utilize SNSs. Thirdly, in order to effectively interact with and support users in the digital age, academics, practitioners, educators, and policymakers will find these insights to be highly beneficial. Fourthly, knowing what increases SNS usage might help marketers adjust their approach to successfully attract and retain digital consumers. Finally, by applying these ideas, platform designers can create user interfaces that customize SNSs to each user's preferences and needs, increasing their allure and intrigue.

2. THEORETICAL BACKGROUND

With regard to contributing an overall and inclusive meaning of IS success that reconciles information systems assessment from multiple perspectives, DeLone and McLean (2002) revised the current model and its measures and separated them into six leading sorts. Consequently, they provided a framework that can be used from multidimensional perspectives and which has interdependencies among constructs. Reviewing all the modifications and empirical studies, DeLone and McLean (2003) updated their original model accordingly, revealing a rationalized framework of IS success pertaining to these newly added dimensions. The six paradigms of the updated model include information quality, service quality, system quality, user satisfaction, intension to use, and net benefits.

DeLone and McLean (2002) argue that user satisfaction is a critical indicator of computer system success. *Satisfaction* refers to the comparison between perceived performance and expectations. The attitudes of users toward computer systems within their surroundings are a key component of user satisfaction. According to DeLone and McLean (2003), one of the most important quality factors for determining a system's success is system or information quality. The following criteria were used to assess *system quality*: importance, flexibility, accessibility, dependability, ease of use, and integration. It is anticipated that improved system quality will increase user satisfaction and usage, which will boost personal productivity. On the other hand, the accuracy, context, relevancy, timeliness, completeness, and accessibility of the information were the metrics used to gauge *information quality*. The objectivity of a website or information system is increased by great information quality (Dong et al., 2014).

Furthermore, regardless of whether the assistance is given to an Internet service provider, a new structural unit, or an IS department, service quality is a full support process offered by its provider. According to Grönroos (1984), *service quality* is defined as the general assessment and opinion of customers regarding the performance of a service provider, that has significant impacts on customer satisfaction in the SNS context. Due to the fact that users are now customers rather than employees, bad user assistance results in lost sales and funds, which is a crucial aspect in an e-commerce setting (DeLone & McLean, 2004). Additionally, service quality in e-commerce gauges the entire assistance provided by the website. The ability for a user to simply add people to a list of friends who are known to him or her, and to communicate with other users, are the most crucial features offered in an SNS setting. According to DeLone and McLean (2002), user satisfaction, which considers how users perceive computers in the context of their surroundings, is essential to the success of computer systems. Recently, user information pleasure has taken the place of model of information systems success and effectiveness (DeLone & McLean, 2003). User satisfaction was identified in this current study as the primary indicator of an information system's success. In the D&M model, user happiness has been expanded to include any web service that enables online communication, including email or instant messaging.

The current study extends the D&M IS success model by adding particular benefit constructs for a number of

causes. First, DeLone & McLean suggested in the conclusion of their study that a number of research works should conduct investigating and incorporation to measure net benefits. Seddon (1997) clearly argued that different stakeholders may have dissimilar views about what brings them benefit. Therefore, researchers must carefully and precisely specify the stakeholders and the setting in which they calculate the net advantages of an IS (DeLone & McLean, 2003). This result was backed up by Yuthas and Young (1998), who emphasized that examining usage and satisfaction metrics is insufficient as a substitute for accurately assessing performance or net benefits. Progress should be made in developing and testing net benefit measures on individual, group, industry, firm, and national levels (DeLone & McLean, 2003). In particular, this present study proposes to expand net benefits on an individual level basis.

First, Mouakket (2015) has pointed out that the use of SNSs should include the construct of enjoyment as an important factor that motivates users to keep using SNSs. According to Li (2011), *enjoyment* is "the extent to which the activity of using information technology is perceived to be enjoyable." Lin and Lu (2011) mentioned that perception of enjoyment is a vital factor in using any SNS. In other words, the individual adopts information technology as he/she perceives the chances of getting enjoyment from it. Second, *expected relationship* refers to the closeness or strength of the relationship that is predicted to increase consumer loyalty (Hennig-Thurau, 2000). Wilson et al. (2012) emphasize that crystallizing ephemeral relationships are advantageous in SNSs in order to retain strong and weak ties binding people. On the other hand, as Hennig-Thurau et al. (2010) report, SNSs have become a tool for users to create and maintain relationships with friends, family, and other people. Furthermore, Dunne et al. (2010) mentioned that maintaining relationships is a key driver of using SNSs.

Finally, an online user's *reputation* refers to how their peers in the virtual community perceive them as valuable members (Lin et al., 2017). According to Madden and Smith (2010), 71 percent of SNS users are between the ages of 18 and 29 and have modified their privacy settings to prevent others from viewing their online activity. This data shows that SNS users are concerned about their online reputation. Reputation is not built on sight; rather, users spend extensive time to share their status, information, and images, aiming to build self-reputation. This demonstrates a long-lasting relationship with individual SNS usage behavior; however, reputation has not been examined as an antecedent of continued SNS use behavior. Therefore, this study perceives reputation as an important individual benefit achieved by continuously using SNSs. In particular, this study includes enjoyment, expected relationships, and reputation as antecedents of user satisfaction and use intention in SNSs.

Based on these discussions, the current study offers a comprehensive and multidimensional research model (Fig. 1) for measuring the net individual benefits of using SNSs, where the information, system, and service quality of any SNS is allegedly the key to satisfaction and use intention, ultimately providing benefits including enjoyment, expected relationships, and reputation.

3. HYPOTHESES DEVELOPMENT

3.1. Information, System, and Service Quality to Satisfaction and Use Intention

Previous researchers have shown that user perceptions of quality, such as information quality, system quality, and service quality are prerequisites for user satisfaction and intention to use any SNS (Dong et al., 2014; Wang et al., 2014). In this regard, Zheng et al. (2013) mentioned that

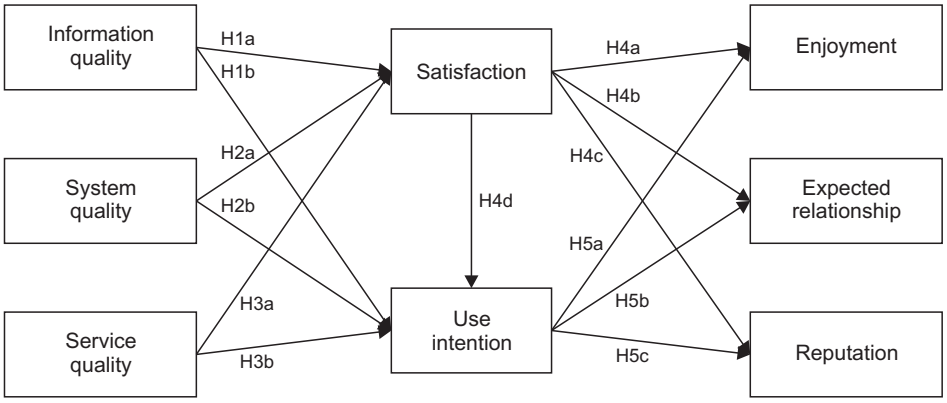


Fig. 1. The proposed framework.

system and information quality have a positive impact on satisfaction and use intention in the virtual community information sharing perspective. In particular, considering information, system, and service quality as an example, if a website is easy to use, the content is accurate, and the service is trustable, the use and satisfaction of SNSs will increase. Thus, this paper proposes the following hypotheses:

H1: Information quality has a positive influence on (a) satisfaction and (b) use in the context of SNSs.

H2: System quality has a positive influence on (a) satisfaction and (b) use in the context of SNSs.

H3: Service quality has a positive influence on (a) satisfaction and (b) use in the context of SNSs.

3.2. Satisfaction, Net Individual Benefits (Enjoyment, Expected Relationships, and Reputation) and Use Intention

In the D&M IS success model, satisfaction is identified as a direct determinant of net welfare (DeLone & McLean, 2003). Zheng et al. (2013) identified the significant positive relationship with user satisfaction and net benefits in the situation of information sharing in virtual communities. Lin et al. (2017) found that enjoyment has a significant positive impact on the satisfaction of using SNSs. Furthermore, Lee and Chung (2009) discovered positive disconfirmations in the case of keeping offline contacts. They noted that information and entertainment have a major impact on Facebook user satisfaction, which in turn has a strong impact on user desire to stick with Facebook.

However, the D&M paradigm only has a tenuous relationship between utilization and user satisfaction. The greater the user happiness, the greater the likelihood that they will use it (DeLone & McLean, 2003). According to Zheng et al. (2013), Dong et al. (2014), and Wang et al. (2014), contentment in the context of SNSs significantly affects use. A substantial positive association between satisfaction and ongoing SNS use was also discovered by Lin et al. (2014). Thus, this paper proposes the following hypothesis:

H4: Satisfaction has a positive relationship with (a) enjoyment, (b) expected relationship, (c) reputation, and (d) use intention.

3.3. Use Intention and Net Individual Benefits (Enjoyment, Expected Relationships, and Reputation)

Use is acknowledged as a direct cause of net benefits in the D&M IS success model (DeLone & McLean, 1992; 2003). Enjoyment is a crucial factor in determining the use intention of SNSs, according to Lin and Lu (2011). Reputation has been identified as an important construct and has a favorable impact on the intention to use SNSs in Lin et al. (2017)'s study. Higher individual advantages in particular (enjoyment, anticipated relationships, and reputation) raise users' expectations, which can persuade them to keep using the SNS. Therefore, this paper also tests the following hypotheses:

H5: The use intention of SNSs will lead to attaining more (a) enjoyment, (b) expected relationships, and (c) reputation in the SNS context.

4. RESEARCH METHODOLOGY

4.1. Research Design

This study is a quantitative one in which several hypotheses are formed to validate the relationships among variables. In accordance with the purpose of the study, we chose the United States, since the users there are among the most technologically savvy, varied, and fast-paced people in the world. As per the report of Singh (2024), there are 302.35 million social media users in the USA, and by 2024, that figure was expected to rise to 313 million, and 90% of Americans use social media regularly. Overall, a total of 302 million SNS users are the population of this study. Thus, the current study gathered data from American SNS users, which should result in more accurate and representative statistics overall, especially for SNSs.

The current research targets respondents who are users of multiple SNSs in the United States on a random sampling basis. An online survey was conducted for collecting data, where SNS users are taken into consideration and data were collected through random sampling from respondents within the United States. The survey was conducted using Amazon Mechanical Turk; MTurk (a research wing of Amazon.com), and respondents were paid $0.40 per completed response. There were two phases: (1) choosing specific SNS that they had ever used, (2) and then answering questions according to it. The survey was created using the authors' email address in a Google Doc, and afterwards the link was posted on the MTurk web-

Table 1. Constructs, formal definitions, and items

Construct	Code	Measurement item
Information quality (Dong et al., 2014)	IQ1	SNS provides me with all the up-to-date information for my purpose (deleted)
	IQ2	SNS provides me with all the information I need
	IQ3	SNS provides accurate information
	IQ4	SNS provides comprehensive information
	IQ6	The information content in the SNS meets my needs
System quality (Dong et al., 2014)	SQ1	SNS allows information to be readily accessible to me (deleted)
	SQ2	SNS is easy to use
	SQ3	SNS enables me to get on to it quickly
	SQ4	SNS interface is user friendly
	SQ5	SNS function is reliable
Service quality (Wang et al., 2014)	SeQ1	My SNS provides me with a higher level of online support and explanation
	SeQ2	My SNS service provider interacts extensively with users
	SeQ3	My SNS service provider provides high availability for consultation
	SeQ4	My SNS provides satisfactory support to users
	SeQ5	My SNS provides more worthy support than typical friends (deleted)
Use (Dong et al., 2014)	USE1	I intend to continue using the SNS in the future
	USE2	I will frequently use SNS in the future
	USE3	I expect my use of the SNS to continue in the future
	USE4	I will recommend others to use SNS (deleted)
	USE5	My intention is to continue using SNS rather than use any alternative means
Satisfaction (Dong et al., 2014)	SAT1	I am pleased with the experience of using the SNS
	SAT2	I am very satisfied with the SNS effectiveness and efficiency
	SAT3	I am happy with the use of SNS (deleted)
	SAT4	My overall experience of Facebook use was very pleasant
	SAT5	Using SNS was the best decision for me (deleted)
Enjoyment (Lin & Lu, 2011)	EJ1	I spend some enjoyable time using SNS
	EJ2	I derive fun and pleasure
	EJ3	It entertains and cheers up my mind
	EJ4	It helps to pass the time away when feel bored
	EJ5	I spend relaxing time using SNS (deleted)
Expected relationships	ER1	Participation in the SNS enables me to get connected with my old friends (deleted)
	ER2	Participation in the SNS can enable me to become familiar with new members
	ER3	Participation in the SNS can expand the scope of my association with other members
	ER4	The SNS helps strengthen my connections with other members
	ER5	Participation in the SNS can create new relationships with new friends
Reputation (Lin et al., 2017)	RP1	Participating in SNS can improve my value to others (deleted)
	RP2	Participating in SNS can improve my status
	RP3	I participate in the SNS to improve my reputation in the field
	RP4	Using SNS improves my image
	RP5	Participation improves other members' recognition towards me in the SNS community

Source: literature survey.
SNS, social networking site.

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site, giving prospective responders the choice to accept or decline the invitation to participate. Following the review of a few qualifying questions, potential respondents took part in this survey. A pilot survey was done with 25 samples prior to the final survey. Based on the findings of the pilot study, we made minor modifications to the survey items and questions before moving forward with the final survey operation.

Initially, 455 data were collected, and after data cleansing and removal of invalid responses, 421 valid samples were kept for further analysis. Given that numerous other distinguished scholars have employed samples in their research in manners akin to our own, we believe the final sample size we chose to be standard. For instance, Mouakket (2015) used 397 samples, Lin and Lu (2011) used 402 samples, Dong et al. (2014) used 346 samples, and Zheng et al. (2013) used 281 samples. In addition, structural equation modeling (SEM) requires a sample size with at least 10 times the largest number of indicators of the construct in the model (Wixom & Watson, 2001), and our sample size is far larger than this cutoff.

The online survey was operationalized from July 22-31, 2022. SEM was employed for data analysis using IBM SPSS Statistics 24 (IBM Co., Armonk, NY, USA). This study utilized confirmatory factor analysis (CFA), which is a two-step process for constructing an effective measurement model, as recommended by Anderson and Gerbing (1988). First, CFA evaluated the measurement model to determine the validity and reliability of the constructs. The relations of the hypotheses in the conceptual research model were then analyzed by looking at the structural model.

4.2. Instrument Development

The questionnaire was made while keeping an eye on previous literatures, and items taken into consideration are given in Table 1 (Dong et al., 2014; Lin & Lu, 2011; Lin et al., 2017; Wang et al., 2014). Therefore, some items are adopted from previous literature, whereas some others are modified. The survey's questionnaire was written in English, and responses were graded on a 7-point Likert scale (1 being the strongest disagreement, 7 the strongest agreement, and 4 being neutral).

4.3. Data

The sex distribution of the respondents is well balanced, as shown in Table 2. 27.3% of respondents are between 26-30 years old, followed by 21.1% who are over 40 years old. The majority of the participants have at least a

Table 2. Demographic details of the respondents

Demographic	Frequency	Percentage (%)
Sex		
Female	201	47.7
Male	220	52.3
Age (yr)		
Under 20	5	1.2
21-25	72	17.1
26-30	115	27.3
31-35	72	17.1
36-40	68	16.2
Over 40	89	21.1
Educational level		
Bachelor degree	212	50.4
College degree	78	18.5
High school degree	55	13.1
Master's degree	69	16.4
Ph.D/more	7	1.7
Position		
Student	42	10.0
Government employee	48	11.4
Private employee	230	54.6
Businessman	53	12.6
Others	48	11.4
Mostly used SNS		
Facebook	181	42.9
Twitter	59	14.0
Instagram	53	12.6
Reddit	19	4.5
LinkedIn	13	3.1
TikTok	11	2.6
Others	85	20.2
How long have you been using the SNS?		
Less than 6 mo	28	6.7
6-12 mo	33	7.8
1-3 yr	43	10.2
3-5 yr	81	19.2
More than 5 yr	236	56.1

Table 2. Continued

Demographic	Frequency	Percentage (%)
How long you use SNS every day?		
Less than 10 min	37	8.8
10-30 min	95	22.6
30 min-1 hr	112	26.6
1-2 hr	118	28.0
More	59	14.0

Source: survey findings.
SNS, social networking site.

bachelor degree (50.4%), and 18.5% and 16.4% of respondents have a college or master's degree, respectively, and the dominant respondents are private employees (54.6%). In this study, respondents with different SNSs comprised, in particular, users of Facebook 42.9%, Twitter 14.0%, Instagram 12.6%, Reddit 4.5%, and other SNSs including TikTok, Snapchat, WeChat, and YouTube. Most of the respondents have been on these SNSs for more than 5 years and around 56.1% of them use the SNS for 30 minutes to two hours per day.

4.4. Common Method Bias Test

When data are acquired from the same source at the same time, method bias is a prevalent problem. First, to evaluate the method bias, this study used the Harman's Single Factor Test suggested by Podsakoff et al. (2003). If the majority of the variance is explained by one component, all indicators would likely fall under it, which would be a problem. The principle axis factoring approach using the none rotation and fixed number of factors was tested. Results show that the first factor and some other factors with more than one eigenvalue were found to account for 45 percent of the variance, demonstrating that the method was not biased. Second, this study applied Pavlou et al. (2007)'s suggestions to assess systematic bias in data. Systematic bias may arise if the correlation value exceeds 0.90; however, the measurement model shows that correlation values exceeding 0.90 were not detected. This further revealed that there was no systematic bias in the data. Therefore, it is established that the data are unlikely to be compromised by major biases.

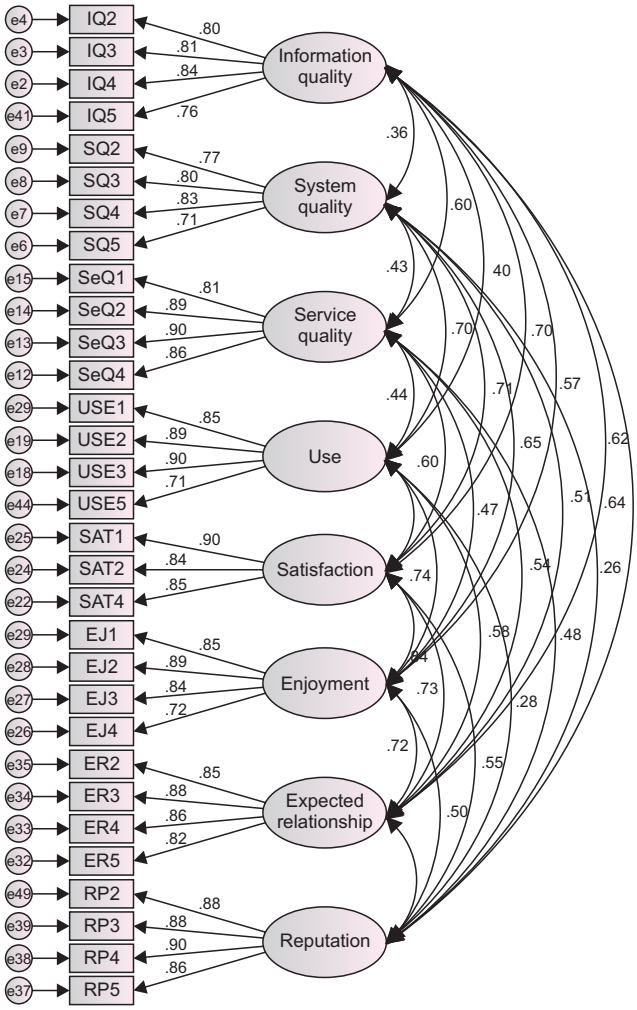


Fig. 2. Measurement model.

5. EMPIRICAL RESULTS

5.1. Measurement Model

5.1.1. Convergent Validity

A measurement model output is shown in Fig. 2, showing that the CFA factor loads with their respective constructs surpass the 0.70 threshold value; this represents that the data are highly loaded and enabled to generate higher reliability and validity (Hair et al., 2010). However, a few items of some constructs are removed due to being below the loading of 0.70. To retain consistency, our eight-construct model had five questions for each construct. Information quality, system quality, service quality, use of SNSs, enjoyment, expected relationship, and reputation all had one item removed. Additionally, two items were removed from the satisfaction variables.

Cronbach's alpha (α), composite reliability (CR), average variance extracted (AVE), and coefficients are all displayed in Table 3 (Browne & Cudeck, 1993; Doll et al., 1994; Hair et al., 2010) for each summed scale. Cronbach's alpha, which quantifies internal consistency reliability, ranges from 0.86 to 0.93, exceeding the cutoff point of 0.7 and suppressing higher internal consistency (Hair et al., 2010). The CR and AVE values should be in the 0.70 and 0.50 ranges, respectively, or higher (Fornell & Larcker, 1981). The study's findings reveal that the CR value varies from 0.86 to 0.93 and the AVE varied between 0.61 and 0.77, showing higher measuring instrument validity.

5.1.2. Discriminant Validity

The results of the analysis demonstrate that the square correlations for each construct are less than the variance that each construct's indicators have recovered. Additionally, values of the variance inflation factor that are within its cutoff value of 10 show the model's achieved discriminant validity. Based on the aforementioned validity and reliability, it can be said that the measurement model has reached acceptable convergent and discriminant validity.

5.1.3. Model Fitness Test

To have a suitably great model fit for the measurement model, the overall model fit was evaluated in terms of the goodness-of-fit index (GFI), adjusted GFI (AGFI), comparative fit index (CFI), and the root mean square error of approximation (RMSEA). As demonstrated in Table 3 (Browne & Cudeck, 1993; Doll et al., 1994; Hair et al., 2010)'s lower panel, all of the model fit indices fall within their respective recommended ranges, indicating that the suggested model fits the sample data well.

5.2. Structural Model

In the structural model, the relationships between latent variables are taken into consideration to test the hypotheses, where the values of the causal paths are shown in Fig. 3. The structural model also produced good model fit indices (e.g., the ratio of chi-square to degrees of freedom=3.31, GFI=0.824, AGFI=0.793, CFI=0.911, incremental fit index=0.911, and RMSEA=0.074). Variance explained by use, satisfaction, enjoyment, expected relationship, and reputation were at 71%, 66%, 69%, 60%, and 52% respectively, representing that the model has good explanatory power.

Table 3. Reliability and validity statistics

Construct	α	CR	AVE	IQ	SQ	SeQ	USE	SAT	EJ	ER	RP
IQ	0.88	0.88	0.66	0.81[a)]							
SQ	0.86	0.86	0.61	0.36	0.78[a)]						
SeQ	0.92	0.92	0.75	0.60	0.42	0.87[a)]					
USE	0.90	0.91	0.71	0.40	0.69	0.44	0.84[a)]				
SAT	0.89	0.90	0.75	0.69	0.71	0.59	0.77	0.87[a)]			
EJ	0.89	0.90	0.70	0.57	0.65	0.47	0.74	0.82	0.83[a)]		
ER	0.91	0.92	0.73	0.61	0.50	0.54	0.58	0.72	0.71	0.85[a)]	
RP	0.93	0.93	0.77	0.64	0.26	0.47	0.27	0.55	0.50	0.72	0.88[a)]

Model fit indices	Obtained value	Recommended value	Reference
CMIN/DF	2.546	≤3	Hair et al. (2010)
CFI	0.942	≥0.90	Hair et al. (2010)
AGFI	0.828	≥0.80	Doll et al. (1994)
NFI	0.909	≥0.90	Hair et al. (2010)
GFI	0.859	≥0.80	Doll et al. (1994)
RMSEA	0.061	≤0.08	Browne & Cudeck (1993)

α, Cronbach's alpha; CR, composite reliability; AVE, average variance extracted; IQ, information quality; SQ, system quality; SeQ, service quality; USE, use of social networking site; SAT, satisfaction; EJ, enjoyment; ER, expected relationships; RP, reputation; CMIN/DF, the ratio of chi-square to degrees of freedom; CFI, comparative fit index; AGFI, adjusted GFI; NFI, normalized fit index; GFI, goodness-of-fit index; RMSEA, root mean square error of approximation.
[a)]The values in the diagonal line are average variance extracted.

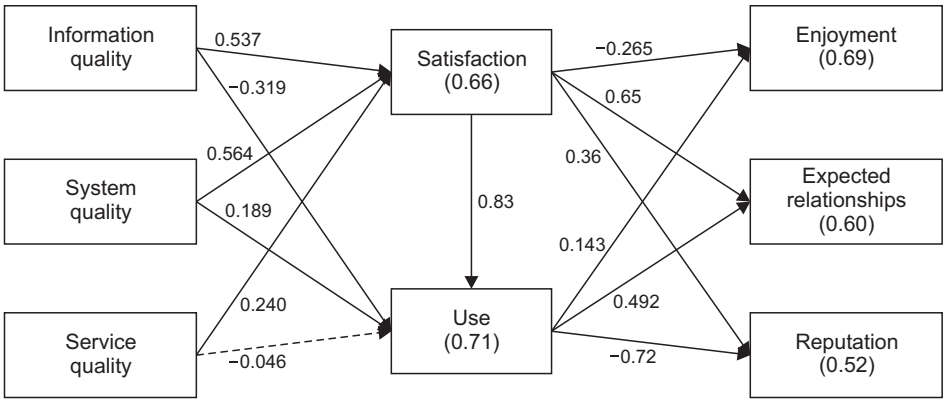


Fig. 3. Structural model. Straight line, significant paths; dash line, non-significant path.

The path analysis showed that the information quality has a significant positive effect on satisfaction (β=0.537, p<0.001) and negative effect on use intention (β=-0.319, p<0.001), thus accepting H1a and rejecting H1b. System quality has a significant impact on satisfaction (β=0.564, p<0.001) and use (β=0.189, p<0.001), supporting H2a and H2b. Despite having a significant impact on satisfaction (β=0.240, p<0.001), service quality had a negligible effect on use intention (β=-0.046, p>0.001), hence showing accepting H3a and rejecting H3b.

Satisfaction was found to have a substantial negative influence on enjoyment (β=-0.265, p<0.001), but a positive influence on expected relationships (β=0.65, p<0.001), reputation (β=0.36, p<0.001), and use intention (β=0.83, p<0.001), thereby rejecting H4a and supporting H4b, H4c, and H4d. Furthermore, use intention was found to have a noteworthy positive influence on enjoyment (β=0.143, p<0.001) and expected relationship (β=0.492, p<0.001), but negative on reputation (β=-0.72, p<0.001), providing support for H5a, H5b, and rejecting H5c.

6. DISCUSSION

Examining SNS success determinants and understanding the user benefits which can be gained through continuous use intension and satisfaction were this study's primary goals. The study findings are consistent with the notion that user satisfaction and use intention are mostly determined by the three system success dimensions of SNSs, namely, information quality, system quality, and service quality. Again, satisfaction and use intention were found to have a significant impact on user benefits. Overall, our study demonstrated flawless prediction capabilities with a higher variance explained in use, satisfaction, enjoyment, expected relationship, and reputation (71%, 66%, 69%, 60%, and 52%, respectively).

The study discovered the considerable impact of information quality on satisfaction and a negligible detrimental effect on use intention, which reveal the fact that user psychological acceptance and a favorable attitude, such as satisfaction, is largely generated by the information shared in SNSs. These findings are in line with the findings of Dong et al. (2014) and Zheng et al. (2013), who found that the virtual world values information quality when it comes to sharing knowledge. Thus, it is widely accepted that valid, reliable, need-based, and problem-solving information are the building blocks for achieving SNS users' satisfaction. However, the present study finds a negative relationship between information quality and use intention. Our data indicate negligible influences, contrary to Wang et al. (2014) who report a beneficial impact of information quality on use intention. The possible reasons could be explained as aggressive information sharing in different SNSs nowadays, such as self-promotional news by various parties, repetitive promotions and commercials for numerous unpopular products and services, and huge numbers of unimportant viral messages hampering user comfortability, thus creating users' disinterest.

This study interestingly finds a significant positive effect of system quality on satisfaction and use intention, consistent with the findings of Wang et al. (2014) and Dong et al. (2014). They regarded system quality as a requirement for the SNS platform, suggesting the fact that users seeking online platform engagement have strongly focused on usability, functionality, ease of use, and many others technical features of the system. Reliable, trusted, and secured systems in the virtual world are the top priority of users. Again, service quality appeared to be a substantial predictor of satisfaction, which is consistent with Mouakket (2015). Nonetheless, it was discovered

that the impact of service quality on usage intention was negligible, which does not corroborate Dong et al. (2014). The findings imply that service quality, associated with the actual outcome received by users from SNSs and the conditions under which the service is rendered, are the significant predictors of satisfaction. Another possible explanation could be that the way users interact with service providers is the prime dimension and constitutes a crucial factor in the development of user attitude. However, excessively misleading information, uninteresting viral news, fear of loss of privacy, and lack of direct interaction with service providers may be the causes of the negligible impact of service quality on usage intention.

The satisfaction of SNS users is a powerful factor in establishing expected relationships, reputation, and use intention. These results are similar to the findings of Lin et al. (2017), DeLone and McLean (2003), and Zheng et al. (2013). According to their arguments, when it comes to information sharing on SNSs, individuals are primarily concerned with their own happiness and thereby achieve individual benefits. Individuals perceive that joining an SNS will enable them to connect with new users, make friendships with them, strengthen the relationship, build their social status, and cultivate a positive self-image, which ultimately results in continued use of the SNS (Jahan & Kim, 2021). These findings reveal that as much as users are satisfied with a particular SNS, they perceive that they have benefited personally, socially, and that they will continue to use the SNS as they can.

However, satisfaction does not show a positive impact on enjoyment benefit, because users may find enjoyment from different sources rather than an SNS, or as the SNS industry matures, users may not think it is as enjoyable as perceived. On the other hand, use intention works as a powerhouse of enjoyment and expected relationship benefits, but not reputation. In line with our result, Lin and Lu (2011) noted that a major motivator for using SNSs is enjoyment. However, Lin et al. (2017) contended that reputation is a key component of SNS use, which runs counter to our findings. A user may exhibit greater enjoyment, feel engaged, expect strong relationships with other users, and be open to forming mutually beneficial relationships on SNSs, and as a result spend much more time on that SNS. Although users may spend much more time on an SNS, they do not feel credible merely because of their enrolment in an SNS, but rather for doing something contributory to other users or to the community.

6.1. Theoretical Implications

The empirical evidence provides supports for our proposed RQs and the model that relates SNS quality to two important attitudinal facts that can potentially allow users to derive individual benefits from SNS use, thus offering several theoretical contributions and managerial implications. The first addition this study makes to the literature on D&M IS in the context of individual benefits is theoretical. Particularly, system quality has a greater impact on SNS users' use intentions and satisfaction. User satisfaction appears to be mostly dependent on the quality of the information and services provided. In order to anticipate user satisfaction and use intention in the context of SNS, the D&M IS model with system, information, and service attributes has remarkable potential and deepens useful knowledge of the existing literature. Second, empirical evidence supports that user satisfaction of SNSs provides users with individual benefits such as enjoyment, expected relationships, and reputation, firmly contributing to continued SNS use intention. Besides this, the study finds evidence that continued use intention of SNSs notably contributed to enriching the individual benefits expected by their users. Taking note of all of these findings, the current study sees a contribution of fresh knowledge to the body of literature.

6.2. Managerial Implications

The followings are the specific applications of the current study for practitioners. First, SNS managers or practitioners may wish to increase user satisfaction to achieve a large and loyal user base. They could do so by extending special focus to the system quality of their SNS in regards to privacy, security, ease of use, and offering many more interesting features. By being aware of these elements, companies may better cater their SNS presence to the interests and tastes of users, strengthening both brand loyalty and consumer engagement. Second, managers can strengthen user satisfaction by paying special care to information shared on their board and services they offer to their users. Businesses may concentrate on encouraging trustworthiness, credibility, and transparency in their online interactions by understanding the factors that affect perceived trust on SNSs. By doing this, they can forge deeper relationships with their customers. However, caution should be applied to information and service quality in building a loyal user base, as these factors generate a negative impact on it. Third, businesses can create advertisements and content that resonate with their target market by recognizing the main features that draw customers.

This strategy will raise brand awareness and consumer happiness while also increasing marketing return on investment.

Fourth, the success of information systems depends heavily on user engagement, as demonstrated by the DeLone and McLean model. This translates for businesses into promoting active involvement, comments, and discussions on SNS platforms. Businesses can gain insightful information, handle client issues, and improve their online community by fostering user involvement. Fifth, in order to tailor their SNS interactions and content to each target market's unique cultural context, firms can use the DeLone and McLean approach to assess and personalize their online presence. As a result, their offerings may be more relevant to customers and they may develop stronger connections with them. Sixth, in dreaming toward a higher level of individual benefits and a loyal user base, managers should carefully deal with the effects of user satisfaction. Individuals in SNS platforms desire personal benefits in the form of pleasure, building reputation, and making trustworthy and mutually beneficial relationships, thus managers should critically observe how and to what extent users have received personal benefits. Finally, use intention requires special care as it means a loyal user base that potentially affects individual benefits. Managers should deliberately try to save their SNS from the adverse effects of satisfaction to enjoyment, and of use intention to reputations. Managers may screen information shared in the SNS board to make it reliable and appropriate, keeping away from any controversy or personal attacks, misleading information, or any negative issues to society. Businesses can spot possible problems or bad user experiences on SNSs with the aid of the model's insights. Businesses may stop bad comments from spreading and protect the reputation of their brand by proactively addressing these issues and promptly delivering solutions.

7. CONCLUSION

Using the updated DeLone and McLean updated model (2003) in the context of SNSs, the goal of this study was to investigate the net benefits that users can receive from using SNSs. The current study sheds light on the individual benefits highlighting the enjoyment, expected relationships, and reputation derived from the satisfaction and use intention of SNS users. This study explores the causes and effects of user satisfaction and usage intention using the D&M IS model as a theoretical foundation. In this study, the information, system, and service quality of SNSs are primarily considered as the antecedents of user satisfaction and use intention, with system quality having the greatest impact on both. Thus, successfully addressing (RQ1), what elements will have an impact on individual net benefits in the IS success model? Our research has successfully demonstrated that the main pillars of information quality, system quality, and service quality are what enable users to use SNSs in the IS success model and thus realize personal net benefits and increase user happiness. In addition, it has been demonstrated that satisfaction and usage intention are the antecedents of enjoyment, expected relationships, and reputation. The expected relationship is the advantage that respondents reported having the most concern about, according to the survey. It answered the questions being considered regarding RQ2, what notable personal advantages do SNS users experience? Overall, our research indicates that people use SNSs mostly for fun, to fulfill expectations with other users, and to establish a reputation for themselves ahead of others.

Thus, it is important to draw the conclusion that people typically use SNSs for personal enjoyment, forming connections with others, and attempting to enhance their online identities. Accordingly, understanding the advantages of SNSs is essential for organizations looking to use these platforms for marketing, customer interaction, and general organizational performance, given that consumers continue to place a high value on SNSs.

Despite the significant contributions and implications, there are certain limitations to the current study that may provide guidance for future studies. First, it was a survey-based study, which inherently produces a few drawbacks related to actual responses and intended responses. As this study collected data using a self-administrated and structured questionnaire, respondents may have faced hesitation to provide their responses, and they may have provided responses that may not be what they intended. Second, although this study produces unique evidence of SNS quality and individual benefits using the D&M IS model, other important theories may not have been considered, such as social capital, social exchange, or other factors. Third, demographic characteristics were not considered in the discussion that may indicate a lack of knowledge in this study.

Therefore, future researchers can consider the limitations of this study and validate this model in a more integrated manner. Future researchers may collect data from SNS users with an interconnected process to avoid the limitations mentioned above. Second, future trials can assess individual benefits from a social capital or social

 https://doi.org/10.1633/JISTaP.2024.12.4.1

exchange perspective, which may generate interesting insights into SNS literature. Third, the daily use of SNSs, how long users have been connected, how often users log into SNSs, etc. can be considered as an actual use intention in future studies.

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CONFLICTS OF INTEREST

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

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Bridging Bytes and Behaviors: Unraveling the Multifaceted Interplay of Technology and Employee Dynamics Over Time Through Text-Mining and Systematic Literature Review

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ABSTRACT

This study investigates the intricate relationship between technological integration and its consequences for employees, focusing on the evolving impacts of advanced technologies on organizational operations and workforce dynamics from 1983 to 2022. Utilizing a sophisticated method combining rigorous text-mining analysis and a systematic literature review, the research analyzes an extensive dataset of 7,000 articles to track the progression of technology-related topics and keywords within the literature. The findings reveal a dual nature of technology's impact on the workforce. On one side, technological advancements are associated with challenges such as increased turnover intentions, anxiety, and health concerns. On the other, there is an emerging shift towards understanding the nuanced differences between technology-mediated interactions and traditional face-to-face engagements. The study underscores the necessity of strategic technology integration that not only enhances productivity but also safeguards employee well-being. Emphasizing the need for a redefined approach to work-life balance, the research sets a foundation for future explorations into the multifaceted effects of technology within organizational contexts, specifically recommending a deeper examination of individual information behaviors and sector-specific technology impacts in response to technological advancements. This refined focus aims to contribute more directly to information science by addressing how these technological integrations influence information behaviors across various organizational layers and over time.

Keywords: evolution, management, systematic literature review, technology, text-mining

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1. INTRODUCTION

Over the past decade, the surge in digital technology adoption has transformed organizational operations with various integrated advanced tools such as big data analytics, cloud computing, and artificial intelligence (AI) (e.g., ChatGPT, Gemini, Claude, and DALE III; Bharadwaj et al., 2013; McKinsey & Company, 2023; Tilson et al., 2010). Digital transformation (DT), described as organizational adaptations prompted by digital technologies, empowers firms to rejuvenate their business models and equips them to navigate a modern volatile business landscape (Hanelt et al., 2021; Warner & Wäger, 2019).

This technological pivot has marked our lives and work, with a significant body of research documenting these shifts (Fichman et al., 2014; Kim & Roh, 2023). As technology continues to evolve, understanding its future impact is crucial. Notably, 40% of all organizations are escalating their AI investments and anticipating transformative outcomes, especially in knowledge-driven sectors (McKinsey & Company, 2023; OpenAI, 2023).

Scholars and practitioners are becoming increasingly interested in DT (Westerman et al., 2011). However, this concept is often misinterpreted as a mere technological evolution. DT encompasses broader human and organizational metamorphoses steered by technology (Kane, 2019). Given the rapid technological advancements and burgeoning discourse on the intersection of technology with management, it is pivotal to chart the academic evolution of this field and discern its future trajectory (Nambisan et al., 2017).

The profound impact of digital technologies on organizations and their workforce has garnered significant attention from both academia and industry. As organizations navigate the complexities of DT, there is a pressing need to understand the multifaceted interplay between technology and employee dynamics. This understanding is crucial for organizations to effectively leverage digital technologies while fostering a productive and engaged workforce. However, the existing literature on this topic is fragmented, and a comprehensive synthesis is lacking.

This study meticulously examined seminal papers indexed on the Web of Science (WoS), focusing on the evolutionary trajectory of technology-related research. This study was initiated in 1983 and marked the onset of significant technology-related studies in the WoS database. We purposefully chose this starting point to trace the evolution of technological research over four decades, culminating in 2022. This timeframe enabled a comprehensive understanding of the field's progression and its contemporary relevance. Our approach involved a detailed text-mining analysis of titles, abstracts, and keywords from a carefully selected subset of 21 journals in the management and information technology (IT) disciplines. These journals, which are part of the highly cited *Financial Times* 50 journals, were selected because of their global recognition and significant impact on the scholarly community. Furthermore, these 21 journals have been at the forefront of publishing research on the intersection of technology, management, and strategy, collectively accounting for a substantial portion of the relevant literature in this domain. This concentration of relevant literature in these high-impact journals highlights their influential role in shaping the discourse and advancing knowledge in this field. The selection process led to the identification of 7,000 technology-related articles published from 1983 to 2022. Text-mining analysis has been instrumental in revealing how technology studies have evolved over time, particularly in relation to employee and workplace technology interaction.

After a thorough review of the patterns and progression of technological studies, this study focuses on the trajectories and patterns of research examining the interplay between technology and employees over the past four decades. In addition to text-mining analysis of technology-related studies, 1,046 articles were identified under technology and employee keywords. We reviewed them based on the abstract and title and selected 18 articles for systematic literature reviews.

Thus, our study provides a valuable reference point for scholars by answering the research question, "How has the evolution of technology research, particularly in relation to employee and workplace dynamics, transformed over the past four decades, and what implications does this transformation hold for understanding and anticipating the future intersection of technology and management in the workplace?" This historical lens helps contextualize present-day studies within a broader academic lineage, fostering a richer understanding of how past research has laid the groundwork for contemporary inquiries.

Furthermore, the shift from merely focusing on technology management to exploring the intersection of organizational behavior, team dynamics, and organizational success underscores the maturation of the discipline. The cross-pollination of ideas across traditionally distinct domains such as computer science, psychology, sociology, and business ethics offers an interdisciplinary lens that enriches the theoretical depth and breadth of management research. For instance, integrating computer science

with organizational behavior has led to novel insights into how technology influences workplace behavior, whereas the combination of sociology and business ethics offers a new understanding of ethical issues in technology-driven workplaces. Additionally, through a meticulous, systematic review, we emphasize the multifaceted impact of technological advancements on individual employees, offering insights ranging from tangible effects on job roles to more nuanced psychological and emotional ramifications. Finally, our findings accentuate the redefined essence of work in the contemporary digital age, underscoring the imperative to delve deeper into qualitative shifts in employment perceptions and roles in a world increasingly intertwined with AI and advanced technologies.

2. EVOLUTION OF TECHNOLOGY-RELATED STUDIES

Academic research themes continuously evolve with societal and chronological shifts (Lee et al., 2024). Recognizing these transformations is instrumental in forecasting academic trajectories and unearthing novel research topics (Morillo et al., 2003). Our study explored the metamorphosis of academic themes over time by leveraging topic modeling (Blei et al., 2003) on the abstracts of scholarly statistics sourced from international journals between 1983 and 2022. This analysis will unearth myriad insights into past and current academic development trajectories, facilitating the discernment of academic trends, excavation of emergent research themes, comprehension of contemporary research dynamics, and probing of interdisciplinary potential (Börner et al., 2003).

In our contemporary information-centric society, an immense amount of data is generated, underlining the importance of effectively analyzing and harnessing this deluge (Hilbert & López, 2011). By applying topic modeling to academic studies, this study aims to mine embedded values and insights from previous studies related to technology (Blei & Lafferty, 2009). Consequently, the primary aim of this study was to meticulously trace and analyze the evolution of scholarly focus within the realms of technology and management. By examining topic trends across four distinct time periods (1983-1992, 1983-2000, 1983-2010, and 1983-2022), we sought to understand how academic research has progressively responded to and influenced real-world technological and organizational development. This analysis not only highlights the dynamic shifts in academic priorities, but also aims to identify emerging patterns that offer practical insights for contemporary and future applications in technology management. Our findings provide invaluable insights for future studies and researchers from diverse disciplines during their research journeys (Chen, 2006).

2.1. Method

2.1.1. Text-Mining Approach

Academic discourse continues to embrace and integrate technological advances to refine its methodology. One such method, text mining, facilitates the extraction of meaningful insights from extensive unstructured text data through techniques that span natural language processing (NLP), information retrieval, and machine learning (Feldman & Sanger, 2007). This method is crucial for identifying prominent patterns and gaining insights into document corpora. As a specialized realm within text mining, topic modeling, an unsupervised learning technique, is used to identify subjects within a collection of documents (Blei et al., 2003). Unsupervised learning refers to the process in which an algorithm learns patterns from untagged data without any explicit instruction on what patterns to find, making it well-suited for discovering hidden thematic structures in large textual datasets (Hoffman et al., 2010). This methodology has recently garnered significant attention, and has been applied in various academic disciplines.

Widespread recognition of the potential of topic modeling is evident in existing studies, which highlights the complexities of individual research topics within business studies and illuminates interdisciplinary research possibilities. Previous findings significantly underpin our extensive topic modeling approach in previous studies on technology. Moreover, Lee and Bozeman (2005) emphasized the need to understand international research trends in academic journals. Their approach motivated us to survey academic transformations from a global perspective, using the WoS International Academic Database. Although Börner et al. (2003) aimed to offer the academic directionalities required in actual fields, our study pivots more towards directly utilizing topic modeling rather than visualization.

Building on these foundational studies, our study aims to systematically explore changes in academic topics over time through extensive topic modeling of academic databases. These endeavors are expected to shed light on the trajectories of academic development in the past and present, further aiding the forecasting of future research subjects and directions. With the massive amounts of data

generated in our digital era, as emphasized by Hilbert and López (2011), effectively analyzing and utilizing these data has become paramount. From this standpoint, our study analyzed more than 7,000 academic studies recorded in 21 *Financial Times* 50 listed journals via topic modeling to excavate their inherent value and insights. Our research relies on insights and knowledge gained from previous studies and anticipates that the outcomes will provide valuable material to researchers across various fields (Chen, 2006). By evolving and building on the results of prior studies, our research offers robust methodologies and approaches for visualizing academic subject transformations over time and illustrates how they can be harnessed to predict future research trends.

2.1.2. Data and Preprocessing

Data were collected from the WoS database based on 21 journals, including the *Academy of Management Journal* (*AMJ*), *Administrative Science Quarterly* (*ASQ*), *Human Relations* (*HR*), *Human Resource Management* (*HRM*), *Information Systems Research* (*ISR*), *Journal of Applied Psychology* (*JAP*), *Journal of Business Ethics* (*JBE*), *Journal of Business Venturing* (*JBV*), *Journal of International Business Studies* (*JIBS*), *Journal of Management* (*JOM*), *Journal of Management Information Systems* (*JMIS*), *Journal of Management Studies* (*JMS*), *Management Science* (*MS*), *MIS Quarterly* (*MISQ*), *Organization Science* (*OS*), *Organization Studies, Organizational Behavior and Human Decision Processes* (*OBHDP*), *Research Policy* (*RP*), *Sloan Management Review* (*SMR*), *Strategic Entrepreneurship Journal* (*SEJ*), and *Strategic Management Science* (*SMJ*), and amassed 7,000 scholarly articles from 1983 to 2022. These articles were sourced from various academic journals, including 1,655 from *Research Policy* and 734 from *MIS Quarterly*. The selection of these 21 journals, which predominantly focused on management, strategy, and technology, was deliberate. This choice aligns with our research objective of examining the evolution of technology-related studies and their impact on organizational employees. By focusing on journals that closely interlink technology with management and strategy, we ensured that our review comprehensively covered the multifaceted ways in which technology intersects with organizational dynamics and strategic decision-making. This approach facilitates an inclusive glimpse into diverse academic development trends by ensuring a comprehensive scope within the stipulated timeframe.

Topic modeling, a statistical model employed to discern topics within a collection of documents, has been used to analyze the evolution of academic subjects (Blei et al., 2003). Given its recent surge in popularity across various academic disciplines, this is a powerful, unsupervised learning technique. To implement the Latent Dirichlet Allocation (LDA) model, an integral tool for this research, we utilized the Python library *tomotopy*. The LDA operates on the premise that each document comprises multiple topics, and learns to associate distinctive word distributions with each topic (Blei et al., 2003). The model underwent 200 iterations, with the log-likelihood values produced at each stage to provide real-time insights into the model's performance enhancement. The top 10 words from multiple topics were extracted to discern the essence of each topic.

The preprocessing phase is crucial for data refinement. Using the natural language toolkit (nltk) package, a comprehensive suite of libraries and programs for symbolic and statistical NLP in the English language, we retained English stems and excised extraneous elements such as special characters. The nltk is widely used in text mining for tasks such as tokenization, stemming, and tagging, making it an appropriate choice for ensuring the accuracy and consistency of linguistic analysis. Additionally, English stop words were excluded to ensure a focus on core semantic content (Bird et al., 2009). To achieve a granular analysis of data from 1983 to 2022, the research duration was segmented into four distinct intervals: 1983-1992 (Time period 1), 1983-2000 (Time period 2), 1983-2010 (Time period 3), and 1983-2022 (Time period 4) to see how studies have evolved. The use of overlapping periods was integral to our approach, allowing us to observe the cumulative and evolving nature of this research. By separately examining periods such as 1983-1992 and 1993-2002, we identified distinct trends within each decade. However, overlapping periods are necessary to fully understand the evolution and additive impact of research over time. For instance, examining 1983-1992 and then extending this to include 1993-2000 reveals not only the continuation of trends from the first period, but also the emergence of new ones, providing a clearer picture of the study's evolutionary trajectory. By doing so, we can trace evolutionary paths and key topics by investigating trends with overlapping periods. Topic modeling was executed for each segment, enabling a structured understanding of the evolution of academic subjects over time. After the model training, the primary themes were interpreted using the top words associated with each topic. These interpretations are underscored as one of the principal outcomes of this study.

2.1.3. Exploratory Data Analysis and Optimization

Embarking on the preprocessed data, this study applied an LDA topic-modeling algorithm. Determining the most appropriate number of topics is crucial for modelling precision and efficiency. The coherence and perplexity metrics map the evolution of academic research topics over time. A grid-search method was used to identify the optimal parameter values during the model learning phase. This grid encompasses Alpha and Eta values, considering cases such as [0.01, 0.05, 0.1, 0.2, 0.3] and topic number k as [5, 8, 10, 12, 15, 20, 25, 30]. After training the LDA model for each combination, coherence and perplexity values were computed, leading to the selection of the best parameter combination (Röder et al., 2015). Coherence, which exemplifies the congruence of words within a topic, indicates optimal performance with higher values. By contrast, perplexity shows the model's capability to predict new data; lower values indicate more desirable outcomes (Newman et al., 2010). The decision to use 10–20–20–30 topics across the four phases was based on the results of the grid search (Table 1). We aimed to balance the granularity of topics with the overall coherence of the models. As the volume and complexity of the data increased over time, progressively larger topic numbers (from 10 in the earliest phase to 30 in the latest) offered the best balance between detailed topic representation and model coherence.

In the LDA learning phase of our study, we used an optimal combination of parameters to ensure the high reliability of topic modeling. This approach allowed us to focus on the evolution of research subjects as reflected in the incremental increase in the number of topics discerned from the optimization process. This increase from 10 to 30 topics across the four periods (1983-1992, 1983-2000, 1983-2010, and 1983-2022) mirrors fluctuations in technological and sociocultural trends. In evaluating these topic trends, we deliberately chose not to consider topic frequencies. This decision was made to avoid potential biases arising from the disproportionate representation of certain topics in the larger datasets. Hence, our focus was on the diversity and evolution of topics rather than their frequency. Regarding the data presented in Table 1, a direct comparison of different time periods with varying data point sizes (24, 1,177, 3,495, and 7,000) presents a unique challenge. The stark contrast in data-point volumes across these periods necessitates a nuanced approach to analyzing and interpreting the evolution of topics. This is particularly evident when juxtaposing the initial period (1983-1992) with subsequent periods, as the expansion in data points reflects not only the growth of the field, but also the broadening scope of the topics explored.

One of the pivotal observations of this study was the rapid proliferation of academic papers over time, as depicted in Fig. 1. This surge in data led to the decision to extract 10, 20, 20, and 30 topics across the delineated time intervals, respectively. This approach ensures that the primary topics of each period do not merely represent the themes emerging during that epoch, but more crucially, reflect the relative frequency of their coverage in academic discussions. By adopting this strategy, this study transcends the mere chronological mapping of topic evolution and successfully captures fluctuating academic interests across different timeframes.

2.1.4. Results and Interpretation of Topic Evolution over Time

Diving into topic modeling outcomes for each period yields the following insights (Table 2):

Time period 1 (1983-1992): During this nascent phase of technological advancement, the primary emphasis was on "Information Technology Management and Problem-solving." This highlights the initial stages of computer technology and the emergence of the Internet, in which research was chiefly centered on optimizing IT resource management and devising innovative problem-solving methodologies using these technological instruments.

Time period 2 (1983-2000): This interval heralded

Table 1. Results of parameters and hyper-parameter for optimization

Time period	Alpha	Eta	k	Best coherence	Perplexity
1983-1992	0.01	0.1	10	0.575	142.249
1983-2000	0.3	0.05	20	0.488	1,578.080
1983-2010	0.2	0.3	20	0.537	2,028.227
1983-2022	0.1	0.3	30	0.549	2,344.293

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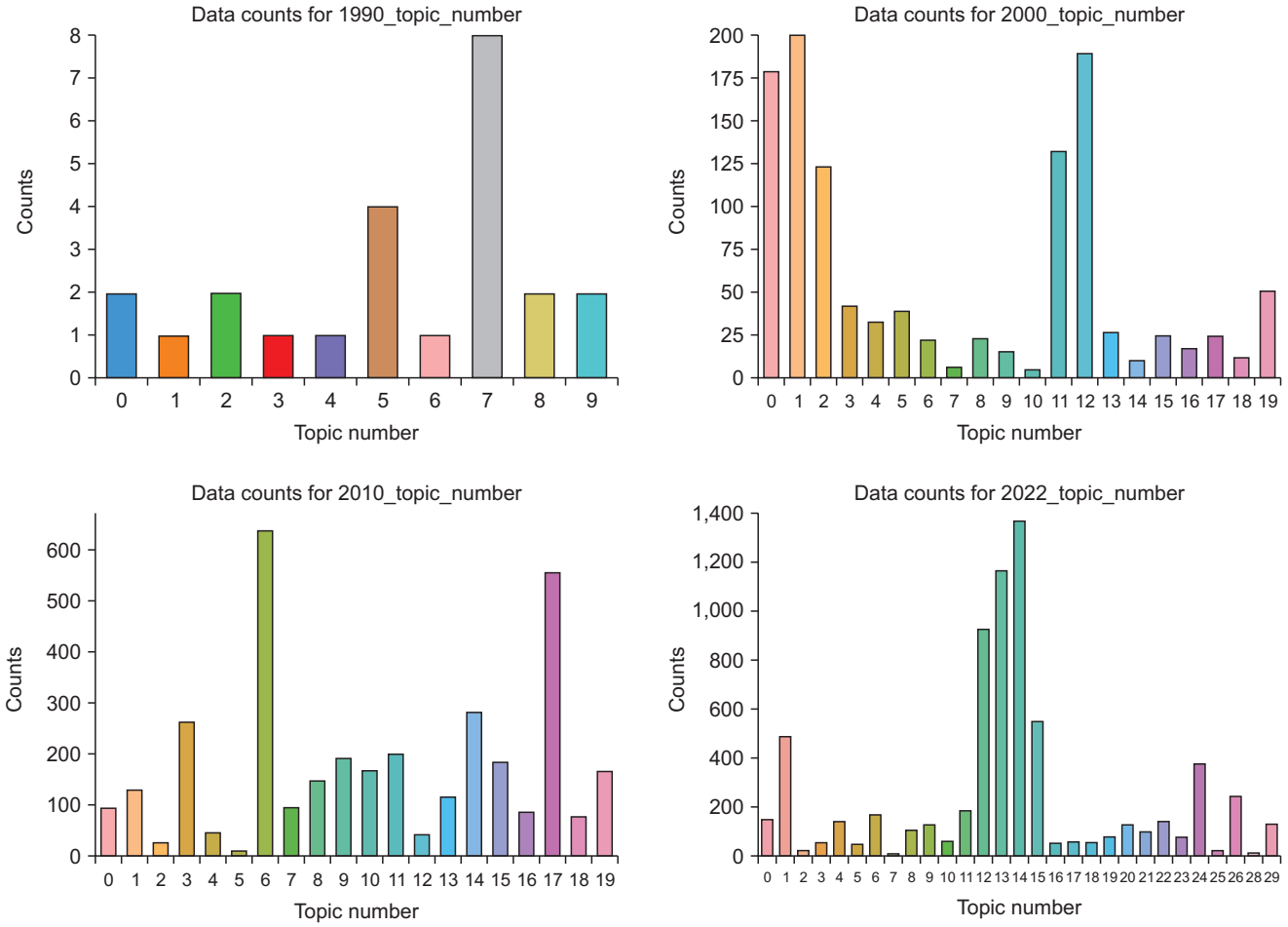


Fig. 1. Number of publications over time.

a more diverse scholarly landscape, encompassing subjects such as "Research Methodology and Performance Measurement Analysis," "Technological Development and Organizational Information Systems," and "Technology Innovation and Industry Adoption Dynamics." This period reflected academia's proactive response to swift technological advancements, emphasizing the intersection of technological development and organizational management methodologies.

Time period 3 (1983-2010): During this period, salient themes emerged, such as technological innovation, industrial policy and research models, and information system management. Simultaneously, the emergence of themes such as "Team Management and Project Development Performance" and "Organizational Change and Social Theory in Technology" emphasized the growing confluence of organizational behavior and technological breakthroughs. Such themes underscored the increasing significance of technological policies, management of information systems, and the nuanced dance between organizational metamorphoses and technological progress.

Time period 4 (1983-2022): The most recent scholarly trends gravitate towards "Firm Performance and Investment Value," "Technology Policy and Innovative Science," and "Research Models and Technology Development." Concurrently, subjects such as "Product Pricing and Market Dynamics in Technology" and "Organizational Learning and Knowledge Management" have garnered significant academic attention. This indicates a sophisticated evolution in research priorities from preliminary technological management considerations, to a holistic evaluation of organizational performance in the face of technological advancements and their strategic implications.

In summary, topic modeling elucidates the discernible

Table 2. Keywords and labelled topic name from time period 1 to 4

Time period	Topic number and labelled topic name
Time period 1 (1983-1992)	Topic #0: Group Behavior Analysis & Organizational Functionality Topic #1: Software Development & Quality Assurance in Business Topic #2: Planning & Environmental Impact on Product Design Topic #3: Cellular Layout & Operational Performance Topic #4: Application Development & Project Management Topic #5: System Adoption & Research in Implementation Strategy Topic #6: Organizational Theory & Technology Diffusion Roles Topic #7: Information Technology Management & Problem Solving Topic #8: Professional Threats & Opportunity Identification Topic #9: Group Decision Support & Time-Based Experience Comparison
Time period 2 (1983-2000)	Topic #0: Technology Innovation & Industry Adoption Dynamics Topic #1: Research Methodology & Performance Measurement Analysis Topic #2: Product Development & Strategic Manufacturing Topic #3: Competitive Market Strategy & Venture Success Topic #4: Small Firm Growth & Entrepreneurial Strategies Topic #5: Group Dynamics & Decision Support in Teams Topic #6: Communication Theory & Social Media Utilization Topic #7: Venture Investment & Value in Capital Funding Topic #8: Performance Improvement & Time Efficiency Topic #9: Network Alliances & Collaborative Partnerships Topic #10: Corporate Internationalization & Global Activity Topic #11: Science Policy & Industrial Technology Research Topic #12: Technological Development & Organizational Information Systems Topic #13: Project Management & Problem Solving Models Topic #14: Investment Value & Market-Based Customer Services Topic #15: Knowledge Transfer & Organizational Learning Capability Topic #16: Business Management & Executive Strategic Planning Topic #17: Organizational Design & Structural Theory Topic #18: Patent Evaluation & University Technology Applications Topic #19: Information Systems & Decision Support Technologies
Time period 3 (1983-2010)	Topic #0: Ethics in Business Technology & Professional Responsibility Topic #1: Firm Performance & Entrepreneurial Venture Strategies Topic #2: Contract Management & Outsourcing Risks in Investments Topic #3: Team Management & Project Development Performance Topic #4: Professional Training & Employee Skill Development Topic #5: Service Quality & Employee-Customer Satisfaction Topic #6: Technology Innovation & Industrial Policy Topic #7: Firm Competitive Advantage & Resource Integration Topic #8: Company Strategy & Technology Management Topic #9: Product Marketing & Consumer-Centric Pricing Topic #10: Patent Research & University Intellectual Property Topic #11: User Behavior & Technology Adoption Influences Topic #12: Information Network Systems & Privacy in Technology Adoption Topic #13: Knowledge Transfer & Organizational Learning in Innovation Topic #14: Organizational Change & Social Theory in Technology Topic #15: Investment Value & Performance Measurement in Technology Topic #16: Group Dynamics & Communication in Decision Support Topic #17: Research Models & Information System Management Topic #18: Internationalization & Foreign Investment in Technology Firms Topic #19: Firm Alliances & Industrial Network Strategies

evolution in research emphases across various epochs. From foundational themes centered on IT management at the dawn of the technological age to the intricate considerations of technological policies, organizational performance metrics, and investment implications in contemporary times, this evolution underscores academia's dynamic response to the symbiotic relationship between technology and management. Such shifts reiterate the critical role of advanced analytical methods, such as topic modeling, in shaping the trajectory of scholarly endeavors, ensur-

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Table 2. Continued

Time period	Topic number and labelled topic name
Time period 4 (1983-2020)	Topic #0: Consumer Online Behavior & Service Experience Topic #1: Product Pricing & Market Dynamics in Technology Topic #2: Employee & Human Capital Development Topic #3: Supplier Management & Outsourcing Relationships Topic #4: Competitive Advantage & Sustainable Business Strategy Topic #5: Digital Platforms & Internet Service Development Topic #6: Decision-Making & Information Control Systems Topic #7: Software Efficiency & Cloud Computing Optimization Topic #8: Academic Research & University-Industry Collaboration Topic #9: Project Management & Software Implementation Quality Topic #10: Strategic Alliances & Partnership Management Topic #11: Patent Analysis & Intellectual Property Licensing Topic #12: Firm Performance & Investment Value Topic #13: Technology Policy & Innovative Science Topic #14: Research Models & Technology Development Topic #15: Technology Adoption & Industrial Market Dynamics Topic #16: Group Communication & Electronic Support Systems Topic #17: Employee Training & Professional Ethics in the Workplace Topic #18: Entrepreneurial Ventures & Start-up Investments Topic #19: Social Network Analysis & Peer Influence Topic #20: Institutional & Ethical Practices in Organizational Change Topic #21: Team Performance & Virtual Work Relationships Topic #22: User Behavior & Trust in Information Systems Topic #23: Internationalization & Global Firm Knowledge Topic #24: Organizational Learning & Knowledge Management Topic #25: Healthcare Systems & Patient Data Management Topic #26: Firm Innovation Performance & Resource Management Topic #27: Fraud Detection & Risk Management in Auctions Topic #28: Cybersecurity & AI-Driven Risk Management Topic #29: Company Strategy & Business Technology Adaptation

ing that they remain agile and pertinent in a perpetually evolving technological and managerial milieu.

Academic research's beauty lies in its ability to trace the ebb and flow of intellectual curiosity over time. Examining the evolution of specific topics in our study makes it evident that the scholarly focus has shifted and transformed, echoing larger societal and technological changes. As an illustration, Topic 7 from Table 2 (1983 to 1992) was dominantly classified as "Information Technology Management and Problem Solving," emblematic of a nascent period when IT and problem-solving management were of prime interest. However, this topic morphed into broader and more sophisticated arenas as decades passed. By 2000, it transmuted to Topic 12, emphasizing "Technological Development and Organizational Information Systems," and by 2010, it had evolved yet again to Topic 3, shedding light on "Team Management and Project Development Performance." This dynamic shift from a focus on technology management to the nuanced aspects of team dynamics and project success within organizations signals a maturation in academic pursuits, culminating in 2022 with Topic 6, "Decision-Making and Information Control Systems."

Such mutable narratives of a single topic encapsulate how academic interests are not static but reflective of broader societal, technological, and organizational shifts. This is further illustrated by the Sankey Diagram (a powerful visualization tool widely used across sectors such as marketing and energy analysis), as shown in Table 2. While the volume of data for the period up to 1992 was deemed insufficient for comparison, the visualization from 1983 to 2000 elucidates the flux in popular topics over time, offering a holistic overview of interconnected academic trajectories.

Fig. 2 provides a panoramic view of the flow of popular topics through 2000, 2010, and 2022. It meticulously traces the progression from micro-level insights such as "Product Development and Strategic Manufacturing" to macroscopic evaluations focusing on "Investment Value and Performance Measurement in Technology" and, eventually, "Firm Performance and Investment Value." This trajectory mirrors a broader shift in research emphasis from

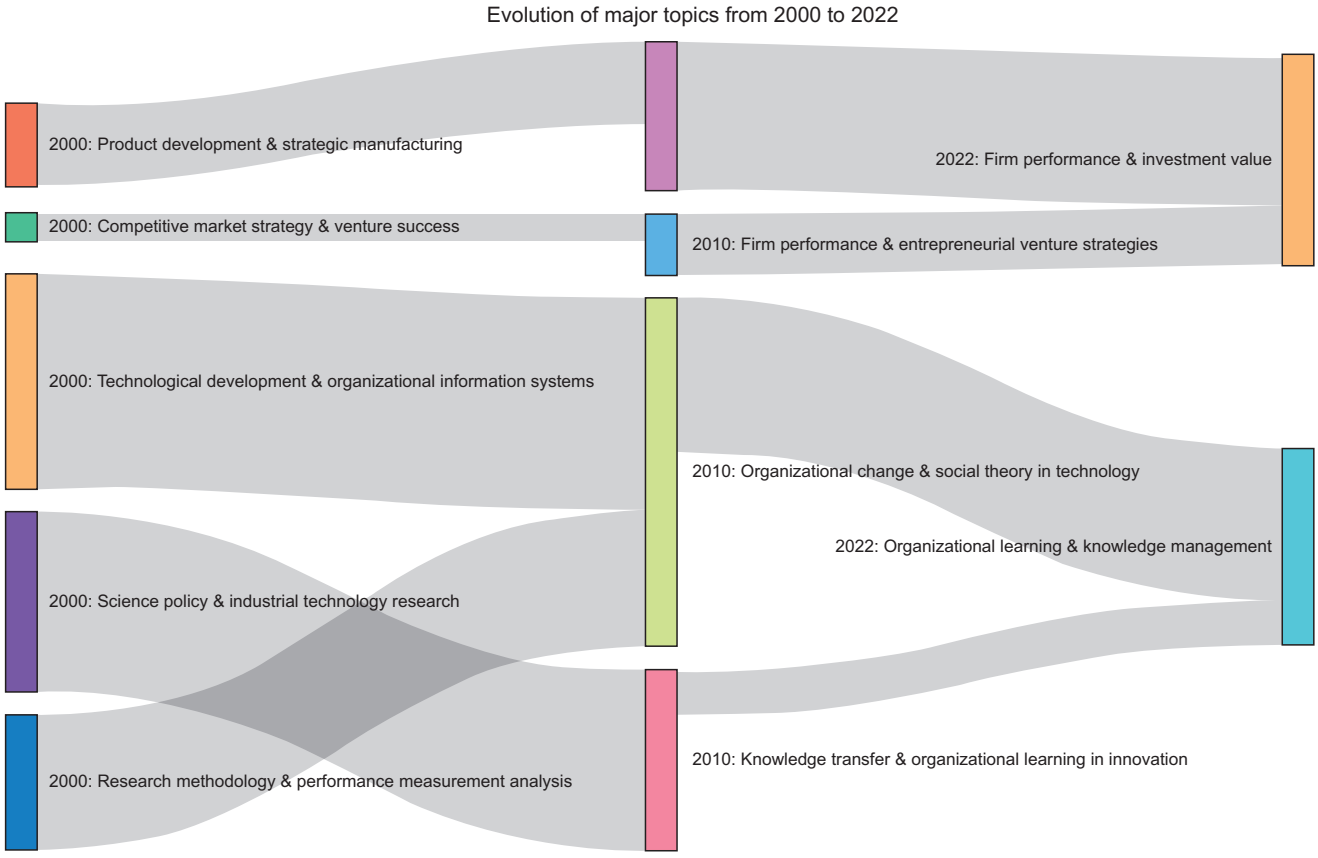


Fig. 2. Evolution of important topics over time.

an initial focus on tangible product development and operational efficiency to a broader, long-term perspective on organizations' overall value and performance in the technological landscape.

Moreover, the transformation from "Technological Development and Organizational Information Systems" to themes such as "Organizational Change and Social Theory in Technology" and "Organizational Learning and Knowledge Management" underscores a nuanced evolution. Organizations have transcended merely altering their internal processes and information systems to strategically position themselves within larger societal narratives. The elevated emphasis on continuous learning and knowledge management foregrounds the importance of technological advancements and accentuates the intricate interplay between intra-organizational dynamics and external technological changes. This intricate interplay highlights the importance of management research for technology-related studies. Understanding its ramifications for organizational structures, processes, and strategies becomes paramount as technology continues its inexorable march forward. Thus, management research bridges technological advancements with organizational realities, ensuring that innovations are harnessed effectively, ethically, and strategically.

In the nexus between interpretation and introduction of new technologies, the increasing centrality of technology's role in shaping workplace dynamics becomes evident. The interpretive journey from initial technological product development to its current profound influence on organizational value and performance emphasizes the intrinsic relationship between technological advancement and management. Organizations have evolved from viewing technology as a tool for operational optimization to recognizing its fundamental role in shaping organizational structures, processes, and long-term strategies. Such an evolution parallels scholarly recognition that the successful adoption of new technologies hinges significantly on employees' willingness and capability to integrate these technologies into their work roles and practices (Blanka et al., 2022; Eller et al., 2020). The introduction and adaptation of new technologies in the workplace are not solely a

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function of the technologies but are interwoven with the broader organizational fabric. As technology becomes an institutional infrastructure component, its effects resonate beyond mere operational facets, shaping the sociotechnical contexts in which employees operate (Barley & Kunda, 2001; Orlikowski & Barley, 2001). This evolving symbiotic relationship underscores the imperative for management scholars to delve deeper into the nuanced interplay between technology and its human and organizational implications. Ensuring that the benefits of technology are harnessed while mitigating potential disruptions requires a holistic understanding of both technological tools and the organizational and individual contexts in which they are situated.

3. EVOLUTION OF MANAGEMENT AND TECHNOLOGY STUDIES

The transformation of scholarly focus from early IT management to the broad implications of technology in organizational contexts, as delineated in our topic analysis, sets the stage for a deeper dive into the evolution of management- and technology-related studies. This progression underscores the necessity of examining the role of technology within organizational structures and employee dynamics, a focus explored in detail in the following section. As we transition to discussing the evolution of management- and technology-related studies, it becomes imperative to understand how these shifts in academic focus, from the tactical use of technology to its strategic implications, have influenced the development of organizational theory and practice. The forthcoming section further elaborates on this by providing empirical insights and theoretical frameworks that reflect the intricate relationship between technology, organizational structures, and employee behaviors.

3.1. Foundations of Technology on Work

The adaptation of technology can cause a change in the patterns of social organization and organizational structure by considering how the context causes the change (Barley, 1986; 1990; Rousseau, 1979), and technology is part of the institutional infrastructure in the organization (Orlikowski & Barley, 2001). Rousseau (1977) emphasized context and organization as interconnected components, including a social structure to relate employees to technology and technology to transform raw materials into output. Therefore, incorporating IT into the organizational context is necessary to understand employees and corporations (Barley & Kunda, 2001).

New IT has represented an opportunity for competitiveness and innovation and a new organizational attitude and behavior perspective, leading to positive and negative consequences (Zuboff, 1988). For example, Brynjolfsson (1993) explains the productivity paradox of technology adaptation and finds no strong relationship between IT and performance. Additionally, a meta-analysis of the adaptation of telecommuting technology found no detrimental effects on workplace-related outcomes (Gajendran & Harrison, 2007). Likewise, we have seen mixed results of technology on organizations and employees and have understood the role of context in adopting technology in the organization. Therefore, it is critical to consider the impact of technology in the socio-techno context (Barley, 1986; 1990).

To understand how organizational attitudes and behaviors are affected by context, we must assume that employees are the agencies affected by the structure (i.e., rules and resources) and can affect the structure simultaneously (Whittington, 2015). Based on the theory of structuration (Giddens, 1984), the duality of the technology concept was developed to explain technology as enacted by human agency and institutionalized in structure (Yates & Orlikowski, 1992). In this context, changes related to technology adaptation can be explained either by the technology applied by the employee (Grint & Woolgar, 2013) or by the context in which employees are involved (Barley & Kunda, 2001). The study of change has received considerable attention from practitioners and scholars because employees and organizations struggle to adapt to changing environments. Cognitive and affective aspects are antecedents that explain how individuals and organizations are ready for change (Rafferty et al., 2013). Furthermore, when employees experience organizational changes, including technological advances and strategic transformation, these changes impact their affective and cognitive attitudes (Fedor et al., 2006).

3.2. New Technologies in the Workplace

Organizational scholars have long recognized the importance of technology adoption in organizations (e.g., Aldrich, 1972; Blau et al., 1976; Rousseau, 1977; Thompson & Bates, 1957). They proposed that adopting new technologies could affect organizational structure, decision-making processes, performance, and survival (Giddens, 1984; Rousseau, 1977; Sutton & Rousseau, 1979).

One consistently recognized notion in this tradition is that employees play a crucial role in adopting and uti-

lizing new technologies (Blanka et al., 2022; Eller et al., 2020; Verhoef et al., 2021). Even when a technology is formally adopted by top management, were it not for the employees' willingness and capability to learn and leverage the focal technology at work, the focal technology may not practically contribute to organizational effectiveness (Xiong, 2022).

3.3. Systematic Literature Review

To identify the effects of new and advanced technology usage, we conducted empirical studies that focused on the relationship between new and advanced technology usage and employee and organizational outcomes. Based on a systematic search of published research in 21 journals from the *Financial Times* 50 list, out of 7,000 articles we identified 1,046 empirical studies. We reviewed them to examine the relationship between technology usage and employee outcomes. We excluded unpublished studies (e.g., working papers and dissertations) and studies published in non-English languages. We selected and reviewed the 17 most relevant articles, generating interesting findings for the targeted relationships. The studies included in this review are summarized in Table 3 (Ayyagari et al., 2011; Bala & Venkatesh, 2016; Becker et al., 2021; Benlian, 2020; Boswell & Olson-Buchanan, 2007; Butts et al., 2015; Chapman et al., 2005; Derks et al., 2016; Gajendran & Harrison, 2007; Golden & Fromen, 2011; Long, 1993; Morris & Venkatesh, 2010; Pirkkalainen et al., 2017; Tong et al., 2021; van Zoonen et al., 2021; Venkatesh et al., 2016; Wu & Kane, 2021).

First, when Orlikowski and Scott (2008) analyzed 2,027 articles from leading journals, only 100 were directly related to the role and influence of technology in organizations. Likewise, our analysis found that 1,046 (2.3%) are directly associated with the role and influence of technology out of 7,000 articles. Second, as shown in Table 3 (Ayyagari et al., 2011; Bala & Venkatesh, 2016; Becker et al., 2021; Benlian, 2020; Boswell & Olson-Buchanan, 2007; Butts et al., 2015; Chapman et al., 2005; Derks et al., 2016; Gajendran & Harrison, 2007; Golden & Fromen, 2011; Long, 1993; Morris & Venkatesh, 2010; Pirkkalainen et al., 2017; Tong et al., 2021; van Zoonen et al., 2021; Venkatesh et al., 2016; Wu & Kane, 2021), there are mixed results regarding the use of technology on employee outcomes, including attitudes, emotions, productivity, and performance. However, there is a negative impact on individual-level variables, including turnover intention, anxiety, and health.

The Table 3 provides an insightful exploration of the empirical relationship between implementing new and advanced technological tools and their associated outcomes, particularly regarding their impact on employees. In particular, the earliest study by Long (1993) delved into the effects of introducing new IT on job quality, noting a significant gendered disparity in its impact. This lays the groundwork for understanding how technology can affect diverse employee groups. Fast forwarding to more recent studies, such as Pirkkalainen et al. (2017), Benlian (2020), and Becker et al. (2021), reveals a recurrent theme of "technostress." These studies collectively underscore the emerging challenges that modern employees face owing to the ubiquity of technology, emphasizing the need for proactive and reactive coping mechanisms to mitigate the adverse effects of technology-induced stress. These findings serve as poignant reminders of the dual-edged nature of technological integration in the workplace.

Studies such as those by Chapman et al. (2005) and Golden and Fromen (2011) highlight the shifting paradigms in job interviews and managerial dynamics in a digital era. They emphasized the perceptual and experiential differences between technology-mediated interactions and traditional face-to-face encounters. Furthermore, Morris and Venkatesh (2010), Bala and Venkatesh (2016), and Tong et al. (2021) focus on the strategic adoption of technology in organizations, with a keen focus on its effects regarding job satisfaction, operational efficiency, and performance feedback. These studies emphasize the value of understanding the broader organizational implications of technological implementation, specifically, the need for organizations to remain adaptive and cognizant of the evolving technological landscape.

Lastly, Boswell and Olson-Buchanan (2007), Derks et al. (2016), and van Zoonen et al. (2021) delve into the realm of telecommunication, emphasizing its role in shaping work-life dynamics. These studies underscore the increasing convergence of professional and personal domains brought about by the proliferation of digital communication tools. The implications for work-life balance, role conflict, and the boundaries between professional and personal spheres are salient in these discussions.

4. FUTURE RESEARCH DIRECTIONS

As we stand on the frontier of a new era of organizational dynamics and technological integration (Gao & Jin, 2023; Ling, 2023), it is imperative to anticipate and understand the evolving landscape of the workplace. The rapid proliferation of advanced digital technologies,

Table 3. A summation of the empirical evidences for the relationship between new and advanced technology usage and outcomes

Study	Outlet	Method	Independent variable	Dependent variable	Contingency	Findings
Long (1993)	HR	Quantitative+ interview	Use of new information technology (IT)	- Job quality of white-collar workers (+) - Woman larger impact than man	- Gender (woman and man) - Occupational group (secretarial, technical, and managerial employees) - Industrial sector (primary, manufacturing, and services)	Comparison between woman and man as well as among types of workers (cross-sectional data)
Chapman et al. (2005)	JAP	Quantitative (signal theory)	Video conferencing interview	- Perception of fairness (-) - Higher job acceptance intentions (-)	- Number of offers an applicant received	Technology-mediated interview has less favorable reaction than face-to-face one to applicants (data collected in a field sample)
Gajendran & Harrison (2007)	JAP	Meta-analysis	Telecommuting using electronic media	- Perceived autonomy (+) - Job satisfaction (+) - Job performance (+) - Role stress (-) - Work-family conflict (-)	- Telecommuting intensity	Reviewing 46 studies with 12,883 employees resulting in positive view of telecommuting (causal relationship tentative)
Boswell & Olson-Buchanan (2007)	JOM	Quantitative	Using telecommunication technology after working hours	- Work-to-life conflict (+) - Ambition (+) - Job involvement (+)		There are positive and negative outcomes using telecommunicating technology (effects across an organization rather than a specific job group and cross-sectional data)
Morris & Venkatesh (2010)	MISQ	Quantitative (job characteristics model)	Job characteristics (task significance, identity, skill variety, autonomy, and feedback)	- Job satisfaction	- Buffering impact of use of enterprise resource planning (ERP) systems on skill variety, autonomy, and feedback on job satisfaction	Adding of new knowledge to existing findings through use of ERP systems and proving implementation of ERP (sample from single organization)
Golden & Fromen (2011)	HR	Quantitative (social exchange theory)	- Telework - Virtual work	- Work experience (feedback, empowerment, development, and workload) (less positive than traditional work) - Subordinate's job satisfaction (-) - Higher turnover intentions (+)	- Subordinate work modes (traditional and virtual)	Suggesting the importance of manager's work mode (cross-sectional and self-report data)

Table 3. Continued

Study	Outlet	Method	Independent variable	Dependent variable	Contingency	Findings
Ayyagari et al. (2011)	MISQ	Quantitative (person-environment fit)	- Perception of technology presenteeism - Perception of technology anonymity	- Work-home conflict (+) - Invasion of privacy (+) - Work overload (+) - Role ambiguity (+)	- Stressors (work-home conflict, invasion of privacy, work overload, and role ambiguity) as a predictor of strain	Extension of past stress research: predictors of strain due to ICTs and determinants of technostress
Butts et al. (2015)	AMJ	Quantitative (affective events theory)	- Electronic communication (negative) affective tone (ECAT) - Time required for electronic communication (TREC)	- Anger (+with ECAT) - Happiness (-with ECAT) - With-in person anger (+with TREC) - Work-to-nonwork conflict (+TREC)	- Abusive supervision - Communication sender - Segmentation preference	Finding the mechanism between affective process to work-to-nonwork conflict (sampling method and measurement of within-person item)
Derks et al. (2016)	HR	Quantitative (boundary theory)	Smartphone use after hours	- Work-family conflict (-) - Family role performance (+)	- General segmentation preference (integrators or segmenters)	Different results of smartphone use on work-family-conflict (self-report measures)
Venkatesh et al. (2016)	ISR	Quantitative+ interview	Implementation of information and communication technologies (ICT)	- Operational efficiency (-) - Job satisfaction (-) - Customer satisfaction (-)	- Pre and post implementation	Conducting multimethod longitudinal study and finding traditional barriers to ICT implementation (single sample in an India)
Bala & Venkatesh (2016)	MS	Quantitative (coordination theory)	Collaboration technology use	- IT-enabled collaboration capability (+) - Collaboration satisfaction (+)	- Process orientations (exploration, exploitation, ambidexterity)	Process orientation (ambidexterity) strengthens the relation between collaboration tech use and IT-enabled collaboration capability and satisfaction (cross-sectional data and operationalization of moderator through functional affiliations)
Pirkkalainen et al. (2017)	JMIS	Quantitative (technostress)	Technostress creators	- IT-enabled productivity (-)	- Proactive coping (positive reinterpretation and IT control) - Reactive coping (distress venting and distancing from IT)	Theorizing and validating proactive and reactive coping behavior related to technostress (self-report data and specific coping behavior)

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Table 3. Continued

Study	Outlet	Method	Independent variable	Dependent variable	Contingency	Findings
Benlian (2020)	MISQ	Quantitative (technostress)	- Technology challenge stressor (TCS) - Technology hinder stressor (THS)	- Partnership satisfaction (+with TCS) - Partnership satisfaction (-with THS)	- Work-home role integration - Perceived organizational support in work-home boundary management	Conceptualization of work stressor framework and emphasizing daily technology-drive work stressors (potential reverse causality and timing of data collection)
Becker et al. (2021)	JOM	Quantitative (resource based view)	Electronic communication	- Level of anxiety (-) - Health (-) - Relationship quality (-)	- E-mail triggered anxiety	Extension of job-related stressors and suggestion of role of e-anxiety (crossover effects of Study 2)
Wu & Kane (2021)	OS	Quantitative	Adopting an expertise search tool	- Employee work performance in billable revenue (+)	- New connections - Information diversity	Finding the mediating effect of network connections and information diversity and larger impact from two type of employees
Tong et al. (2021)	SMJ	Quantitative	Performance feedback using artificial intelligence (AI)	- Deployment effect: job performance (+) - Disclosure effect: job performance (-)	- Negatively moderating the impact with longer tenure	Positive and negative impact from AI feedback coexist and suggesting contingency matters
van Zoonen et al. (2021)	JOB	Quantitative (technology-assisted supplemental work [TASW])	Collaboration technology use	- TASW (+)	- Positively moderating effect of team-level response expectations - Positively moderating effect of persistence of communication	Identifying mechanism drivers of process that contribute to increase in workday span and acknowledge what constitutes afterhours work remains relevant (cross-sectional data)

HR, Human Relations; JAP, Journal of Applied Psychology; JOM, Journal of Management; MISQ, MIS Quarterly; AMJ, Academy of Management Journal; ISR, Information Systems Research; MS, Management Science; JMIS, Journal of Management Information Systems; OS, Organization Science; SMJ, Strategic Management Journal; JOB, Journal of Organizational Behavior.

coupled with changing societal norms and expectations, challenges traditional paradigms and necessitates the re-evaluation of established constructs. The intersections of humans and machines, the meaning and essence of work, and the spatiotemporal dimensions of the workplace have undergone a profound transformation. In this context, we recommend that scholars and practitioners explore three avenues that provide promising directions for future research.

First, the meaning of work in the age of AI and generative technologies must be further investigated. The digitization of the workplace, as reflected in the studies in Table 3 (Ayyagari et al., 2011; Bala & Venkatesh, 2016; Becker et al., 2021; Benlian, 2020; Boswell & Olson-Buchanan, 2007; Butts et al., 2015; Chapman et al., 2005; Derks et al., 2016; Gajendran & Harrison, 2007; Golden & Fromen, 2011; Long, 1993; Morris & Venkatesh, 2010; Pirkkalainen et al., 2017; Tong et al., 2021; van Zoonen et al., 2021; Venkatesh et al., 2016; Wu & Kane, 2021), underscores the evolving dynamics between technology and the workforce. A logical progression of this trend would necessitate researchers to delve deeper into the qualitative facets of employment in the digital age, particularly the "meaning of work." As AI, robots, and generative technologies have become more pervasive, there has been a transformative shift in job roles and responsibilities. While technology might automate repetitive tasks, it simultaneously places a premium on uniquely human attributes such as creativity, empathy, and complex problem-solving. Future research could explore how employees derive personal values, meaning, and growth opportunities in professions that are increasingly intertwined with AI and generative technologies. Building on the foundational studies of Chapman et al. (2005) on perceptual differences in technology-mediated interactions, understanding the psychological and emotional dimensions of work in such an environment is paramount.

Second, owing to technological advances, the concept of the workforce has expanded to include robots and AI. Studies, particularly those by Morris and Venkatesh (2010) and Tong et al. (2021) have highlighted the strategic adoption of technology and its implications for job satisfaction and performance. Building on these insights, future research can explore the collaborative dynamics between human workers and their AI and robotic counterparts. As the distinction between human and "human jobs" and "machine jobs" blurs, understanding the synergies, conflicts, and productivity enhancements that arise from such collaborations becomes essential. How does the presence of AI in decision-making influence job satisfaction? How do employees perceive value and meaning when working with robotic counterparts? These questions, which are rooted in technology and human resource management, are pivotal for future research.

Third, future studies should reconceptualize the workplace in terms of time and space. The emergence of telecommunications and digital technologies, as highlighted by Boswell and Olson-Buchanan (2007) and Derks et al. (2016), has paved the way for a reimagined concept of the "workplace." Future research should focus on understanding the implications of unconventional work policies, such as the 4-days-a-week model, on employee productivity, well-being, and work-life balance. Additionally, as mixed reality (MR) and virtual reality (VR) technologies mature, the potential of mixed-reality workplaces has become an exciting avenue for exploration. What are the dynamics of team collaboration in a VR office setting? How do MR environments influence job roles, training, and onboarding processes? Although futuristic, these research directions are rapidly becoming pertinent to the evolution of the digital workplace.

5. DISCUSSION

5.1. Academic Contributions

This study contributes to existing literature in several ways. First, it offers an evolutionary perspective on scholarship on technology, illuminating how academic inquiry has transformed in alignment with broader societal, technological, and organizational shifts over time. Drawing from Yoo et al. (2012), we exemplify the nuanced transition from the infancy of technological studies, primarily focused on IT management, to contemporary complexities entailing interwoven technological and managerial considerations. By adopting a text-mining approach, we provide a methodological bridge to understanding such evolutionary trajectories, highlighting the dynamism inherent in academic pursuits vis-à-vis technology.

Second, this systematic review underscores the nuanced, multidimensional relationship between technological advancements and their implications for employees and organizations. Early studies such as Long (1993) emphasized the gendered impact of technology on job quality, suggesting the need for future research that considers intersectionality when assessing the impact of technological tools. As the role of technology in organizations has become more pervasive, themes such as technostress have emerged, as evidenced in more recent works such as Pirkkalainen et al. (2019) and Benlian (2020), indicating a

growing area of concern for organizational scholars. This evolution points to a theoretical trajectory wherein initial explorations of technology integration into the workplace have given way to more complex psychological, emotional, and behavioral considerations. Moreover, the shift from focusing purely on technological tools to understanding the broader implications of technological ecosystems suggests a maturing discourse urging scholars to adopt a more holistic, system-oriented perspective on the role of technology in organizational settings.

Third, we emphasize the profound shifts awaiting future work, particularly in understanding the essence of work in the age of ubiquitous digital technologies. Building on foundational works such as Chapman et al. (2005), our study highlights the imminent need to explore the qualitative facets of employment. With the growth of AI, robots, and generative technologies, scholars are increasingly interested in exploring qualitative shifts in how individuals perceive their roles, derive meaning, and navigate professional trajectories in environments intertwined with advanced technologies.

5.2. Practical Contributions

As organizations continue their inexorable march toward DT, leaders and managers must recognize the profound implications of technology for the workforce (Lee et al., 2021). Our findings emphasize that technology integration has diverse impacts, ranging from enhancing operational efficiencies to nuanced challenges such as technostress. Thus, organizations must strategically align their technological adoption with human-centric considerations to ensure that the tools and platforms they deploy enhance productivity and promote employee well-being and satisfaction.

Given a rapidly changing technological landscape, continuous learning and adaptation are vital. Our study underscores the need for organizations to invest in training programs that cater to the evolving demands of the digital age. This is particularly relevant when AI, robotics, and generative technologies are present in a workspace. A well-structured training regimen can help employees navigate these technologies confidently, minimize anxiety, and maximize productivity.

As highlighted in our findings, the emergent challenges of technostress bring the importance of employee mental health and well-being. Organizations must recognize these challenges and proactively introduce measures to combat them. This could range from fostering a culture that promotes regular digital detoxes to introducing counseling and support services that help employees navigate the complexities of a digital-first work environment.

Finally, as AI and robotic entities become integral parts of organizational teams, managers must foster an environment that promotes seamless collaboration between human employees and their digital counterparts. Clear communication, role delineation, and regular feedback loops can optimize the synergy between humans and machines, paving the way for enhanced productivity and innovation.

5.3. Limitations and Future Research Directions

Although this study makes theoretical and practical contributions, it has some limitations. First, although our research concentrated on the evolution and movement of various topics, it is plausible that more intricate shifts and changes went unnoticed. Moreover, with the escalation in data quantity, it became evident that topics were not merely evolving or transitioning, but entirely new subjects have emerged at a higher rate. This potentially indicates a limitation in our study, as the content we could conclusively categorize as "evolved" might be relatively less than the actual data volume. To alleviate this problem, distributing the data uniformly or in approximate values across each segment would yield a clearer depiction of the evolutionary process.

Second, in dividing our research span from 1983 to 2022 into four distinct intervals, we revealed disparities in data quantities across these segments, thereby altering the appropriate number of topics per period. Extracting an equivalent number of topics from each era becomes challenging when the number of documents significantly surges during specific times, necessitating a larger number of topics in those periods. Too much data combined with topics can increase the perplexity, complicating the topic evolution analysis. Conversely, limited data with fewer topics may be inadequate for evolutionary scrutiny. Therefore, assigning consistent topics to each segment, combined with the corresponding parameters and hyperparameters, is crucial.

Our systematic review provides an extensive exploration of the relationship between advanced technology usage and outcomes for employees and organizations. However, it is constrained by its methodological choices. The limitation of focusing solely on English-language articles from highly ranked journals overlooks significant contributions from non-English sources and unpublished works. This language and publication bias may limit the global applicability and scope of our findings, as important insights from other regions and non-mainstream

publications might be omitted. Therefore, while our review is thorough within its defined scope, our conclusions may not encapsulate the full spectrum of the discourse on the impact of new technologies on employees and organizations.

In addressing the limitations highlighted, it is essential to acknowledge that while the research aimed to capture the impacts of technological evolution on organizational members, the study did not thoroughly explore how these changes influence individual information behaviors within the organization. Future research could benefit from a deeper investigation into how employees adapt their information-seeking, sharing, and usage strategies in response to technological advancements. Such an inquiry would not only enhance our understanding of the micro-level effects of technology on individual behaviors, but also align more closely with information science disciplines that examine human interaction with technological systems.

Moreover, another potential limitation of this study is the underrepresentation of the varying intensities of technology integration across different organizational levels and industries. Future studies should consider a more segmented approach, examining specific sectors or departments to provide a more comprehensive analysis of technological impacts. This approach would allow for a better understanding of how different types of technology affect various organizational structures and roles. Additionally, integrating longitudinal methods to observe these effects over time could offer insights into the long-term consequences of technological integration on organizational dynamics and employee behavior, providing a richer context for both theoretical exploration and practical application in managing technological change in the workplace.

To further deepen exploration of how technologies have evolved, integrating principles from information science offers a significant advancement in understanding these dynamics. Information science provides frameworks that can effectively dissect the mechanisms by which technology influences information behaviors and decision-making processes within organizations. Notably, theories such as the cognitive load theory (Sweller, 1988) and the theory of information seeking behavior (Wilson, 1999) can enrich our understanding of how employees adapt to and interact with new technological environments. Applying these theories, we can more thoroughly investigate how the cognitive aspects of technology use impact employee efficiency and stress levels, providing a more comprehensive view of the technological transformation in organizational contexts.

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CONFLICTS OF INTEREST

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

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Extended Inductive Miner to Discover Semantic Annotated Process Model: A Variability-Based Approach

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ABSTRACT

In recent years, the concept of a configurable process model has made many contributions, with the need for generic and reusable models. The high demand for this type of generic model is accompanied by quality requirements, as these models must be as comprehensive as possible to facilitate the task of customization. Many approaches exist to deal with configurable process models, especially in the field of process mining, including its three types of techniques: discovery, conformance, and enhancement. However, there is a lack of semantic representation in the resulting models. In this study, we propose a novel automated approach based on the extension of the Inductive Miner algorithm used to discover business process models. This method discovers a semantically annotated configurable process model using two ontologies: variability ontology and domain ontology-related concepts, which will improve and facilitate the configurable process model customization.

Keywords: configurable process model, process mining, semantic, inductive miner, ontologies, variability

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1. INTRODUCTION

Nowadays, companies try to make their business processes easy to understand and model while growing and opening to the market, so that the process management activity will be done easily and smoothly. Configurable process models (CPM) are useful for large structures that run several activities (Ayora et al., 2013). These models offer the option to regroup multiple variants related to the same business process in one model, which can be customized according to the execution environment properties (Pereira Detro et al., 2020). However, configurable process models present some limits and difficulties such as complexity, redundancy, and misunderstanding (Assy et al., 2014).

Process mining techniques have been very helpful in discovering business process models and configurable process models that represent the real execution of processes (Buijs et al., 2013). Process mining is divided into three types of techniques: discovery, conformance checking, and enhancement. Process model discovery explores event logs to create a clear process model based on the order of activities present in event logs (Ozates et al., 2024). Conformance checking uses the event log to detect any deviation during the process execution. Enhancement aims to improve the process model based on the data present in the event log (Ozates et al., 2024).

In spite of the number of contributions in the process mining field, most of the works have been focusing primarily on the syntactic analysis of process execution traces, which generate multiple issues related to the size and complexity level of the model (Barbieri et al., 2023). And, usually, only business analysts and domain experts can handle analysis regarding the resulting process model, due to the absence of domain knowledge in the process model (Berti et al., 2024). To remedy these limitations, semantics were introduced as a support tool to improve process mining results (Barbieri et al., 2023; Pereira Detro et al., 2020; Rebmann & van der Aa, 2022). For configurable process models, the lack of semantics complicates the task of configuration and impacts on the quality of process model variants (El Faquih et al., 2015; Fang et al., 2023).

As part of this work, we present a new approach to mine configurable process models that are enriched semantically with variability concepts and domain knowledge, starting with a collection of event logs. We aim to capitalize on the semantic analysis of event logs to discover a configurable process model that integrates semantics.

For this purpose, we will use two ontologies, an ontology related to variability concepts and an ontology related to domain knowledge. The main idea is to improve comprehension and quality of the process model discovered. The configurable process model enriched semantically will be simpler to configure. Instead of discovering the model and then checking it against ontologies to validate it, ontologies will be used during the discovery phase to provide additional information, related to variability and process domain, on the process model discovered. This will reduce the cost of conformance and enhancement of these models.

The remainder of this paper is organized as follows. In Section 2, we include a background of the most important concepts. Section 3 gives an overview of the existing work related to this research area. Section 4 describes our objectives and contribution. In Section 5, we present a global overview of our approach. Section 6 provides details about the discovery component. Finally, in Section 7 we conclude the paper with an outlook for perspectives.

2. BACKGROUND

2.1. Configurable Process Models

Configurable process models regroup multiple execution cases of the same business process into one single process model. This type of model presents multiple advantages such as reusability, flexibility, and the ability to fit individual needs without performing any process modeling activities (Fang et al., 2023). Configurable process models have been used in different application areas, especially healthcare (Pereira Detro et al., 2020), industry (La Rosa et al., 2011), and e-learning (Azouzi et al., 2017).

Otherwise, configurable process models can be adapted to the execution context through the configuration decisions made at design time (Assy et al., 2014). The configuration allows users to disable all unnecessary process parts in order to derive the appropriate model (Gottschalk et al., 2009).

Configurable process models are characterized by the support of variability via two key elements: variation points and variants (El Faquih & Fredj, 2017). The variation points represent the decision points that link a fragment of common parts along with a fragment of variable parts in the model, and the variants are the multiple alternatives relating to the variation point. The choice of variants is made based on the rules related to the execution context and variation point. During the configuration process, variant activities can be set as ON (Included), OFF (Excluded), or OPT (Optionally included).

A variety of languages integrate variability in order to represent configurable process models: configurable event-driven process chains (C-EPC) (Rosemann & van der Aalst, 2007), configurable integrated EPC (C-iEPC) (La Rosa et al., 2007), configurable BPMN (C-BPMN) (El Faquih & Fredj, 2017), variant rich BPMN (vrBPMN) (Schnieders & Puhlmann, 2007), and configurable yet another workflow language (C-YAWL) (La Rosa & Gottschalk, 2009). Fig. 1 (La Rosa, 2009) represents an example of the configurable process model and its variants.

2.2. Discovery of Configurable Process Models

Configurable process models can be built in two different ways:

- Approaches based on merging variants: The configurable process model is built by merging a collection of existing process models, and the configuration of the resulting model corresponds to the original models (Buijs et al., 2013). Two approaches are included in this category; the difference between them is how to get the variants. Approach (1) discovers the variants individually and then merges them into one consolidated configurable process model. Method (2) merges the collection of event logs, then applies process mining techniques to obtain the common process model, which does not integrate variability, then works on the customization of this model, and after that merges the process variants to get the final configurable process model.
- Direct mining approaches: The discovery of a configurable process model is done automatically by applying process mining techniques (Buijs et al., 2013). There are two approaches: Approach (1) merges the collection of event logs and applies process mining techniques to discover the CPM that will be configured to obtain process variants. Approach (2) discovers the CPM and its configuration in one step. These approaches are not yet implemented concretely.

Several algorithms are present in the field of process model discovery: Alpha Miner (van der Aalst et al., 2004), Genetic Miner (van der Aalst et al., 2005), Heuristic Miner (Weijters et al., 2006), Fuzzy Miner (Günther & van der Aalst, 2007), and Inductive Miner (IM) (Leemans et al., 2013). Each algorithm has its strengths and weaknesses. Table 1 demonstrates a comparison between these algorithms. Following this comparison, IM is the most suitable algorithm to deal with any potential noise or incompleteness in the event logs and can replay the event logs. It constructs a process tree using the method of splitting the event log recursively into sub-event logs (blocs) and determining the relation between blocs until a base case is found (Leemans et al., 2013). There are four types

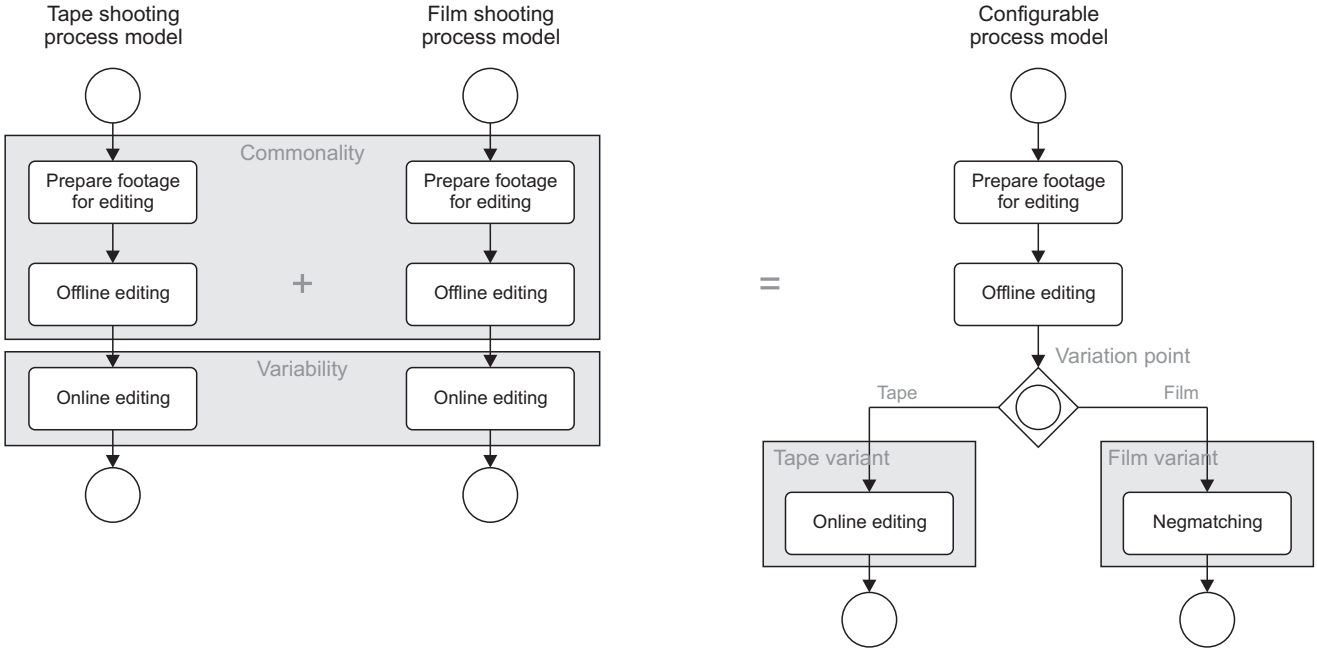


Fig. 1. Example of the configurable process model. Adapted from La Rosa (2009).

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of splits in the event log: Sequential, Parallel, Concurrent, and Loop.

The configurable process models constructed using the different approaches need material support or a human background during the configuration stage. This was considered a weakness of process models discovered, and to overcome it, many works propose integrating semantic technologies.

2.3. Semantics in Configurable Process Models

Configurable process models are designed to be changed and customized depending on the execution conditions of the business environment. However, their ability to represent multiple business process cases impacts other properties, and engenders several challenges due to the size of the model, its complexity, and the time plus resources needed to evolve and keep up this model (Detro et al., 2017; El Faquih et al., 2015).

Present research proves that the integration of semantic features into process models can improve model quality and solve multiple misunderstanding issues. Accordingly, the use of semantics in process modeling becomes a necessity, as they bring more clarity and ease during process model manipulation.

The integration of semantics in the configurable process model is inspired from their integration in the business process model. It corresponds to the combination between business process and semantic web technologies. A semantic process model is made up of a range of activities, including additional information related to the functional, behavioral, organizational, operational, and non-functional aspects of these activities. These aspects are described in a formal representation that is machine-readable and machine understandable. The concept of ontologies serves to illustrate these data in process models (Lautenbacher et al., 2009).

An ontology represents a precise and formal specification of a shared conceptualization related to a specific subject area (Gruber, 1993). It defines concepts of a domain and the relationships between them.

Fig. 2 (La Rosa, 2009) illustrates an example of the BPMN configurable process model, annotated semantically using BPM ontology concepts.

The next section is dedicated to the presentation and discussion of the existing works in relation to our study.

Table 1. Comparison of process mining algorithms

Process mining algorithm	Ability to deal with noisy logs	Ability to deal with incomplete logs	Ability to replay the log
Alpha Algorithm	No	No	No
Heuristic Miner	Yes	Partially	No
Fuzzy Miner	Yes	Yes	No
Genetic Miner	Yes	Yes	No
Inductive Miner	Yes	Yes	Yes

3. RELATED WORKS

Over the last few years, the implementation of business process models has been studied, through both theoretical and practical methods. Thus, various studies have identified the business process weakness in dealing with different execution environment conditions. For that reason, configurable process models were introduced with one principal advantage of integrating all the behaviors of all process variants into one model (Gottschalk et al., 2007). This type provides the possibility of extracting the variant models through two techniques, extension and restriction (La Rosa et al., 2017).

In parallel with this, a study by Hepp et al. (2005) showed that business processes need to adopt a machine-readable representation and proposed to combine business process management and semantic web technology under one consolidated technology, semantic business

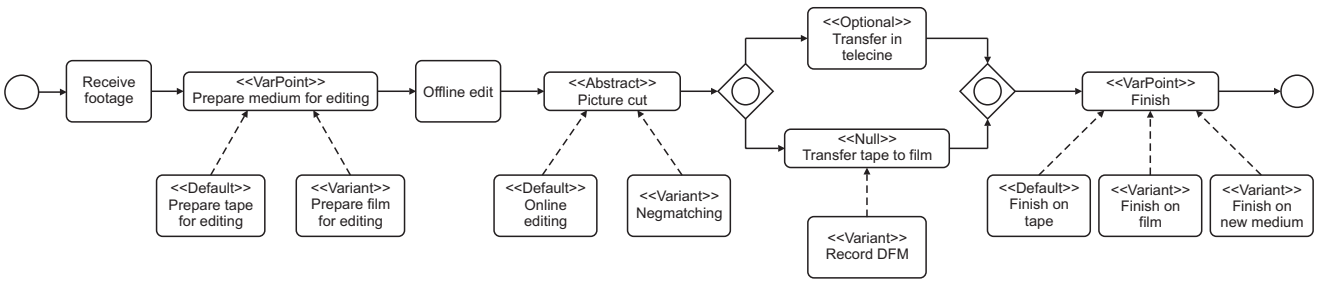


Fig. 2. Example of the semantic configurable process model. Adapted from La Rosa (2009). DFM, digital film master.

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Table 2. Comparison study of process mining applications

Work	Process mining algorithm	Input	Type of the resulting model	Is the approach automatic or manual?	Does the resulting model support variability?	Does the resulting model support semantics?	Type of ontology if used	The objective behind using semantics
Pereira Detro et al. (2020)	Heuristic Miner Decision Mining	Event log	Process variants	Automatic	No	Yes	Domain ontology Business ontology	Providing suggestions during customization
Nykänen et al. (2015)	Heuristic Miner	Event log	Process model	Manual	No	Yes	Domain ontology	Analysing the process models in different abstraction levels
Cairns et al. (2014)	Heuristic Miner Semantic LTL checker	Semantically annotated event log	Process model	Semi-automatic	No	Yes	Domain ontology	Discovering a less complex process model Process analysis at a conceptual level
Fang et al. (2023)	A new algorithm proposed based on trace clusters	Semantically annotated event log	Context tree corresponding to the process variant	Automatic	No	Yes	-	Formalization of the behavior semantic of event log Discovering new process variants that cannot be discovered using existing methods
Rebmann and van der Aa (2022)	A method based on the direct causal relations between events	Semantically annotated event log	Directly-follows graph corresponding to the event log	Automatic	No	Yes	-	Enabling new analysis opportunities that consider the meaning of events
Khodayari Tehraninejad and Khoshnevis (2022)	Alpha Algorithm	Collection of event logs	Configurable process model	Automatic	Yes	No	-	-
Ramos-Gutiérrez et al. (2021)	Inductive Miner	Configuration log	Configuration workflow	Automatic	Yes	No	-	-
Assy et al. (2014)	Alpha Algorithm	Collection of event logs	Configurable process fragment	Automatic	Yes	No	-	-

LTL, linear temporal logic.

process management, to provide a uniformed representation of business processes on a semantic level.

This evolution has a major impact on process mining results, since the first applications of process mining techniques were based on syntactic analysis, and the models discovered were too complicated and large to be maintained. Many studies have used semantics in different ways to improve the process mining results. Table 2 (Assy et al., 2014; Cairns et al., 2014; Fang et al., 2023; Khodayari Tehraninejad & Khoshnevis, 2022; Nykänen et al., 2015; Pereira Detro et al., 2020; Ramos-Gutiérrez et al., 2021; Rebmann & van der Aa, 2022) presents a comparison of existing works in the field of process model discovery. The comparison study was done using the following criteria:

- Process mining algorithm: Indicates the algorithm used to discover the process model.
- Input: The inputs used for process discovery application (one event log, collection of event logs, semantically enriched logs).
- Type of the resulting model: The output of process discovery application (business process model, configurable process model, variant model).
- Automatic/manual: Indicates if the process discovery is done automatically or manually.
- Does the resulting model support variability?
- Does the resulting model support semantics?
- Type of ontology if used: When the resulting model supports semantics, this criterion identifies which type of ontology is used (domain ontology or business ontology).
- The objective behind using semantics: Indicates for which purpose semantics were employed in the approach.

According to this overview, we can observe that there are two categories of works: the first category (Assy et al., 2014; Khodayari Tehraninejad & Khoshnevis, 2022; Ramos-Gutiérrez et al., 2021) includes works that discover configurable process models or fragments through the application of process mining algorithms on collections of event logs. The resulting model supports variability but lacks semantics. The second category (Cairns et al., 2014; Nykänen et al., 2015; Rebmann & van der Aa, 2022) includes works that discover business process models without variability, but integrate semantics to improve event log data quality or improve the resulting model quality. Some other works (Fang et al., 2023; Pereira Detro et al., 2020) use semantics to derive process variants from an existing configurable process.

Following this comparison, we concluded that most of the existing approaches do not combine variability and semantics in process model discovery. No one of the existing works tries to integrate semantics in configurable process model discovery, despite the importance of this element to improve model quality and facilitate its verification and enhancement. Semantics can be also used as a support tool during process model configuration and analysis.

4. OBJECTIVES & CONTRIBUTION

The objective of this work is to integrate semantics in configurable process model discovery. The use of semantics has produced significant results for business process models. By analogy, we intend to apply the same for CPM, especially since configurable process models are too large and complex and require more effort and resources to analyze, configure, and enhance. Therefore, the usage of semantics will provide rich support during the lifecycle management of CPM.

In this paper, we aim to integrate semantics using ontologies (CPM ontology and domain ontology). The CPM ontology is used to pre-process the event logs and mark variability elements in the resulting merged event log. The domain ontology is used during the process mining application, and related annotations will appear in the resulting configurable process model.

Given that IM is the most used algorithm in process mining practices (Amoury & Bertet, 2023) and can deal with noisy, incomplete traces, we choose to extend it to enrich the resulting configurable process models with semantics.

5. APPROACH OVERVIEW

In our approach, configurable process mining has been realized as a multi-step mechanism, schematized in the below Fig. 3. Below are the three main steps of the proposed approach.

- Preparing event logs: As a first step, we prepare the merged event log and insert annotations as presented in our previous work (Khannat et al., 2021). We start with a collection of event logs, variability specification files, and CPM ontology, and as a result, we generate a merged event log enriched semantically with CPM annotations.
- Discovering CPM fragments: In the second step,

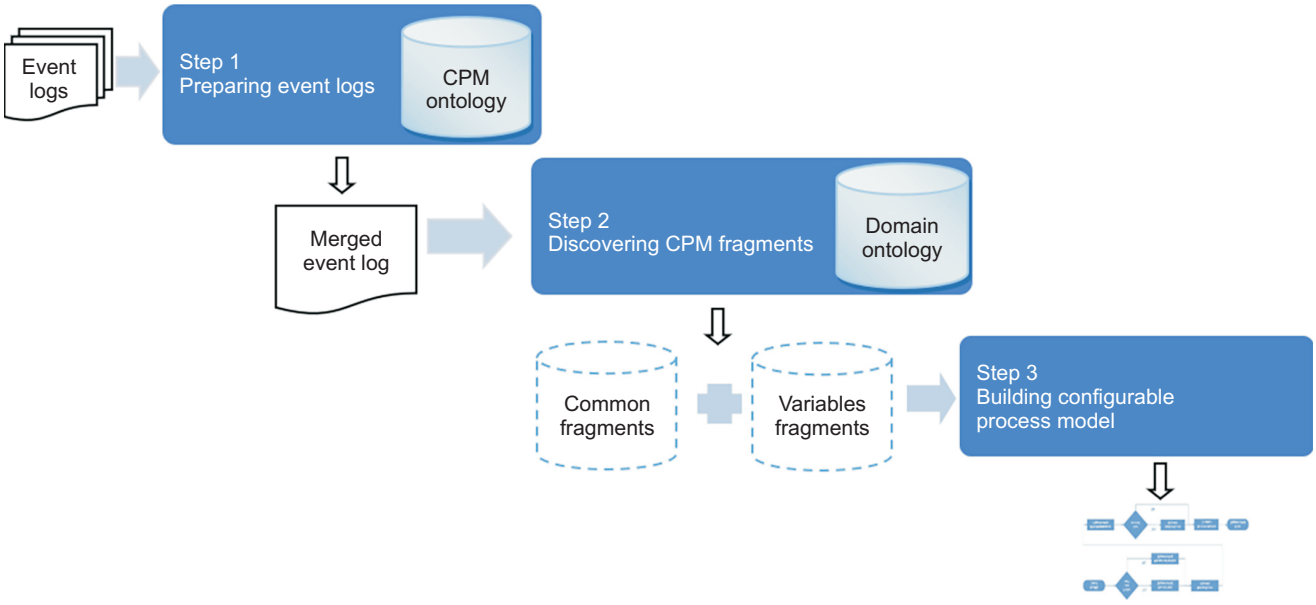


Fig. 3. Semantic configurable process mining approach. CPM, configurable process model.

having the merged event log enriched semantically, we work on the mining of configurable process model fragments. The detail of this step is presented in this paper.

- Building the configurable process model: Finally, in the last step, we consolidate the discovered fragments into the configurable process model.

6. CPM FRAGMENTS DISCOVERY APPROACH

The configurable process model discovery approach is performed on a collection of event logs that is merged and enriched semantically with CPM ontology. The approach proposed is based on multiple steps, as presented in Fig. 3. These steps are described in the next sections.

First, we merge the collection of event logs and annotate the resulting log using the CPM ontology.

We consider that the process we are dealing with is composed of the three types of activities that characterize the configurable process model: i) atomic activity, ii) complex activity, and iii) configurable activity. An atomic activity is a simple activity that performs an atomic task that cannot be divided into sub-activities. A configurable activity includes variability and can be configured during execution. A complex activity consists of more than one atomic activity and configurable activity (Sharma et al., 2014).

In the second step, we will split the merged event log into multiple sub-logs that correspond to CPM fragments, depending on the activity types defined above, and classify them into two categories (with/without variability). Therefore, we will apply mining techniques to discover each CPM fragment separately.

Finally, we will link fragments and integrate activities to obtain the configurable process model.

Input: Collection of event logs+variability specification file+domain ontology+CPM ontology

Output: Configurable process model fragments

1. Pre-processing event logs (merging+annotation with CPM ontology)
2. Annotation of merged event log with taxonomy classes
3. Split merged event log on sub-logs
4. Classify sub-logs in two categories (with variability/without variability)
5. Mining of CPM fragments (common & variant)

6.1. Event Logs Pre-Processing

This step was the subject of our previous work (Khannat et al., 2021). Before starting this step, we assume that the collection of event logs used as input belongs to the same process execution in different conditions, and that the logs are clear from noise, complete, and homogeneous. Thus, we will discover one configurable process model that will be meaningful regarding variability and is less complex.

The first task is performed to merge the collection of event logs into one log. For this we use the technique in-

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troduced in Claes and Poels (2014) that aims to create one consolidated event log starting from two event logs, based on the configured merging rules. After this, we annotate the merged log with CPM ontology concepts based on the variability specification file.

- Definition 1 - Event log: An Event log E is defined as a set of traces (or cases) E=∑T, and each trace is a sequence of events of activities T=∑a.
- Definition 2 - Merged event log: Merged event log mE is defined as a set of event logs corresponding to the execution of the same process mE=∑E, and each event log E=∑T (i, j) is a set of traces with two indexes, where index i: refers to trace id and index j: refers to event log id.
- Definition 3 - Variable traces: Variable traces set VarTrace(E) is defined as a set of traces that contains at least one configurable activity and which will be annotated with #Variable annotation.
- Definition 4 - Variable activities: Variable activities set VarActivity(E) is defined as a set of variation points that will be annotated with #VariationPoint annotation.
- Definition 5 - Activity variants: Activity variants set Var(ai) contains the variants of the activity ai that will be annotated with #Variant annotation.

We test with the sample event logs below:

E1={T1 || T2 || T3}: composed of three traces

E2={T1 || T3 || T4}: composed of three traces

E3={T2 || T4}: composed of two traces

T1={a1 || a2 || a4 || a5 || a7 || a8}

T2={a1 || a3 || a4 || a6 || a7 || a8}

T3={a1 || a3 || a4 || a5 || a7 || a8}

T4={a1 || a2 || a4 || a6 || a7 || a8}

The merged event log is E={T11 || T21 || T31 || T12 || T32 || T42 || T23 || T43}

In terms of activities: E={{a1 || a2 || a4 || a5 || a7 || a8} || {a1 || a3 || a4 || a6 || a7 || a8} || {a1 || a3 || a4 || a5 || a7 || a8} || {a1 || a2 || a4 || a5 || a7 || a8} || {a1 || a3 || a4 || a5 || a7 || a8} || {a1 || a2 || a4 || a6 || a7 || a8} || {a1 || a3 || a4 || a6 || a7 || a8} || {a1 || a2 || a4 || a6 || a7 || a8}}

VarTrace(E)={T1 || T2 || T3 || T4}

VarActivity(E)={a1 || a4}

Var(a1)={a2 || a3}, Var (a4)={{a5 || a6}}

6.2. Semantic Annotation of Merged Event Log

The objective of this step is to enrich the merged event log with meta-data related to domain knowledge. For this purpose, we are using a domain ontology that includes a taxonomy classifying process tasks in a hierarchical structure, as shown in Fig. 4 (Paquette, 2010).

Using the knowledge shared about the process, we try to link each event in the merged log to one class of the taxonomy. Through this method, we can determine if the event reports to a complex activity or atomic activity. For example, if our process is composed of the below activities:

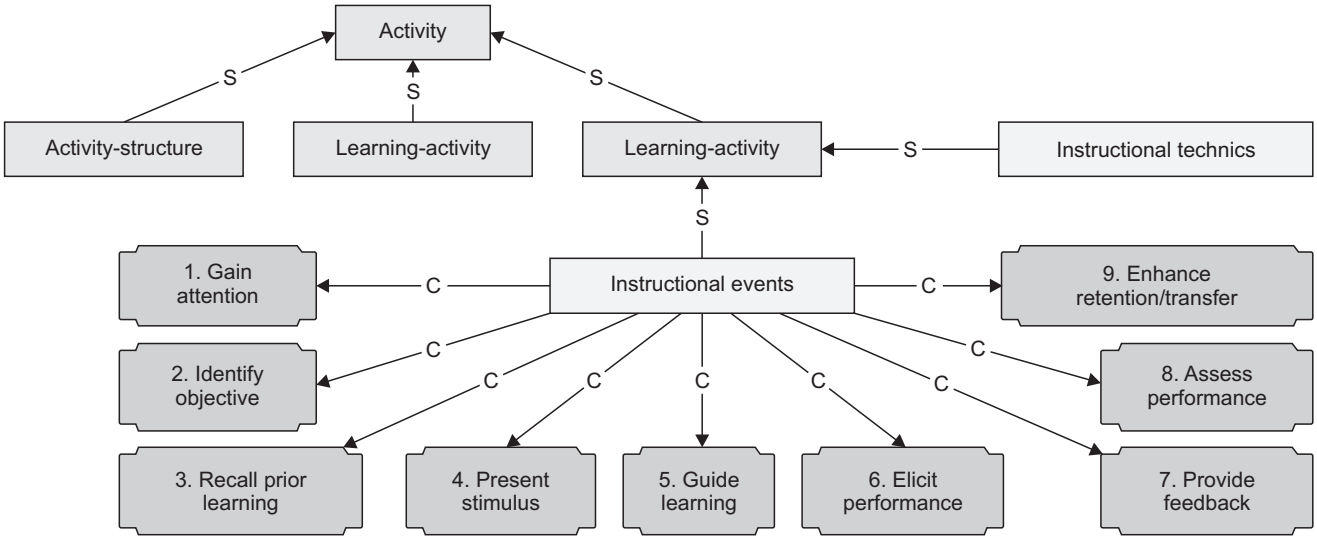


Fig. 4. Taxonomy of class activity in ontology learning design. Adapted from Paquette (2010). S, SubClassOf; C, Class.

Table 3. Semantically annotated event log

Case ID	Task name	Originator	Timestamp	Semantic annotation
1	a1	User1	20-07-2004 14:00:00	<<CA1>>
1	a2	User1	20-07-2004 14:05:01	<<CA1>>
2	a1	User2	20-07-2004 14:06:00	<<CA1>>
2	a3	User2	20-07-2004 14:20:00	<<CA1>>
2	a4	System	20-07-2004 15:00:00	<<CA2>>
3	a1	User3	20-07-2004 15:01:00	<<CA1>>
1	a4	System	20-07-2004 15:13:00	<<CA2>>
2	a5	User2	20-07-2004 15:27:00	<<CA2>>
3	a3	User3	20-07-2004 16:00:00	<<CA1>>
3	a4	System	20-07-2004 16:09:00	<<CA2>>
2	a7	SYSTEM	20-07-2004 16:35:00	<<CA3>>
2	a8	SYSTEM	20-07-2004 16:38:00	<<CA3>>
1	a6	SYSTEM	20-07-2004 17:00:00	<<CA2>>
1	a7	SYSTEM	20-07-2004 17:14:00	<<CA3>>
1	a8	SYSTEM	20-07-2004 17:22:00	<<CA3>>
3	a5	User3	20-07-2004 18:00:00	<<CA2>>
3	a7	SYSTEM	20-07-2004 18:21:00	<<CA3>>
3	a8	SYSTEM	20-07-2004 18:30:00	<<CA3>>

CA1: {a1 || a2 || a3}
CA2: {a4 || a5 || a6}
CA3: {a7 || a8}
(CA_i) refers to complex activity, and (ai) refers to atomic activity.

Table 3 demonstrates a fragment of the event log enriched semantically with domain ontology; the event log captures atomic activities executed during the process. For each activity (ai) in event log, we use the column "Semantic Annotation" to reference related complex activity (CA_i).

6.3. Split Merged Event Log

To discover a less complex model, we chose to split the merged event log into multiple sub-logs, where each sub-log corresponds to one complex activity. The idea here is to obtain the sub-logs that will serve as an input for the process mining algorithm to discover configurable process model fragments. Fig. 5 demonstrates the algorithm proposed for this step.

This algorithm builds a set of sub-logs based on the merged event log and a list of complex activities present in the log.

Algorithm 1 Algorithm for splitting merged event log

```
input: Merged Event Log  L ⊆ ℰ
output: Set of sub-logs S(L)= {l_i; i ∈ N}
{Create sub-logs corresponding to complex activities}
i = 1;
for C ∈ Comp_L do {for each complex activity of L}
    l_i = Clone (L, i)  {create a copy of L with identifier i}
    for ℰ ∈ L then
        if GetSemanticAnnotation(ℰ)≠C then
            Cleanlog(l_i, ℰ)
        end if
    end for
    i = i+1;
end for
```

Fig. 5. Algorithm for splitting merged event log.

For each complex activity, it clones the merged event log and goes through the elimination technique to keep only events related to this complex activity in the copy created. Once we deduced a sub-log for each complex activity of the process, we used the algorithm in Fig. 6 to classify them into two categories: Category 1: sub-logs

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that contain variability (at least, they contain one variable activity) and Category 2: sub-logs without variability (all activities are common).

Regarding our example, the split event logs are below:

E(CA1) = {{a1 || a2} || {a1 || a3} || {a1 || a3} || {a1 || a2} || {a1 || a3} || {a1 || a2} || {a1 || a3} || {a1 || a2}}
E(CA2) = {{a4 || a5} || {a4 || a6} || {a4 || a5} || {a4 || a5} || {a4 || a5} || {a4 || a6} || {a4 || a6} || {a4 || a6}}
E(CA3) = {{a7 || a8} || {a7 || a8} || {a7 || a8} || {a7 || a8} || {a7 || a8} || {a7 || a8} || {a7 || a8} || {a7 || a8}}
Variable_logs = {E(CA1) || E(CA2)}
Common_logs={E(CA3)}

6.4. Mining CPM Fragments

After classifying the sub-logs into two categories, we will apply the process mining algorithm to discover configurable process model fragments. We are expecting to get for each sub-log a fragment of the configurable process model.

Variable fragments will be discovered from variable sub-logs, and common fragments will be discovered from common sub-logs.

Knowing that the common logs did not contain any variable activity, we will directly apply IM to discover the corresponding fragments, and for variable sub logs, we will apply a customized algorithm Inductive_Miner_Var that includes variability in the process tree discovered.

6.4.1. Mining CPM Common Fragments

For the common fragments we directly apply the basic version of IM (Pohl, 2019), which is based on four main functions: cut detection, log splitting, base cases, and fall through. IM takes as input an event log and builds the appropriate directly-follows graph (dfg). IM looks for a cut in dfg, following this order of priority:

1) XOR Cut
2) Sequence Cut
3) Parallel Cut
4) Loop Cut

Depending on the cut found, one of the different split functions below is applied to split the initial log into one or more sub-logs.

1) XOR Split
2) Sequence Split
3) Concurrent Split
4) Loop Split

After this step, the algorithm is recursively applied to each sub-log until a base case, i.e. a dfg with a single activity (Leemans, 2017), is detected. In case no base case is found and no more cuts are detected, a fall through is applied (i.e. a process tree is discovered) (Leemans, 2017). Fig. 7 shows the common fragment mined from sub-log E(CA3).

6.4.2. Mining CPM Variable Fragments

For the variable fragments, we conceived the new algorithm, Inductive_Miner_Var, that represents an extension of the IM supporting variability notions. This algorithm (Fig. 8) is also based on the four main functions of an IM, with further processing to include variability as metadata in the resulting process tree. When a cut is detected, we search for single activities in the cut partitions. Then, we check if this activity is a variant, according to the annotations present in the log; if yes, we mark the activity with the label <<Variant>> and mark the direct relation connected to this activity with one of the labels <<Vp 1..1>>,

Algorithm 2 Algorithm for classifying sub-logs

```
1: input: Set of sub-logs S(L)= {l_i: i ∈ N}
2: output: Variable_logs, Commun_logs
   {Build Variable_logs and Commun_logs sets}
3: i = 1;
4: for l_i ∈ S(L) do {for each sub-log}
5:     var_flag=true;
6:     while var_flag do
7:         for ε ∈ l_i then
8:             if GetCpmAnnotation(ε) is not NULL then
9:                 Variable_logs = Variable_logs ∪ l_i
10:                var_flag=false;
11:            end if
12:        end for
13:    end while
14: end for
15: Common_logs = S(L) \ Variable_logs;
```

Fig. 6. Algorithm for classifying sub-logs.

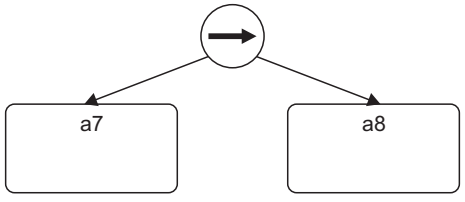


Fig. 7. Process tree discovered from sub-log E(CA3).

<<Vp 0..n>>, or <<Vp 0..1>>, depending on the type of the variation point, i.e. Alternatif or Optional or Optional-Alternatif.

Fig. 9 illustrates the resulting variable fragment related to the sub-log E(CA1).

Algorithm 3 Algorithm for mining variable fragments

```
1:  input: Set of sub-logs Var(S(L))={l_i: i ∈ N }
2:  output: Set of process trees (Q_1,..., Q_n)
3:  R = NULL {Relation between cuts}
4:  i = 0
5:  While not (Var(S(L)).isEmpty()) do
6:  BC = findbaseCaseIM (l_i)
7:    if (i> 0 & BC is not NULL) then
        {Delete sub-log processed from the list}
8:      Var(S(L)) = Var(S(L)) \ (l_i)
9:      if (BC ≠ τ) then {Base Case is a single activity}
10:       An = GetCPMAnnotation(BC)
11:       if (An = CPMO#default) then
           {Annotate the activity BC with CPM annotation}
12:         Annotate(BC, <<Default>>)
13:         else if (An = CPMO#variant) then
14:           Annotate(BC, <<Variant>>)
15:           else if (An = CPMO#alternative) then
              {Annotate relation linked to BC with CPM annotation}
16:             AnnotateRelation(BC, <<Vp 1..1>>)
17:             else if (An = CPMO#optional) then
18:               AnnotateRelation(BC, <<Vp 0..n>>)
19:               else if (An = CPMO#optionalAlternative) then
20:                 AnnotateRelation(BC, <<Vp 0..1>>)
21:                 end if
22:               end if
23:             end if
24:           end if
25:       end if
26:     end if
27:     i =i+1
28:   else
        {Calculate Directly-following graph resulting of the sub-log}
29:     DFG = ComputeDFG(l_i)
30:     (R, P_1, P_2,..., P_k) = FindCut(l_i) {Find a cut partition}
31:     if R is not NULL then
          {Apply split to sub-log using relation R}
32:       E_1, ..., E_k = Split(R, l_i)
33:       Var(S(L)) = Var(S(L)) ∪ {E_1, ..., E_k} {Add sub-logs to the list}
34:     else
35:       return FallThrough (l_i)
36:     end if
37:   end if
38: end While
```

Fig. 8. Algorithm for mining variable fragments.

6.5. Consolidation of CPM

The last step is designed for the consolidation of the configurable process model by linking the discovered common and variant fragments. During this step, we annotate common fragments with the label <<Common>> and variable fragments with the label <<VAR>>. Fig. 10 shows the resulting process tree of our example after linking variables and common fragments.

7. CONCLUSION

Seen from an analysis point of view, configurable process models are too large, complex, and difficult to evolve efficiently. Therefore, representing semantics that reference concepts of a formal ontology in those models is much needed.

The semantics of annotations will provide support during the configuration and the extension of the configurable process model. Going further, these labels can be used for the validation of derived variants. In this regard, we focus on discovering configurable process models enriched semantically. Semantics are incorporated using annotations related to variability and domain concepts.

In the present paper, we proposed a novel approach to discover a configurable process model annotated semantically, starting with a collection of event logs and two ontologies: domain ontology and business process ontology.

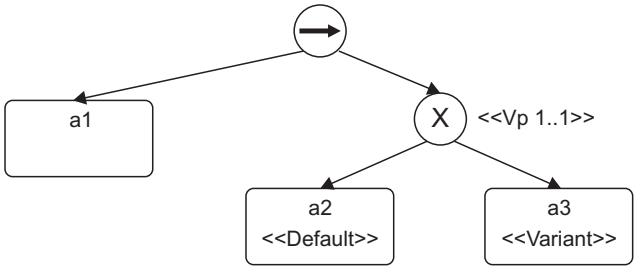


Fig. 9. Process tree discovered from sub-log E(CA1).

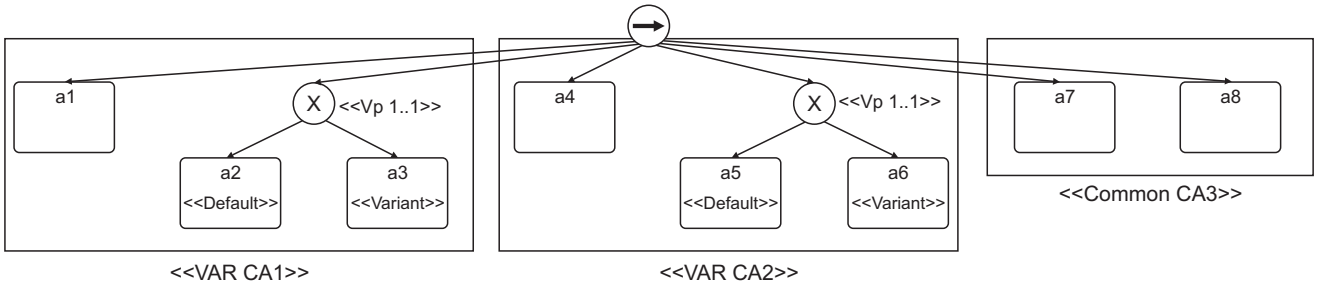


Fig. 10. Semantic configurable process tree.

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The method consists of discovering common fragments and variable fragments of configurable process models separately, and after that linking them. For variable fragments, we proposed an extension of the IM algorithm to generate variability annotations in the discovered process trees.

The proposed approach shows the theoretical approach related to the creation of annotated models. However, the implementation of the test environment and testing on real logs should be the subject of future research. Moreover, we plan to provide a model evaluation of the proposed method. Also, as future work, we aim to extend this approach to include the discovery of variants/configurations at the same time of the configurable process model discovery through the configuration matrix, and contribute to the enhancement of existing configurable process models using ontologies.

CONFLICTS OF INTEREST

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

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The Impact of Socio-Demographic Characteristics on Amulet Collectors' Information-Seeking Behaviours

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ABSTRACT

Thailand's amulet business is a Buddhist commercial sector with substantial economic importance. As a result, many individuals interested in purchasing religious items seek information to guide their buying decisions. This study aims to evaluate whether various personal characteristics of information seekers, such as gender, age, occupation, or field of study, influence their behaviour when looking for information about Thai amulets. Survey research was conducted with 375 respondents interested in amulets. The online quiz was based on the Ellis Information Behaviour Model. Data were analysed using descriptive and inferential statistics, including t-tests, chi-squared analysis, analysis of variance, and structural equation modelling, to evaluate differences in information-seeking behaviour based on gender, age, educational background, and occupation. The findings revealed that personal characteristics such as gender, age, occupation, and field of study result in diverse information-seeking behaviours, confirming the study's hypothesis. The study also revealed that many information seekers prefer to learn from personal sources such as credible experts or online social networking sites. Furthermore, the coefficient of variation indicated that men gender, age between 21 and 30 years, and an academic career all had a positive relationship with information-seeking behaviour. Academic career variables have the most influence on amulet collectors' information-seeking behaviour. The research results will benefit future information services or information search systems for disseminating information about amulets in response to client behaviour and information requirements.

Keywords: information seeking, information behaviour, Thai amulet, amulet collector, socio-demographic characteristics, Buddhist

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1. INTRODUCTION

Information-seeking behaviour involves finding and gathering information to suit user needs. Information professionals have examined how people search for information and created models to reflect these searches. Bates (1989) introduced "Berry Picking," where information users constantly search and accumulate data until they find complete, relevant information that meets their needs. In contrast, Ellis and Haugan (1997) described the multiple stages of information-seeking, including tracking, connecting, investigating, and organizing outcomes. Depending on the time, one may perform these tasks in different sequences. Kuhlthau et al. (2008) developed the information search process in the 1980s and revised it in 2008 by applying it to a digital environment. She described informational behavior as a physical activity that relies on one's emotions, interests, and ability to make decisions about a variety of information sources. Nicholas et al. (2000) also showed that ubiquitous web data has transformed information-seeking. Although Nicholas considers information behaviour during online interactions—where users primarily seek information on websites—this model is consistent with Choo et al. (2000). Users choose a search engine to meet their information needs, skim content, and carefully evaluate material before downloading anything useful. Wilson (1999) talked about information behavior, which includes discovering and acquiring information.

Researchers have used information behaviour or information-seeking models to study the information-seeking behaviour of different professional or user groups. Police officers' information-seeking behaviour was studied by Guclu and Can (2015). Officers typically used office documents and fellow officers for information, not books, journals, or other official sources. Sahu and Nath Singh (2013) showed that Indian astronomy and astrophysics experts use astronomical data platforms to meet their research and instructional objectives. Folorunso (2021) explored how doctors seek patient treatment information and improve healthcare delivery. They found that doctors sought information based on specialty, age, gender, and employment experience. In a comparable a similar direction, Adongo et al. (2022) discovered a substantial correlation between the health-seeking behavior of patients and the utilization of public and private health facilities in relation to their socio-demographic characteristics (gender, marital status, education, and income). Lavranos et al. (2015) examined artists' information-seeking behaviour during genre composition. In addition, a recent study on the information-seeking behaviour of sacred artefact enthusiasts in Thailand found that Thai people adore sacred artefacts because they believe these items can improve their academic and business success (Chitiyaphol & Kwiecien, 2023). Chanchai et al. (2023) found that Thai women worship sacred stones to improve their work and education. Similar to Kalchankit and Taiphapoon (2016), Chanchai et al. (2023) also investigated the use of lucky stone jewellery to enhance work and study performance. Both studies found that participants learned from people and online social networks. This contradicts Tosomboon and Rungkhunakorn (2021), who found that amulet collectors study amulets for religious reasons. They begin by reading literature and consulting with amulet experts, and then buy actual amulets to study, compare, or fulfill other needs.

Buddhist-related enterprises have grown significantly due to the strong belief in and reverence for these amulets (Kerdnaimongkol, 2017; McDaniel, 2011; Sawangsri, 2006; Yurungruangsak, 2012). These businesses utilize Buddhist-related objects or symbols to generate profit and gain competitive advantages. To respond to the desires of individuals seeking blessings in various areas of their lives, such as their careers, education, fortune, or safety, a profitable approach is to offer the rental or purchase of amulets, focusing on the belief in their sacredness (Taisrikhot et al., 2020). The trade of amulets has gained significant popularity in Thai society and abroad. The prices of amulets advertised on temple boards, in magazines, or on websites usually span from hundreds to millions of Thai baht. The cost of acquiring an amulet is variable and depends on the level of satisfaction experienced by the collectors (The Standard Wealth, 2021). Several factors influence the price of renting or purchasing sacred artefacts, including the condition of the amulets (no cracks, chips, or scratches), their reputation or popularity among enthusiasts, their aesthetic beauty in Buddhist art, and their age (Anansiriwat, 2016; Aranyapoom, 2017; Chantanee, 2016). Moreover, pilgrimage travel, along with amulet marketing, can boost the economy. The Public Relations Department of Thailand estimated a value of 10,800 million baht in 2019 ($300 million US dollars) and increased global recognition. Future Markets Insight (Bangkok Business Media, 2023) predicted that global faith-based tourism will be worth 1.37 trillion US dollars by 2025. This is expected to triple in a decade, reaching 40.9 trillion US dollars by 2035.

As a result of the previously mentioned shifts in beliefs and economic worth, collectors now have a heightened

demand for knowledge regarding amulets. Their interest involves acquiring knowledge about legends, tales, and associated stories, along with methods for verifying the accuracy of these items. Duplicates are increasingly prevalent due to the growing scarcity of unique objects. Hence, collectors now require accurate information and information technology to verify or suggest authentic amulets.

Therefore, gaining insight into the information search behaviour of users will enable information professionals to customise information services and systems that align with the varied information-seeking behaviours of users. According to previous research, people who search for specific information, such as various beliefs, often have different information-seeking behaviours compared to those who use information about general topics. Hence, the researchers aims to investigate the diverse information-seeking behaviours exhibited by amulet collectors with distinct characteristics. Based on the study findings, we will further enhance the semantic search system to encompass a wide range of behavioural patterns observed by amulet collectors.

2. RESEARCH QUESTIONS AND HYPOTHESES

The main objective of this study is to evaluate and examine the socio-demographic factors that influence the information-seeking behaviour of amulet collectors in Thailand. Since this research is a preliminary study in the design and development of the amulet semantic search system, its focus is solely on examining the information-seeking behaviour related to amulets. It excludes the utilisation of information about amulets. This study addresses the following research questions and hypotheses:

2.1. Research Questions

1. What are the primary sources users use when seeking information regarding amulets?

2. What is the impact of various socio-demographic factors on information-seeking behaviour?

3. What is the correlation between the socio-demographic aspects of amulet collectors and their information-seeking behaviour?

2.2. Hypothesis

Prior research has identified personal characteristics such as gender, age, educational level, field of study, occupation, and income level as influencing information-seeking behavior. This research exclusively selected socio-demographic characteristics that influence the information-seeking behavior of sacred object collectors: gender, age, occupation, and educational background. The following hypotheses were formulated and utilized as a framework for the research study:

H0: There are no evident differences in the information-seeking behaviours among amulet collectors, regardless of their characteristics, including gender, age, subject background, and occupation.

H1: The objectives of amulet collectors in seeking information vary significantly depending on their gender, age, academic discipline, and occupation.

H2: The information sources utilised by amulet collectors are significantly influenced by variables such as gender, age, academic background, and occupation. Amulet fans usually rely on personal sources of information to acquire knowledge about amulets. With the exception of academic groups, only information sources such as books or journal articles will be utilised.

H3: Gender, age, academic discipline, and occupation have significant effects on the information-seeking behaviour of amulet collectors.

H4: Occupation and academic discipline have a more significant positive influence on information-seeking behaviour about amulets than gender and age.

3. DEFINITION OF VARIABLES IN THIS RESEARCH

3.1. Amulet Collector

An amulet collector refers to a person who collects amulets or is interested in information about amulets. The purpose may be to collect amulets for personal reasons or to pursue academic goals.

3.2. Auspiciousness

Auspiciousness means acquiring knowledge about amulets with the aim of increasing the happiness and motivation of amulet collectors to practice according to the principles of Buddhism.

3.3. Faith in Amulets

Faith in amulets means seeking information about amulets to satisfy the desire for good things in one's life, such as success, wealth, safety, and so on.

3.4. Social Engagement

Social engagement refers to the active participation and interaction of individuals in social activities, such as

conversations, events, or community initiatives. Wearing amulets, similar to wearing jewellery, is a way to socialise and earn acceptance among others who value them. Furthermore, it functions as a mirror of the collector's societal and financial standing.

3.5. Data Verification

Data verification is the business procedure of checking the version or appearance of amulets. Data verification has a significant impact on the value of purchasing and selling amulets. Should the amulet possess rarity or be in high demand, its price will correspondingly be elevated.

4. RESEARCH METHODOLOGY

4.1. Population and Sample

This study adopted a quantitative research methodology to examine the information-seeking behaviour of individuals who collect amulets. The researchers chose a simple random sampling technique from those interested in collecting amulets. A sample size of 384 persons was selected with a 95% confidence level, representing an unknown population.

4.2. Research Instruments

The researchers developed a questionnaire to collect data on information-seeking behaviours. The questionnaire consists of three parts. The first part includes the personal data of the respondents, which will be used as a variable to analyze individual characteristics that impact information-seeking behaviour. The second part inquires about the specific objectives and preferred sources of information utilized by amulet collectors. The third part focuses on the information-seeking behaviour derived from Ellis's information-seeking behaviour model.

The questionnaire is comprised of two sections: multiple-choice questions and a final section of questions presented on a five-point Likert scale, ranging from (1) strongly disagree to (5) strongly agree. Three experts specializing in information-seeking behaviour evaluated the content validity of the questionnaire through the utilization of item-objective congruence analysis. A score of 0.93 suggested that the content validity was sufficient for data collection. The researchers evaluated the questionnaire's reliability by examining the alpha coefficient, utilizing data collected from 30 people with the same characteristics as the sample group. The reliability, shown by a value of 0.978, was determined to be sufficient for collecting study data.

4.3. Data Collection

The researchers distributed the online questionnaire and encouraged its completion among amulet collectors or enthusiasts through online social networks. The term "amulet collectors" in this study refers to individuals who collect, believe in, study, or research various kinds of amulets. Consequently, the researchers published an online questionnaire on the Amulets Club's social network, a community for individuals who are interested in, intrigued by, or hold faith in amulets. The online questionnaire was chosen due to Thailand's implementation of social distancing measures from January to February 2022 in response to the COVID-19 outbreak. A total of 378 individuals completed the questionnaire. Subsequently, the questionnaires were carefully reviewed to ensure precision and to identify any missing data, resulting in a final count of 375 respondents for analysis.

4.4. Data Analysis

Percentages were used to represent the participants' data, their purposes for seeking information, and the sources they used. Mean and standard deviation were used to examine information-seeking behaviour. t-test, one-way analysis of variance, and chi-square statistics were used to examine the differences among the investigated variables. Furthermore, structural equation modelling was employed to explain the impact of individual variables on amulet collectors' information-seeking behaviour. The construct validity was assessed using principal component analysis and Varimax rotation techniques, employing Kaiser Normalisation. The Kaiser–Meyer–Olkin value of 0.952 suggests that the correlation matrix was appropriate for analysis.

Ethical approval: The research project code for this study is HE623117, and it was granted ethical approval on December 20, 2021.

5. FINDINGS

5.1. Demographic Information

Of the 375 respondents, 267 (71.0%) were men, while the remaining 109 (29.0%) were women. A total of 125 respondents (33.2%) were between 41 and 50 years old, followed by 86 respondents (22.9%) between the ages of 31 and 40, and 68 respondents (18.1%) younger than 21. An examination of the respondents' fields of study revealed a similar distribution. Of these, 194 respondents (51.6%) studied science and technology, while 182 respondents

(48.4%) focused on the humanities and social sciences. The majority of the sample, 153 respondents (40.7%), worked as business owners or general employees. Additionally, 113 respondents were affiliated with universities or educational institutions, and another 110 had specific occupations such as doctors, nurses, police officers, or soldiers.

5.2. Comparing the Differences in Distinct Characteristics of Users Regarding Their Objectives in Seeking Information

Regarding RQ1, the primary sources users used to obtain information about amulets, and H2, the information-seeking objectives among amulet collectors, showed significant differences in gender, age, academic background, and occupation. The researchers assessed and compared differences in users' objectives when obtaining information regarding amulets. They conducted a comparative analysis of four variables: gender, age, occupation, and educational background.

The study found differences between women and men in seeking knowledge about amulets in terms of social participation and good luck. The data in Table 1 showed that 14.7% of women searched for information about amulets and participated in social activities more than men did (11.6%), and women (71.6%) searched for information about amulets more than men did (60.7%). No differences were found between men and women for other purposes, such as career objectives, purchasing amulets, or supporting work duties.

Table 2 shows that people under 21 are less objective when searching for information regarding purchasing amulets (8.8%), career support (10.3%), and auspiciousness (51.5%) than are other age groups. For example, individuals under 21 had just 8.8% of their objectives in this sector, while those over 50 had 47.3% of their goals related to

Table 1. Differences in objectives in seeking information about amulets among respondents of different genders

Objective	Men (n=267)	Women (n =109)	Chi-square	Sig.
Occupation	89 (33.3)	33 (30.3)	0.422	0.516
Purchasing amulets	81 (30.3)	30 (27.5)	0.712	0.399
Supporting work duties	56 (21.0)	22 (20.2)	0.913	0.339
Social engagement	31 (11.6)	16 (14.7)	18.408[a)]	<0.001
Auspiciousness	162 (60.7)	78 (71.6)	22.762[a)]	<0.001
Data verification	71 (26.6)	26 (23.9)	0.050	0.822
Faith in amulets	73 (27.3)	22 (20.2)	1.401	0.237

Values are presented as number (%).
Multiple responses.
[a)]Statistically significant level at 0.05.

Table 2. Differences in objectives for seeking information about amulets among respondents of different ages

Objective	Less than 21 (n=68)	21-30 (n=42)	31-40 (n=86)	41-50 (n=125)	More than 50 (n=55)	Chi-square	Sig.
Occupation	16 (23.5)	16 (38.1)	40 (46.5)	33 (26.4)	17 (30.9)	12.984	0.110
Purchasing amulets	6 (8.8)	9 (21.4)	33 (38.4)	37 (29.6)	26 (47.3)	26.891[a)]	<0.001
Supporting work duties	7 (10.3)	11 (26.2)	26 (30.2)	23 (18.4)	11 (20.0)	10.420[a)]	0.034
Social engagement	6 (8.8)	6 (14.3)	10 (11.6)	18 (14.4)	7 (12.7)	1.438	0.838
Auspiciousness	35 (51.5)	35 (83.3)	53 (61.6)	83 (66.4)	34 (61.8)	12.234[a)]	0.016
Data verification	19 (27.9)	6 (14.3)	14 (16.3)	37 (29.6)	19 (34.5)	10.370[a)]	0.035
Faith in amulets	15 (22.1)	8 (19.0)	25 (29.1)	28 (22.4)	20 (36.4)	5.965	0.202

Values are presented as number (%).
Multiple responses.
[a)]Statistically significant level at 0.05.

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Table 3. Differences in objectives for seeking information about amulets among respondents with different occupations

Objective	Professional (n=110)	Business owner or self-employed (n=154)	Academician (n=112)	Chi-square	Sig.
Occupation	33 (30.0)	57 (37.0)	32 (28.6)	2.533	0.282
Purchasing amulets	48 (43.6)	50 (32.5)	13 (11.6)	28.451[a)]	<0.001
Supporting work duties	21 (19.1)	41 (26.6)	16 (14.3)	6.262[a)]	0.044
Social engagement	22 (20.0)	18 (11.7)	7 (6.3)	9.750[a)]	0.008
Auspiciousness	68 (61.8)	102 (66.2)	70 (62.5)	0.566	0.753
Data verification	28 (25.5)	44 (28.6)	23 (20.5)	2.220	0.329
Faith in amulets	34 (30.9)	36 (23.4)	26 (23.2)	2.365	0.306

Values are presented as number (%).
Multiple responses.
[a)]Statistically significant level at 0.05.

Table 4. Differences in objectives for seeking information about amulets among respondents with a different field of study

Information sources/resource	Science & Technology (n=194)	Humanities & Social Sciences (n=182)	Chi-square	Sig.
Occupation	60 (30.9)	62 (34.1)	0.422	0.516
Purchasing amulets	61 (31.4)	50 (27.5)	0.712	0.399
Supporting work duties	44 (22.7)	34 (18.7)	0.913	0.339
Social engagement	38 (19.6)	9 (4.9)	18.408[a)]	<0.001
Auspiciousness	102 (52.6)	138 (75.8)	22.762[a)]	<0.001
Data verification	54 (27.8)	41 (22.5)	1.401	0.237
Faith in amulets	42 (21.6)	54 (29.7)	3.177	0.075

Values are presented as number (%).
Multiple responses.
[a)]Statistically significant level at 0.05.

collecting data for purchasing and selling amulets. People aged 21 to 30 are 83.3% more likely to seek a prosperous future, compared to 51.5% of those under 21. People over the age of 41 are more likely to obtain data that confirms the validity of amulets than any other user group. According to the study, individuals of various ages seek information for a variety of reasons. The objective of information search differs, with statistical significance set at 0.05.

The respondents' information-seeking objectives varied depending on their occupation. Table 3 shows that the academic group had fewer information-seeking aims than the other occupational groups, with statistical significance at the 0.05 level. Specifically, 11.6% of academics seek information to buy amulets, 14.3% to support their work, and only 6.3% to participate in society. Researchers discovered that 43.6% of professional groups and 32.5% of business owners specifically seek information about purchasing amulets. This is much greater than the academic group at the 0.001 level. Furthermore, just 6.3% of academics seek information on amulets to participate in society, compared to 20.0% of professionals and 11.7% of business owners, with statistical significance at the 0.008 level. This represents an acceptance of H1 (Table 3).

Table 4 shows that participants from different academic disciplines had different information-seeking objectives. When comparing the academic subjects of the humanities and social sciences with those of science and technology, the study revealed a statistically significant difference at the 0.01 level. Four point nine percent of those from humanities and social sciences backgrounds sought information about amulets, compared to less than 19.6% of the science and technology group. The results of studies on auspiciousness reveal a different picture. Seventy-five point eight percent of people with humanities and

social sciences backgrounds seek out information about auspiciousness, up from 52.6% of people with science and technology backgrounds. The study's results confirm the acceptance of H1.

The study found that age, gender, education, and occupation affected information-seeking aims. Women are more likely than men to learn about amulets, mostly for socializing or luck. Young amulet collectors are more likely than older collectors to research amulets for trading, good fortune, verification, or support. Academic institutions researching amulets for trading and work share similarities with individual amulet collectors, despite their lower social interaction. Science and technology amulet collectors prefer amulets that allow them to participate in society and bring more luck compared to those from the arts and social sciences. Thus, the study supports the hypothesis. Consequently, the findings of the study provide evidence in support of the stated hypothesis.

5.3. Analyzing the Selection of Information Sources Among Participants with Varying Personal Attributes

According to H2, the information sources used by amulet collectors differ significantly based on gender, age, subject, and occupation. Hence, the researchers undertook a comparison of the information sources used by those interested in amulets during the era of digital technology. The results of this study revealed significant differences, as outlined below.

Table 5's data reveals that men prefer to use informa-

Table 5. Differences in information sources/resources for seeking information about amulets among respondents of different genders

Information sources/resource	Men (n=267)	Women (n=109)	Chi-square	Sig.
Friends/family	106 (39.7)	54 (49.5)	3.066	0.080
Monks	93 (34.8)	43 (39.4)	0.715	0.398
Experts in amulets	114 (42.7)	37 (33.9)	2.467	0.116
Books	80 (30.0)	32 (29.4)	0.140	0.907
Articles/journals	55 (20.6)	16 (14.7)	1.771	0.183
Amulet clubs	49 (18.4)	16 (14.7)	0.730	0.393
Amulet flea markets	27 (10.1)	4 (3.7)	4.247[a)]	0.039
Amulet websites	48 (18.0)	15 (13.8)	0.986	0.321
Social media	136 (50.9)	53 (48.6)	1.650	0.199

Values are presented as number (%).
[a)]Statistically significant level at 0.05.

Table 6. Differences in information sources/resources for seeking information about amulets among respondents of different age groups

Information sources/resource	Less than 21 (n=68)	21-30 (n=42)	31-40 (n=86)	41-50 (n=125)	More than 50 (n=55)	Chi-square	Sig.
Friends/family	18 (26.5)	20 (47.6)	44 (51.2)	55 (44.0)	23 (41.8)	10.363[a)]	0.035
Monks	25 (36.8)	26 (61.9)	34 (39.5)	35 (28.0)	16 (29.1)	17.288[a)]	0.002
Experts in amulets	11 (16.2)	20 (47.6)	45 (52.3)	47 (37.6)	28 (50.9)	25.530[a)]	<0.001
Books	13 (19.1)	12 (28.6)	30 (34.9)	37 (29.6)	20 (36.4)	5.939	0.204
Articles in journals	9 (13.2)	11 (26.2)	12 (14.0)	28 (22.4)	11 (20.0)	5.299	0.258
Amulet clubs	5 (7.4)	3 (7.1)	18 (20.9)	26 (20.8)	13 (23.6)	11.144[a)]	0.025
Amulet flea markets	3 (4.4)	3 (7.1)	7 (8.1)	10 (8.0)	8 (14.5)	4.285	0.369
Amulet websites	10 (14.7)	8 (19.0)	11 (12.8)	25 (20.0)	9 (16.4)	2.282	0.684
Social media	29 (42.6)	16 (38.1)	33 (38.4)	78 (62.4)	33 (60.0)	26.876[a)]	<0.001

Values are presented as number (%).
[a)]Statistically significant level at 0.05.

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tion sources from online social networks the most (50.9%), followed by amulet experts (42.7%), while women prefer to use friends or family (49.5%), which is similar to using online social networks (48.6%). However, at the 0.05 level, there was a statistically significant difference between men and women in choosing to use the amulet market. Specifically, 10.1% of men use the amulet market as an information source, compared to 3.7% of women. In Thailand, the amulet market serves as a hub for men who have a strong passion for amulets. As a result, women amulet collectors often do not prefer to use this type of information source.

Table 6 shows that amulet collectors of various ages have distinct preferences for information sources. The study found that people under the age of 21 (42.6%), those aged 41 to 50 (62.4%), and those aged 50 and older (60.0%) were the most likely to use online social networks as their primary information source. On the other hand, amulet collectors aged 21 to 30 (61.9%) prefer to use monks as their main source of information. While those group aged 31 to 40-year-olds (52.3%) chose to use amulet experts. Chi-square analysis was used to examine the differences between users of different ages and their information sources at the 0.05 level. The research findings revealed a statistically significant variance in the selection of information sources across age groups. People under the age of 21 rely on their friends and family for knowledge and consult with fewer specialists than other age groups. Meanwhile, respondents aged 21 to 30 were more likely to seek information from a monk on amulets than other age groups. Furthermore, respondents under the age of 21 and those over the age of 41 are more likely to utilize social media platforms to acquire information about amulets than those between the ages of 21-30 and 31-40. This represents an acceptance of H2.

Table 7 shows the engagement of several career groupings and the numerous information sources selected. Professionals used amulets and online social networks the most (50.9%), followed by inquiries from friends or family members (40.9%). The self-employed or private business group, on the other hand, chose to seek information from friends or family members the most (51.3%), mirroring the preference for online social networks (50.0%). The majority of academics (50.0%) preferred to use online social networks, followed by consultations with monks (38.4%).

When the information source choices of different occupational groups were compared, the research results revealed differences. Entrepreneurs, for example, preferred to obtain information from friends and family, publications, and the amulet market over other occupations. In contrast, the academic group used information sources such as experts, books, and amulet clubs less frequently than the other professional groups. This supports H3, which states that different occupations have distinct effects on the selection of information sources while seeking information. At the 0.05 level, this difference is statistically significant.

Respondents with various academic backgrounds chose different information sources. Respondents with a background in science and technology chose social networks as the most common source of information (42.3%), followed by monks (40.7%) and close friends or family (40.2%). In contrast, respondents with a background in humanities and social sciences also chose social networks

Table 7. Differences in information sources/resources for seeking information about amulets among respondents of different occupations

Information sources/resource	Professional (n=110)	Business owner or self-employed (n=154)	Academician (n=112)	Chi-square	Sig.
Friends/family	45 (40.9)	79 (51.3)	36 (32.1)	9.905[a)]	0.007
Monks	37 (33.6)	56 (36.4)	43 (38.4)	0.548	0.760
Experts in amulets	56 (50.9)	65 (42.2)	30 (26.8)	13.894[a)]	<0.001
Books	34 (30.9)	57 (37.0)	21 (18.8)	10.434[a)]	0.005
Articles/journals	12 (10.9)	45 (29.2)	14 (12.5)	18.290[a)]	<0.001
Amulet clubs	23 (20.9)	31 (20.1)	11 (9.8)	6.245[a)]	0.044
Amulet flea markets	6 (5.5)	20 (13.0)	5 (4.5)	7.826[a)]	0.020
Amulet websites	12 (10.9)	28 (18.2)	23 (20.5)	4.068	0.131
Social media	56 (50.9)	77 (50.0)	56 (50.0)	10.558[a)]	0.005

Values are presented as number (%).
[a)]Statistically significant level at 0.05.

Table 8. Differences in information sources/resources for seeking information about amulets among respondents with different academic disciplines

Information sources/resource	Science & Technology (n=194)	Humanities & Social Sciences (n=182)	Chi-square	Sig.
Friends/family	78 (40.2)	82 (45.1)	0.903	0.342
Monks	79 (40.7)	57 (31.3)	3.596	0.058
Experts in amulets	63 (32.5)	88 (48.4)	9.851[a)]	0.002
Amulet books	56 (28.9)	56 (30.8)	0.163	0.687
Articles/journals	43 (22.2)	28 (15.4)	2.818	0.093
Amulet clubs	29 (14.9)	36 (19.8)	1.533	0.216
Amulet flea markets	12 (6.2)	19 (10.4)	2.246	0.134
Amulet websites	28 (14.4)	35 (19.2)	1.550	0.213
Social media	82 (42.3)	107 (58.8)	6.259[a)]	0.012

Values are presented as number (%).
[a)]Statistically significant level at 0.05.

Table 9. Differences in information-seeking behaviours among information users of different genders

	Men (n=267)		Women (n=109)		t	p-value
	$\bar{x}$	S.D.	$\bar{x}$	S.D.		
Starting	3.41	0.952	3.24	1.109	-1.475	0.142
Chaining	3.64	1.021	3.52	1.098	-1.011	0.312
Browsing	3.61	0.960	3.39	1.081	-1.919	0.056
Differentiating	3.99	0.968	3.92	1.006	-0.575	0.566
Monitoring	3.26	1.107	2.91	1.297	-2.481	0.014[a)]
Extracting	3.45	1.120	3.19	1.260	-1.958	0.025
Verifying	3.68	1.089	3.59	1.170	-0.740	0.460
Ending	3.19	1.175	2.95	1.387	-1.617	0.108
Total	3.53	0.901	3.34	1.007	-1.800	0.073

S.D., standard deviation.
[a)]Statistically significant level at 0.05.

as the most common source of information (58.8%), followed by advice from amulet experts (48.4%).

When statistical differences were examined, the research findings revealed that respondents from diverse academic backgrounds used distinct information sources. Respondents in the humanities and social sciences were more likely than those in science and technology to rely on online social networks and experts for knowledge. Table 8 exhibits statistical significance at the 0.05 level.

5.4. Comparing Information Seeking Behaviours of Respondents with Different Personal Characteristics

H3 suggests that gender, age, academic background, and occupation significantly affect the information-seeking behaviour of amulet collectors. The researchers analyzed and compared the differences in information-seeking behaviour patterns related to amulets. Respondents with varying personal characteristics exhibited diverse information-seeking behaviours. In this study, the researchers utilized Ellis and Haugan (1997)'s information behaviour model as a framework, which involves the eight stages of information seeking.

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Table 9 shows the information-seeking behaviour of respondents of various genders using Ellis. The results revealed that respondents engaged in moderate to high levels of information-seeking behaviour. In the context of the eight-stage information-seeking model, it was observed that the information behavior associated with evaluating differences across information sources had the highest average information seeking score for both genders, which involved assessing differences in information and then validating its accuracy. According to the Ellis model, men and women behave similarly while seeking information. However, with the exception of behaviours related to tracking or following the flow of information about amulets, the research indicates that men show more passion for engaging with information on amulets compared to women.

Table 10 shows that amulet collectors of all ages often have average information-seeking behaviours regarding amulets, with significant differences at the 0.05 level. This verifies H3's findings. The age range of 30 years and older has the highest level of overall information-seeking behaviour (31-40, $\bar{x}$=3.62; 41-50, $\bar{x}$=3.61; over 50 years, $\bar{x}$=3.58), as opposed to the group under 30 years of age, which has moderate information-seeking behaviour (21 or less, $\bar{x}$=3.07; 21-30, $\bar{x}$=3.28). The study discovered differences in each step of data extraction when comparing users of

Table 10. Differences in information seeking behaviours among information users of different age groups

Information seeking	Less than 21 (n=68)		21-30 (n=42)		31-40 (n=86)		41-50 (n=125)		More than 50 (n=55)		F	p-value
	$\bar{x}$	S.D.	$\bar{x}$	S.D.	$\bar{x}$	S.D.	$\bar{x}$	S.D.	$\bar{x}$	S.D.		
Starting	3.07	1.186	3.14	1.020	3.52	1.043	3.44	0.893	3.49	0.830	2.864	0.023
Chaining	3.05	1.135	3.61	1.064	3.75	1.029	3.81	0.984	3.62	0.837	6.841	<0.001
Browsing	3.10	1.052	3.68	0.873	3.72	0.978	3.60	1.056	3.64	0.787	4.657	0.001
Differentiating	3.21	1.080	4.10	0.875	4.08	0.884	4.18	0.882	4.17	0.840	14.466	<0.001
Monitoring	2.90	1.226	2.10	1.192	3.32	1.229	3.20	1.137	3.37	1.120	1.646	0.162
Extracting	2.97	1.238	3.17	1.358	3.39	1.162	3.53	1.113	3.69	0.895	4.068	0.003
Verifying	3.15	1.243	3.70	1.061	3.89	1.109	3.90	1.073	3.73	0.922	4.499	0.001
Ending	3.08	1.268	2.81	1.357	3.30	1.218	3.21	1.223	2.97	1.238	1.462	0.213
Total	3.07	1.178	3.28	1.100	3.62	1.081	3.61	1.045	3.58	0.933	4.557	0.001

S.D., standard deviation.

Table 11. Differences in information-seeking behaviours among information users with different occupational characteristics

Information seeking	Professional (n=110)		Business owner or self-employed (n=154)		Academician (n=112)		F	p-value
	$\bar{x}$	S.D.	$\bar{x}$	S.D.	$\bar{x}$	S.D.		
Starting	3.62	0.854	3.44	0.984	3.01	1.069	11.543	<0.001
Chaining	3.88	0.889	3.74	1.016	3.15	1.084	17.017	<0.001
Browsing	3.85	0.862	3.61	0.961	3.17	1.065	14.140	<0.001
Differentiating	4.17	0.939	4.10	0.861	3.60	1.066	12.603	<0.001
Monitoring	3.55	1.049	3.17	1.187	2.76	1.154	13.250	<0.001
Extracting	3.70	0.996	3.49	1.146	2.92	1.218	14.236	<0.001
Verifying	3.98	0.969	3.72	1.059	3.24	1.193	13.663	<0.001
Ending	3.44	1.050	3.15	1.267	2.78	1.307	8.314	<0.001
Total	3.77	0.819	3.55	0.903	3.08	0.961	17.564	<0.001

S.D., standard deviation.

amulet data of various ages. Ellis's information-seeking behavior model indicates that users under 21 showed the lowest average information-seeking behavior compared to other demographic groups in terms of starting a search, chaining, exploring, differentiating, extracting, and verifying data.

When searching for information about amulets, users in different careers exhibit a moderate level of information-seeking behaviour. Examining the occupational groups of information users, we found that professionals such as doctors, nurses, soldiers, and police exhibited a strong inclination to seek information about amulets ($\bar{x}$=3.77), followed by those in business or trade-related professions ($\bar{x}$=3.55). However, information-seeking behaviour in the academic group is at a moderate level, with an average score of 3.08, distinguishing it from other occupational categories. According to the results presented in Table 11, users across various professional categories often compare the information they obtain from amulets to identify similarities or differences, thereby verifying the accuracy of the gathered information. The professional group had an average of 4.17, the business entrepreneur group had an average of 4.10, and the academic group had an average of 3.60. Ellis's information-seeking behaviour at each stage differed from that of other occupational groups. Academics exhibit the least information-seeking behaviour at every stage compared to other occupational groups.

When looking up information on amulets, users from different disciplines of study exhibit varying average behaviours. The research findings indicated statistical significance at the 0.05 level. Those in science and technology were more likely to look up information about amulets ($\bar{x}$=3.61) than those in the humanities and social sciences ($\bar{x}$=3.33). The information-seeking behaviour model revealed statistical differences between users from various fields of study. The results include actions such as initiating the search for information, chaining the data, monitoring, extracting, and concluding the search for information about amulets. Participants in science and technology reported a greater desire to seek information than those in the arts and social sciences. As shown in Table 12, the study's findings support H3: Different academic backgrounds result in different information-seeking behaviours among users.

5.5. Relationship Between Socio-Demographic Characteristics and Information-Seeking Behaviour

H4 suggests that occupation and academic discipline have a more significant positive impact on information-seeking behaviour regarding amulets than do gender and age. Structural equations have been utilized to investigate the hypotheses regarding the impact of individual traits on the behaviour of seeking information about amulets. The findings of the investigation are presented in Fig. 1.

The diagram illustrates the influence of the personal characteristics of amulet collectors on their information-seeking behaviour through eight observable variables in the structural model. It can explain the effects of individual characteristics. The research results demonstrate strong consistency when evaluating different criteria and conditions of structural equations. The findings from the struc-

Table 12. Differences in information-seeking behaviour among information users with different educational backgrounds in various fields of discipline

Information seeking	Science & Technology (n=194)		Humanities & Social Sciences (n=182)		t	p-value
	$\bar{x}$	S.D.	$\bar{x}$	S.D.		
Starting	3.59	0.976	3.13	0.976	4.630	<0.001
Chaining	3.70	1.078	3.50	0.997	1.953	0.052
Browsing	3.63	1.029	3.46	0.963	1.714	0.087
Differentiating	3.89	1.023	4.06	0.923	-1.700	0.090
Monitoring	3.37	1.160	2.94	1.153	3.616	<0.001
Extracting	3.54	1.137	3.21	1.178	2.706	0.007
Verifying	3.69	1.113	3.62	1.115	0.514	0.607
Ending	3.47	1.182	2.77	1.210	5.652	<0.001
Total	3.61	1.087	3.33	1.064	2.863	0.004

S.D., standard deviation.

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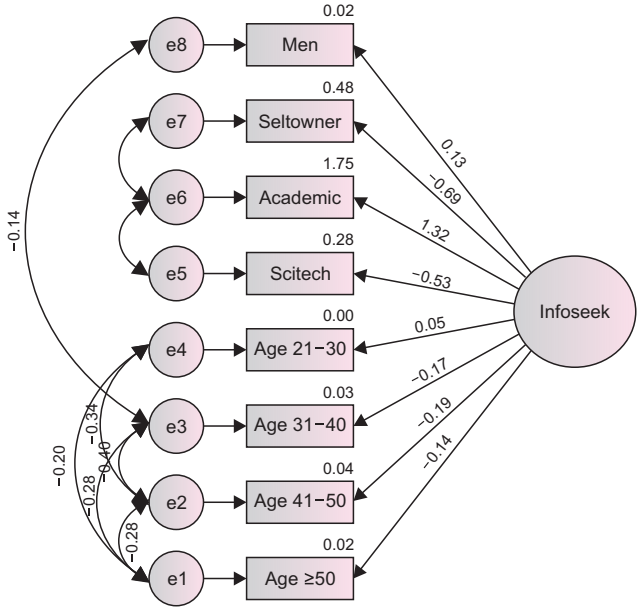


Fig. 1. The structural model diagram. GFI, goodness-of-fit-index; NFI, normed fit index; TLI, Turker-Lewis index; CFI, comparative fit index; RMSEA, root mean square error of approximation; RMR, root mean square residual.

tural equation analysis reveal that personal factors, including gender, age, job traits, and academic background, can account for up to 37% of the variance in information-seeking behaviour. Furthermore, analyzing the coefficient of variation reveals that variables associated with the men gender, ages ranging from 21 to 30 years, and occupational attributes of academics show a positive effect. However, for people aged 31 and above, having only a rudimentary understanding of science and technology has a negative effect. The occupational factor associated with being an academic has the highest impact, with an effect size of 1.32, followed by the occupational factor associated with being an entrepreneur, with an effect size of -0.69. Therefore, the study results support H4, which asserts that the professional characteristics of scholars who collect amulets positively influence their amulet-seeking behavior more than other personal characteristics. However, the study rejects the notion that the field of amulet collectors has a negative influence on the behavior of seeking amulet information.

6. SUMMARY AND DISCUSSION

In the past, people created amulets to honour Buddhist teachings, promoting morale and motivating the wearer. However, in many cases, there are legends that describe stories of holiness or miracles involving amulets, leading people to form beliefs regarding the amulets' abilities. As a result, amulets were converted into products, with people increasingly willing to pay for their spiritual benefits. A business relationship has developed by connecting amulet production to the market system, making amulets marketable commodities with economic value. Like other commodities, amulets are marketed through an organised framework that encompasses production, marketing, public relations, and speculation. To make informed selections, buyers purchasing amulets should learn more about them.

The findings of this study indicate that individuals with varied characteristics exhibit different behaviours when seeking and selecting sources of information. Adolescents are more likely than adults to engage in online activities with the intention of renting or buying religious amulets. This indicates a society heavily reliant on technology, despite embracing traditional elements such as beliefs, superstitions, magic, amulets, and talismans. Young individuals, in particular, experience a sense of uneasiness and seek amulets or sacred objects to swiftly elevate their spirits or assist them in accomplishing their objectives. As a result, they rely on the power of these items to promote success and rapid wealth accumulation. Hence, contemporary amulet designs frequently symbolise attributes of rapid and secure wealth accumulation and upward mobility, catering to the modern desire for swift achievement, akin to the speed of the Internet. The findings of this investigation align with prior research conducted by Chanchai et al. (2023), and Kalchankit and Taiphapoon (2016), which indicate that those who engage in the worship of diverse amulets do so with the belief that it will enhance their chances of achieving success in their professional or academic pursuits.

Another supporting factor is the relatively high pricing of sought-after amulets, consistent with Chantanee (2016)'s research that analyzed amulet prices. Her research revealed a price range for amulets from 10 dollars to millions of dollars. As a result, amulet purchasing behaviour depends on personal characteristics such as age or income, which must be sufficient to purchase amulets. For these reasons, young people may be less interested in researching information before purchasing amulets. This contrasts with the purchasing goals of professional groups such as nurses, police officers, and soldiers. Research has revealed that this particular community of amulet col-

lectors has a higher inclination than other professional groups to gather information before acquiring high-value amulets. This behaviour stems from their strong belief in the efficacy and attributes associated with particular types of amulets. This group of amulet collectors frequently possesses religious artefacts that serve as safeguards against harm or ensure the security of their lives and possessions. In contrast, individuals in the business sector actively pursue religious items with the explicit goal of boosting sales and fostering a sense of confidence. The findings of this research corroborate those of Keawimol (2015), who discovered that individuals in the business sector intend to acquire amulets for the purpose of collecting them and expecting enhanced trading outcomes or profits in the future.

Furthermore, many collectors of amulets rely on various sources of information, particularly experts in the field who can categorise and verify the genuineness of amulets, to obtain the desired knowledge or determine the specific market value of the amulets. Individuals younger than 21 years old tend to use online social networks as their primary means of acquiring information rather than other sources. This younger generation often demonstrates advanced proficiency in using digital technologies for information retrieval. However, the use of Internet social networks to gather information on amulets has transformed the traditional method of in-person meetings into virtual interactions. This indicates that amulet collectors still depend on personal sources for amulet-related information. This is consistent with the findings of Kalchankit and Taiphapoon (2016)'s research, which demonstrated that individuals who have a passion for collecting lucky gemstones often seek information through new media platforms, predominantly Internet-based social networks. Therefore, it is noteworthy that there has been a surge in the use of online social networks as sources of knowledge. The rise of online groups centered around lovers and collectors with a shared interest in holy artefacts is responsible for this phenomenon. Platforms such as Facebook provide convenience, allowing anyone interested in increasing their knowledge about amulets to easily access relevant information without distance or time limitations. It is fascinating that amulet collectors searching for information about religious items often neglect traditional sources such as books and journal articles. This contrasts with the study by Tosomboon and Rungkhunakorn (2021), which discovered that amulet experts primarily acquire knowledge through books or journals, and they also actively gather information using online social networks.

While amulet collectors' beliefs and faith in Buddhism, along with the attributes of amulets, may appear superstitious and defy scientific explanation, individuals still require psychological connections despite significant advancements in digital technology. They express these connections through behaviors that vary based on their unique traits. Fans of amulets actively seek knowledge about these objects to support collectors' ideas and provide explanations or clarifications to others. Thus, it pertains to the psychological and anthropological aspects of human behavior. We can use the findings of this study to advance information services and develop a semantic search system for amulets that aligns with the information-seeking patterns of amulet collectors. An ideal system should facilitate communication among those interested in religion, helping them interact with one another or seek guidance from professionals in the field. The system should also enable amulet collectors to share information or knowledge. Additionally, there must be tools available to examine the attributes of religious artifacts, as each object possesses distinct attributes and carries a unique price. Those interested in renting or buying religious amulets or objects will find this information useful. This material will provide them with fundamental information. Alternatively, it can serve as a platform or learning hub for scholarly endeavors, facilitating the future dissemination of knowledge about amulets among collectors and enthusiasts.

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CONFLICTS OF INTEREST

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

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Causal Relationship Between Information Perception and Preventive Behaviors of COVID-19 Among Working Age People in Bangkok and Metropolitan Area, Thailand

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ABSTRACT

This study aims to examine the causal relationship between information perception and preventive behaviors regarding COVID-19 among working-age people in Bangkok and the metropolitan area of Thailand. The study investigated how information exposure, interpretation, and retention influence hygiene practices, virus spread prevention, health maintenance, and digital lifestyle adaptations among working-age individuals. Employing quantitative research methods, the sample group consisted of 421 working-age people in Bangkok and the metropolitan area. Data collection was conducted using a questionnaire. Analysis involved descriptive statistics, confirmatory factor analysis, and structural equation modeling. The results showed that the measurement model was well fitted to the empirical data. The findings reveal a significant correlation between information perception and the implementation of preventive measures among the working-age population in Bangkok, highlighting the pivotal role of accurate and effective information dissemination in influencing public behavior, especially now that COVID-19 has become a more manageable aspect of everyday life.

Keywords: information perception, preventive behaviors, working age, COVID-19, Bangkok and metropolitan area

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1. INTRODUCTION

The transition from a pandemic to an endemic phase of COVID-19 marks a significant shift in the global public health paradigm. This evolution has profound implications for Thailand, where the virus's endemicity introduces new challenges and necessitates strategic adaptations in response to its mutating strains. This situation has a significant impact on working-age individuals, highlighting the need for innovative approaches to prevent and manage information post-pandemic. Because COVID-19 is now endemic, there is a need for ongoing and flexible methods to share and use health information. In this situation, having current information about COVID-19 is very important for daily life (Kim & Oh, 2023). Working-age individuals actively seek different sources of information to stay updated and adapt to the changing landscape of the disease. This includes not only seeking answers to specific questions, but also utilizing acquired knowledge to tailor responses and reduce risks associated with the regular presence of the virus.

The cognitive process of information perception (INF) plays a pivotal role in this adaptive strategy, encompassing the selection, comprehension, interpretation, and retention of relevant information. This process is inherently influenced by individuals' prior experiences (Clements, 2020). In the current context, the veracity and dependability of information gain unprecedented importance, as misinformation or reliance on unreliable sources can precipitate inappropriate responses, increased anxiety, and potentially hazardous behaviors (Ali et al., 2020). Given the dense population of Bangkok and its metropolitan area, along with its history of significant COVID-19 outbreaks, this region emerges as a critical focal point for examining these dynamics. By focusing on the working-age demographic within this densely populated urban setting, valuable insights can be gleaned into the interplay between INF and self-protective behaviors during the endemic phase of COVID-19.

Previous research has primarily focused on the immediate impact of knowledge and information on the pandemic, addressing short-term responses and crisis management (Duplaga, 2022; Ounsaneha et al., 2023; Pothisa et al., 2022; Sánchez-Arenas et al., 2021). There is a notable gap in understanding how INF influences ongoing preventive behaviors (PVT) in the endemic phase of COVID-19. Therefore, the purpose of this study is to examine how people's perceptions of information relate to their PVT. This understanding not only benefits the working-age population and broader community in adapting to the new normal, but also provides strategic guidance for stakeholders in the medical, public health, and media sectors. Such insights are particularly pertinent for devising tailored information dissemination strategies and public health interventions, thereby facilitating effective management of the endemic stage of COVID-19 in Thailand and analogous contexts.

2. BACKGROUND AND LITERATURE REVIEW

2.1. Information Perception

Perception is a fundamental aspect of human behavior that begins with and is based on knowledge obtained through sensory experiences. Human behavior primarily manifests through the process of organizing, selecting, and interpreting stimuli or other information, which is influenced by how a person perceives their surroundings. This perception is then translated into thoughts, emotions, decisions, and behaviors. Each person's perspective of the same circumstances may result in different interpretations due to the different perceptions that arise from individual values (Gibson, 1991; Greenberg & Baron, 2003; Schiffman & Kanuk, 2007). Ultimately, perception enables individuals to respond to their needs, obtain information that supports decision-making, retention, and interpretation, and make efficient use of the perceived knowledge in varied contexts.

INF is a vital process in understanding the events of the world, incorporating an individual's knowledge, abilities, experiences, and perspectives. The selection of information involves a series of steps, leading to varied perceptions among individuals. Although the perception process is unique to each person, it generally consists of three stages, which are exposure, interpretation, and retention (Assael, 2004; Roediger, 1990; Schermerhorn et al., 2002). Information exposure, the initial stage, involves opening oneself to stimuli and selecting specific information aligned with preferences, often through various media such as daily COVID-19 infection reports. After exposure, individuals interpret the received information, by thinking, analyzing, and evaluating its credibility, influenced by personal perspectives and experiences. For instance, interpreting COVID-19 pandemic information might require analyzing it through personal beliefs. Finally, individuals retain information, storing it for future reference, which enhances awareness and influences future behaviors. For example, members of the working-age population may retain COVID-19 prevention measures for an extended

period. While the INF process is dynamic and individualized, these three stages provide a general framework for understanding how individuals select, interpret, and retain information, ultimately shaping their unique perspectives and responses.

2.2. Preventive Behavior of COVID-19

The COVID-19 disease has become endemic in Thailand, with frequent and widespread occurrences of infections. Members of the working-age population must possess knowledge about proper self-protection methods for themselves and their families to ensure safety from infection. The working-age population, both in Thailand and internationally, exhibits information behaviors categorized into four dimensions: hygiene, prevention of spread, maintaining good health, and digital way of life (Suanrueang et al., 2022). These dimensions guide individuals in adapting diverse aspects of their lives, fostering awareness, and giving emphasis to the severity of the disease's impact on health.

2.2.1. Hygiene

Hygiene includes the observable sanitary practices that reflect people's desire to avoid infection by engaging in various unsafe behavioral practices (Suanrueang et al., 2022). People's knowledge significantly influences self-healthcare behaviors, encompassing rigorous cleaning practices at home using soap. This extends to the sanitization of frequently touched surfaces such as handrails and doorknobs (Hayashi et al., 2022). In response to coughing or sneezing, individuals adhere to the use of tissues to cover their nose or mouth, followed by thorough handwashing. Handwashing is essential for preventing disease transmission (Alzoubi et al., 2020; Hernández-García & Giménez-Júlvez, 2020). It involves washing hands with soap and water for at least 30 seconds, or using alcohol-based hand sanitizers as an alternative (Chavis & Ganesh, 2020). Individuals also exhibit behaviors such as avoiding unnecessary touching, refraining from sharing personal items, and employing designated utensils when dining with others. Additionally, it is recommended to avoid consuming raw or undercooked animal products due to food hygiene, as good food safety practices can prevent transmission through food (World Health Organization, 2020).

2.2.2. Prevention of Spread

Preventing the spread of COVID-19 involves immediate isolation and seeking medical attention at local health-promoting sub-district hospitals or nearby clinics upon showing symptoms, or after exposure to someone with symptoms (Güner et al., 2020). In case of illness, home isolation is advised to prevent close contact with others, encompassing avoidance of face-touching, hugging, or proximity to colleagues or those in the vicinity (Ju et al., 2021). The continuous tracking of COVID-19 information through various channels contributes to heightened awareness, emphasizing the severity of the disease and the importance of preventative measures (Anwar et al., 2020). The adaptability of the working-age population in various aspects reflects their understanding of the COVID-19 situation, showcasing adjustments in physical, role-related, and interdependence aspects (Scheibe et al., 2022). This demonstrates their ability to handle information effectively and make informed decisions for proper self-care and safety.

2.2.3. Maintaining Good Health

In maintaining overall health, various working-age groups are observed to adopt methods that enhance both their physical and mental well-being. These efforts aim to strengthen immunity while adhering to strict measures to control the spread of COVID-19, aligning with their new lifestyle (Khalifa et al., 2021). Noteworthy health maintenance techniques include consuming nutritious food, which is essential. A well-rounded meal has been related to healthier wellness, stronger immune systems, and a lower likelihood of infectious and chronic illnesses in people (Nuertey et al., 2022; World Health Organization, 2024). It was shown that people are more likely to adhere to safe dining guidelines if they have a positive attitude about food safety and strong family norms (Soon et al., 2021). Furthermore, engaging in physical exercise emerges as a pivotal element in equipping and reinforcing the immune system's resilience against COVID-19 (da Silveira et al., 2021; Fernández-Lázaro et al., 2020). Moderate physical activity was shown to be beneficial in modulating the immune system, reducing inflammation, and improving mental health during the pandemic (Hagiu, 2021). Quality sleep and sufficient rest are crucial factors affected by the prolonged COVID-19 pandemic (Varma et al., 2021). Poor sleep was linked to higher levels of anxiety, depression, and stress, emphasizing the need for public health interventions focused on sleep to improve mental health during the pandemic. Nonetheless, prioritizing adequate and effective rest has positive effects on both physical and mental health, contributing to higher immunity and reducing the risk of infection.

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2.2.4. Digital Way of Life

The adoption of a digital lifestyle acknowledges that COVID-19 has become an endemic disease. Measures have been implemented to gather information related to the surveillance of various respiratory system disorders, ensuring a comprehensive understanding of the situation and preparedness for disease treatment (Alghamdi & Alghamdi, 2022). In cases of mild symptoms, individuals can opt for general medication to alleviate the condition. Self-care practices contribute to heightened awareness, fostering self-care and prevention. Adhering to guidelines post-contact or following proximity with symptomatic individuals is essential to prevent severe illness and hospitalization. The working-age population has demonstrated commendable compliance with government recommendations, following disease control protocols during travel, maintaining strict social distancing measures, and minimizing contact with others or shared items. Nevertheless, public health initiatives should persist in providing clear knowledge and guidelines at the individual, community, and institutional levels, adapting to evolving circumstances (Karijo et al., 2021). People have significantly adapted to the new lifestyle, relying on technology for communication in various aspects, including public health, work, education, economics, and social interactions (Dubois et al., 2022). This behavioral shift, influenced by the current circumstances, highlights the role of technology in shaping contemporary life and becoming a familiar aspect of people's lives in the present era.

2.3. The Relationship Between Information Perception and Preventive Behaviors of COVID-19

The persistent acquisition of information pertaining to COVID-19 has been pivotal in shaping self-protective behaviors, aiming to enhance safety and reduce infection risks. The working-age demographic, in particular, values acquiring knowledge on self-health protection and perceives potential risks, thereby fostering motivation for preventive actions. Trust in public health communications emerges as a critical factor, with individuals displaying higher trust levels more likely to encourage adopting measures such as social distancing and meticulous hygiene practices (Ali et al., 2020; Fridman et al., 2020). This underscores the importance of accurate and reliable information dissemination in ensuring public compliance with health advisories. The role of digital platforms and social media in public perception and behavior towards COVID-19 preventive measures has been highlighted, with studies showing their capability to both positively and negatively impact public adherence to health guidelines (Wong et al., 2021). The advent of misinformation on these platforms necessitates a critical evaluation of information campaigns and underscores the importance of digital literacy. Furthermore, the psychological aspects of information processing, including emotional responses to health information, have been shown to significantly influence PVT (Okada et al., 2023).

Consistent exposure to information provides a comparative advantage in healthcare, enhancing individuals' abilities to manage their well-being. Informed individuals are more proficient in making appropriate decisions concerning self-protection. Recognizing the benefits of self-protection leads to heightened motivation for practicing such behaviors. Proactively managing health conditions assists in planning effective disease prevention strategies, leading to improved health and a strengthened immune system. The working-age population's awareness of the disease's severity influences changes in health behavior,

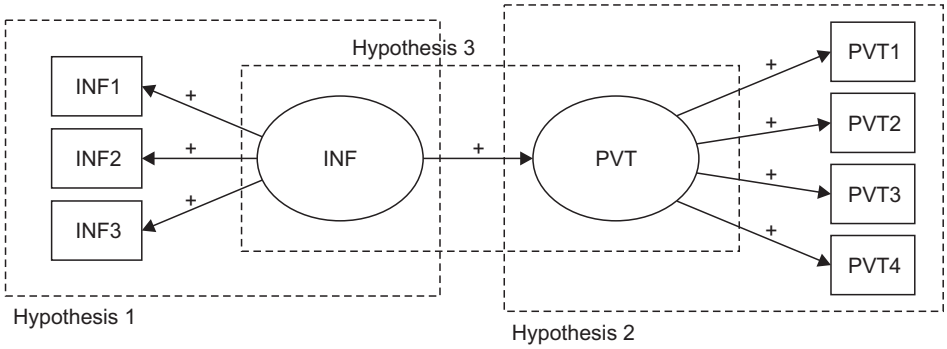


Fig. 1. Hypotheses between information perception and preventive behavior of COVID-19. INF, information perception; INF1, information exposure; INF2, interpretation; INF3, information retention; PVT, preventive behavior; PVT1, hygiene; PVT2, prevention of spread; PVT3, maintaining good health; PVT4, digital way of life.

necessitating lifestyle adjustments, especially for those in Bangkok and the metropolitan area facing heightened infection risks. This underscores the need for evolving public health initiatives to maintain positive behavioral shifts, emphasizing the integration of informed decision-making, collective responsibility, and technological advancement for a resilient health-conscious society amidst COVID-19.

3. RESEARCH HYPOTHESES

Examining the causal relationship between INF and PVT began with exploring correlation patterns among observed variables. Confirmatory factor analysis (CFA) was then utilized to validate the measurement models for each latent variable. Based on the research framework in Fig. 1, hypotheses were developed as following:

H1: INF explains a set of dependent variables comprising information exposure, interpretation, and information retention.

H2: PVT explains a set of dependent variables comprising hygiene, prevention of spread, maintaining good health, and digital way of life.

H3: INF influences PVT.

4. METHODOLOGY

A cross-sectional study was conducted in Thailand, focusing on working-aged individuals aged 18 to 59, comprising a total population of 10,872,100 residing in Bangkok and its surrounding metropolitan area (National Statistical Office of Thailand, 2021). The metropolitan area includes Nakhon Pathom, Nonthaburi, Pathum Thani, Samut Prakan, and Samut Sakhon provinces. The sample size was 421 individuals, which exceeds the minimum indicated in Krejcie and Morgan (1970) determining a sample size table. A convenience sampling method was used to recruit participants. An online structured questionnaire was provided using Google Forms and distributed via social media to citizen groups in each province, aiming to accurately represent demographic diversity. To collect data for this study, an online survey was undertaken from January to February 2023. This study has been certified as conforming to human research ethics by the Human Research Ethics Committees of the University (code SWUEC/E/G-197/2022).

4.1. Instrument

The research tool was a questionnaire divided into four sections: The first section included the respondents' demographic and general information, the second section comprised INF related information, the third section contained PVT of COVID-19, and the last section included an open-ended question for additional suggestions. Five-point Likert scales ranging from 1 to 5 were used to rate each question in Section 2 and Section 3, where 5=highest, 4=high, 3=moderate, 2=low, and 1=lowest.

4.2. Validity and Reliability

The questionnaire was evaluated by three experts to check the qualification by calculating Index of Item Objective Congruence (IOC). The IOC results ranged from 0.67 to 1.00. The survey questionnaire was then adjusted according to the experts' recommendations. Next, reliability testing was validated from gathering 42 data sets using Cronbach's alpha as a measure of consistency, and determining how closely related a set of items are as a group. The Cronbach's alpha for each construct was higher than the recommended level at 0.70 (Cortina, 1993). The values ranged from 0.744 to 0.920, indicating accepted reliability of the research measurement tool. Table 1 presents the results of good convergent reliability.

4.3. Data Analysis

The researchers initially analyzed the collected data using descriptive statistics to understand basic sample characteristics and respondent demographics. Mean and standard deviation calculations were employed to assess INF and PVT against COVID-19. Structural equation modeling (SEM) was then applied to explore the relationship between these variables among working-age individuals in the Bangkok and metropolitan area. Pearson's correlation coefficient was utilized to quantify associations. Additionally, Bartlett's test of sphericity and Kaiser-Meyer-Olkin (KMO) were used to evaluate variable appropriateness,

Table 1. Reliability statistics

Variable	Description	Cronbach's alpha
INF1	Information exposure	0.854
INF2	Interpretation	0.827
INF3	Information retention	0.826
PVT1	Hygiene	0.856
PVT2	Prevention of spread	0.920
PVT3	Maintaining good health	0.816
PVT4	Digital way of life	0.744

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Table 2. Respondents' demographic information

Characteristic	Category	Frequency	Percentage
Working area	Bangkok	295	70.1
	Metropolitan area	126	29.9
Sex	Male	228	54.2
	Female	193	45.8
Age group (yr)	18-24	48	11.4
	25-31	102	24.2
	32-38	55	13.1
	39-45	83	19.7
	46-52	57	13.5
	53-59	76	18.1
COVID-19 vaccine (dose)	≥4	206	48.9
	3	143	34.0
	2	63	15.0
	1	3	0.7
	None	6	1.4
History of COVID-19 addiction	Yes	264	62.7
	No	157	37.3

and CFA was conducted to assess questionnaire validity within the AMOS version 21.0 (IBM Corp., Armonk, NY, USA). Finally, the causal model was adjusted to ensure its fit with the empirical data, depicting the relationships between INF and PVT against COVID-19.

5. RESULTS

5.1. Descriptive Statistics

Table 2 demonstrates the demographic profiles of the respondents. Out of 421 respondents, 295 (70.1%) worked in Bangkok and 126 (29.9%) worked in the metropolitan area. Regarding sex, 228 (54.2%) were male and 193 (45.8%) were female. Regarding the age group, 48 (11.4%) were aged 18-24 years, 102 (24.2%) were aged 25-31, 55 (13.1%) were aged 32-38, 83 (19.7%) were aged 39-45, 57 (13.5%) were aged 46-52, and 76 (18.1%) were aged 53-59. At the time the data was collected, 206 (48.9%) had received at least four vaccine dosages, 143 (34.0%) had received three dosages, 63 (15.0%) received two dosages, 3 (0.7%) received one dosage, and 6 (1.4%) had never received the vaccine. From 421 respondents, 264 (62.7%) had been previously diagnosed with COVID-19.

According to a preliminary summary of INF channels presented in Table 3, the majority of participants (78.1%) obtain information through Facebook, followed by television (72.0%) and personal sources such as friends and

Table 3. Channels of information perception

Channels of information perception	Percentage
Television	72.0
Radio	18.3
Podcasts	9.5
Books and magazines	13.1
Journals/articles	10.7
Newspapers	13.5
Websites/webpages	51.5
Line	56.1
Facebook	78.1
Twitter	32.8
Instagram	29.2
TikTok	30.4
YouTube	47.3
Personal sources, e.g. friends, family	56.3

family (56.3%). Analysis of Table 4 revealed that participants demonstrated a high level of INF regarding COVID-19, both overall and in each component. The highest mean value for information exposure was observed in perceiving COVID-19 from various channels such as social media, television, and radio ($\bar{x}$=4.28). In the area of information interpretation, participants demonstrated a strong understanding of how to wash their hands cor-

Table 4. Information perception of COVID-19

Information perception of COVID-19	$\bar{x}$	Standard deviation
Information exposure		
You are consistently open/exposed to getting information about COVID-19	4.01	0.57
You are willing to receive information on COVID-19 that may be useful to you	4.14	0.71
You are able to obtain information fast and easily	4.26	0.70
You specify that you only want to get COVID-19 information that interests you	4.03	0.76
You can get information on COVID-19 from the World Health Organization, the Ministry of Health, or other relevant organizations	3.97	0.84
You can perceive/receive information about COVID-19 through a variety of channels, including social media, television, and radio	4.28	0.72
Exposure to COVID-19-related material will cause stress and anxiety	3.37	1.05
Total	4.00	0.57
Interpretation		
You evaluate the credibility of COVID-19-related information	4.02	0.77
You can evaluate the trustworthiness of COVID-19 information sources	4.04	0.73
You do not believe information about COVID-19 without a reference	4.04	0.92
You can evaluate the facts of COVID-19 information	3.96	0.69
You collect information on COVID-19 disease that is similar or goes in the same direction, such as material from the World Health Organization Ministry of Public Health, and use it as a guideline for protecting yourself	4.03	0.74
You can synthesize new information about COVID-19 and relate it to the situation around you	4.02	0.72
You know what you should do if you feel sick	4.28	0.65
You understand how to wear a face mask appropriately	4.40	0.64
You understand how to wash your hands correctly	4.45	0.64
You understand how to promote hygiene, such as eating hot food, avoiding using a shared spoon, and washing your hands	4.40	0.65
You understand the guidelines of conduct after having close contact with patients or people at risk of COVID-19 infection	4.37	0.65
Total	4.18	0.52
Information retention		
You obtain a better understanding by watching/using a variety of educational materials (such as pictures, infographics, and videos)	4.24	0.70
You understand how to conduct yourself and deal with troubles affected by the COVID-19 situation	4.23	0.62
You can apply the guidelines to lower the risk of COVID-19 infection in your everyday routine	4.32	0.65
With your knowledge and experience, you can safely protect yourself from COVID-19	4.36	0.65
Total	4.28	0.55
All totals	4.14	0.47

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rectly ($\bar{x}$=4.45), and information retention indicated that with knowledge and experience, people can safely protect themselves against COVID-19 ($\bar{x}$=4.36). Furthermore, the outcomes of PVT indicated very high levels overall ($\bar{x}$=4.21), whereas prevention of spread behavior had the highest mean value ($\bar{x}$=4.27).

5.2. Model Verification

Table 5 shows the mean and standard deviation of each observed variable. The proposed model was initially evaluated by correlation analysis. Table 6 shows the correlation matrix of all observed variables. The statistically significance level of 0.01 implied high correlations of the variables. The highest value was the correlation between interpretation (INF2) and information retention (INF3) (r=0.771), and the lowest value was the correlation between information exposure (INF1) and digital way of life (PVT4) (r=0.442).

Preliminarily, KMO was used to examine the strength of the partial correlation and the Bartlett's test of sphericity was used to analyze the factorability of the data. The value of KMO was 0.873, which implied sampling adequacy, and the chi-square was 1,801.084. From Bartlett's test of sphericity, degree of freedom was 21 and the p-value was 0.000, which is less than the significance level of 0.001. This indicated the positive correlations of the variables. Therefore, the data can be used to conduct CFA to verify factor structures of (1) INF as shown in Table 7, and (2) PVT as shown in Table 8.

The measurement model of INF factor indicated the statistics as follows: χ^2=0.005, df=1, relative χ^2=0.005, p=0.946, root mean square error of approximation (RMSEA)=0.000, root mean square residual (RMR)=0.000, goodness of fit index (GFI)=1.000, normed fit index (NFI)=1.000, Tucker-Lewis index (TLI)=1.005, and comparative fit index (CFI)=1.000. It implied that INF was measured from information exposure (INF1), interpretation (INF2), and information retention (INF3).

The measurement model of PVT factor indicated the statistics as follows: χ^2=1.628, df=1, relative χ^2=1.628,

Table 5. Descriptive statistics of latent variables

Variable	N	Minimum	Maximum	Mean	Standard deviation
INF1	421	2.29	5.00	4.007	0.575
INF2	421	2.91	5.00	4.181	0.521
INF3	421	3.00	5.00	4.286	0.556
PVT1	421	1.20	5.00	4.236	0.555
PVT2	421	2.17	5.00	4.274	0.576
PVT3	421	2.00	5.00	4.148	0.623
PVT4	421	1.57	5.00	4.213	0.537

INF1, information exposure; INF2, interpretation; INF3, information retention; PVT1, hygiene; PVT2, prevention of spread; PVT3, maintaining good health; PVT4, digital way of life.

Table 6. Correlation matrix

	INF1	INF2	INF3	PVT1	PVT2	PVT3	PVT4
INF1	1						
INF2	0.604[a)]	1					
INF3	0.486[a)]	0.771[a)]	1				
PVT1	0.457[a)]	0.530[a)]	0.558[a)]	1			
PVT2	0.481[a)]	0.569[a)]	0.600[a)]	0.728[a)]	1		
PVT3	0.475[a)]	0.452[a)]	0.493[a)]	0.606[a)]	0.712[a)]	1	
PVT4	0.442[a)]	0.598[a)]	0.550[a)]	0.619[a)]	0.686[a)]	0.653[a)]	1

INF1, information exposure; INF2, interpretation; INF3, information retention; PVT1, hygiene; PVT2, prevention of spread; PVT3, maintaining good health; PVT4, digital way of life.
[a)]Correlation is significant at the 0.01 level (2-tailed).

Table 7. Confirmatory factor analysis of INF (information perception)

Variable	Information perception			R^2
	β_i	b_i	Standard error	
INF1	0.616[a)]	0.693[a)]	0.038	0.379
INF2	0.981[a)]	1.000[a)]	-	0.963
INF3	0.786[a)]	0.855[a)]	0.045	0.618
χ^2=0.005, df=1, relative χ^2=0.005, p=0.946, RMSEA=0.000, RMR=0.000, GFI=1.000, NFI=1.000, TLI=1.005, CFI=1.000				

INF1, information exposure; INF2, interpretation; INF3, information retention; RMSEA, root mean square error of approximation; RMR, root mean square residual; GFI, goodness of fit index; NFI, normed fit index; TLI, Tucker-Lewis index; CFI, comparative fit index.
[a)]p<0.001.

Table 8. Confirmatory factor analysis of PVT (preventive behavior)

Variable	Preventive behavior			R^2
	β_i	b_i	Standard error	
PVT1	0.798[a)]	0.844[a)]	0.042	0.637
PVT2	0.912[a)]	1.000[a)]	-	0.832
PVT3	0.775[a)]	0.919[a)]	0.050	0.601
PVT4	0.758[a)]	0.776[a)]	0.043	0.575
χ^2=1.628, df=1, relative χ^2=1.628, p=0.202, RMSEA=0.039, RMR=0.002, GFI=0.998, NFI=0.998, TLI=0.996, CFI=0.999				

PVT1, hygiene; PVT2, prevention of spread; PVT3, maintaining good health; PVT4, digital way of life; RMSEA, root mean square error of approximation; RMR, root mean square residual; GFI, goodness of fit index; NFI, normed fit index; TLI, Tucker-Lewis index; CFI, comparative fit index.
[a)]p<0.001.

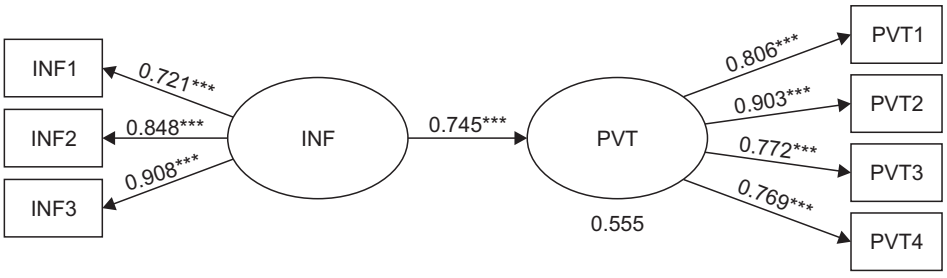


Fig. 2. Structural equation model between information perception and preventive behavior of COVID-19. χ^2=10.434, df=10, relative χ^2=1.043, p=0.403, RMSEA=0.010, RMR=0.005, GFI=0.993, NFI=0.994, TLI=0.999, CFI=1.000. INF, information perception; INF1, information exposure; INF2, interpretation; INF3, information retention; PVT, preventive behavior; PVT1, hygiene; PVT2, prevention of spread; PVT3, maintaining good health; PVT4, digital way of life; RMSEA, root mean square error of approximation; RMR, root mean square residual; GFI, goodness of fit index; NFI, normed fit index; TLI, Tucker-Lewis index; CFI, comparative fit index. ***p<0.001.

p=0.202, RMSEA=0.039, RMR=0.002, GFI=0.998, NFI=0.998, TLI=0.996, and CFI=0.999. It inferred that PVT was found in hygiene (PVT1), prevention of spread (PVT2), maintaining good health (PVT3), and digital way of life (PVT4).

5.3. Findings of the Proposed Model

Fig. 2 illustrates the causal relationship between INF and PVT, analyzed using a SEM. The analysis shown in Table 9 confirms the construct validity of the measurement model, as all the fitness indexes meet the required thresholds. The relative chi-square (chi-square/df) was 1.043, achieving the threshold of less than 3.0. The likeli-

Table 9. Fitness indexes of measurement model

Index name	Index value	Level of acceptance
Relative chi-square	1.043	Chi-square/df<3.0
p-value	0.403	p-value>0.05
Goodness of fit index (GFI)	0.993	GFI>0.90
Comparative fit index (CFI)	1.000	CFI>0.90
Root mean square error of approximation (RMSEA)	0.010	RMSEA<0.08

Table 10. Research findings

	Hypothesis	β	Standard error	T-value	p-value
H1	Information perception → Information exposure	0.721	0.058	14.149	<0.001[a)]
H1	Information perception → Interpretation	0.848	0.045	19.385	<0.001[a)]
Control	Information perception → Information retention	0.908	-	-	-
H2	Preventive behavior → Hygiene	0.806	0.041	20.807	<0.001[a)]
Control	Preventive behavior → Prevention of spread	0.903	-	-	-
H2	Preventive behavior → Maintaining good health	0.772	0.048	19.385	<0.001[a)]
H2	Preventive behavior → Digital way of life	0.769	0.042	18.978	<0.001[a)]
H3	Information perception → Preventive behavior	0.745	0.051	15.149	<0.001[a)]

[a)]p<0.001.

hood ratio (p-value) was greater than 0.05, which indicated the validation of the measurement model and good fitness with empirical data. GFI was 0.993 and the CFI was 1.000, both of which achieved the threshold of greater than 0.90. RMSEA was 0.010, which achieved the threshold of less than 0.08.

The results of the SEM in Table 10 confirmed that INF explained a set of dependent variables comprising information exposure ($\beta_{INF\rightarrow INF1}$=0.721), interpretation ($\beta_{INF\rightarrow INF2}$=0.848), and information retention ($\beta_{INF\rightarrow INF3}$=0.908). PVT explained a set of dependent variables comprising hygiene ($\beta_{PVT\rightarrow PVT1}$=0.806), prevention of spread ($\beta_{PVT\rightarrow PVT2}$=0.903), maintaining good health ($\beta_{PVT\rightarrow PVT3}$=0.772), and digital way of life ($\beta_{PVT\rightarrow PVT4}$=0.769). Therefore, hypotheses H1 and H2 were confirmed. Finally, INF ($\beta_{INF\rightarrow PVT}$=0.745) was a significant predictor of PVT to explain 55.5% of its variance. This supported hypothesis H3.

6. DISCUSSION

This study empirically tested the causal relationship between INF and PVT regarding COVID-19. The results revealed significance in the CFA and showed that the model was suitable for the investigation's purpose. The findings led to the inference that the two factors chosen, INF and PVT, summarized the evidence of observed variables sought in the survey. The dependent variable of the model was the PVT of COVID-19 (PVT), and the independent variable was the INF. PVT of participants regarding COVID-19 consisted of hygiene (PVT1), prevention of spread (PVT2), maintaining good health (PVT3), and digital way of life (PVT4). The factor of INF comprised three items: information exposure (INF1), interpretation (INF2), and information retention (INF3).

INF significantly influenced PVT (β=0.745, p<0.001). This was supported by theories in earlier research. Ample evidence showed that people make decisions based on perceived information (Riva et al., 2015). Thus, INF demonstrated the level of individual health literacy. Perceived information in terms of severity and susceptibility reinforces PVT (Nazione et al., 2021). Understanding health information and the contexts in which they occur would lead to appropriate behaviors in order to achieve healthy routines and disease prevention (Rayani et al., 2021).

In addition, following the onset of COVID-19, the health practices and PVT of Thai people have undergone changes to adapt to the new normal, including practices

such as hand hygiene, mask-wearing, social distancing, maintaining good health, and utilizing digital transactions to prevent virus exposure. These changes reflect the PVT relevant to COVID-19, which include hygiene, prevention of virus spread, health maintenance, and the integration of digital practices into daily life (Suanrueang et al., 2022). The first component of PVT was hygiene: hand hygiene, food hygiene, and hygienic masks have been basic protection recommendations for COVID-19 prevention (Alzyood et al., 2020; Finger et al., 2021). This approach can mitigate the exposure to infection transmission (Jantunen, 2022). The second component was prevention of spread. Even with widespread vaccine adoption, other protective behaviors, e.g., distancing, should be done in parallel to mitigate the risk of COVID-19 (Hall et al., 2023). Next, activities to maintain good health, such as exercise, sleep quality, and relaxation, promoted a healthy immune system. The last component of COVID-19 PVT was digital way of life, such as online activities. This approach can reduce physical contact and transmission of the virus. Among the variables of PVT, the prevention of spread (PVT2) had the highest factor loading at 0.903.

Furthermore, the components of INF include information exposure, interpretation, and information retention. The process initially begins with exposure, as individuals tend to select information that reinforces existing attitudes (Liao & Fu, 2013). Subsequently, information interpretation involves accessing various relevant sources to address knowledge gaps (Sangrar et al., 2021). This step entails identifying subjects, patterns, or connections within the data and using critical thinking, analysis, and evaluation to draw conclusions or make judgments, ultimately leading to a deeper understanding of COVID-19 phenomena. During crises, interpretation relies heavily on trust in information, sources, and public authorities (Moreno et al., 2020). Finally, information retention refers to the ability to recall previously encountered information, which is crucial for retaining knowledge and skills over time (Townshend et al., 2023). Among the variables of INF, retention (INF3) had the highest factor loading at 0.908, followed by interpretation (INF2) at 0.848 and exposure (INF1) at 0.721. These findings suggest that not only clear and accurate information distribution but also how individuals perceive and interpret this information are crucial in shaping COVID-19 PVT. Recognizing these factors can inform interventions aimed at fostering positive health behaviors and mitigating COVID-19 spread.

7. CONCLUSION

This research has demonstrated a significant correlation between INF and PVT in response to COVID-19 among the working-age population in Bangkok and the metropolitan area. Based on statistical analysis of the findings, all hypotheses were confirmed. The findings highlight that effective information dissemination and interpretation play a pivotal role in influencing PVT. This study underscores the importance of tailored public health messaging and interventions that take into account the cultural and contextual nuances of INF. The results advocate for ongoing efforts to provide clear, credible, and contextually relevant information to the public, thus enhancing their capacity for informed decision-making and engagement in PVT.

Based on the results, the process of INF has a positive impact on people's preventative health behaviors. While this study was conducted in Bangkok and the metropolitan area, its findings may have broader implications for public health policy beyond Thailand. The results can be beneficial for Thai local governments and health organizations in other countries. Many countries recognize the importance of self-care for health and include it in their health literacy strategies. Consequently, these organizations should prioritize strategic health information provision, health promotion, and the dissemination of high-quality health information to the public via multiple channels. This includes providing engaging materials, making authoritative sources more accessible, and improving public engagement. Such efforts will enable people to understand essential health knowledge and apply it to promote their own and their families' health. This approach can lower the risk of misinformation, prevent careless health practices, and potentially reduce future medical issues.

CONFLICTS OF INTEREST

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

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From Crisis to Transformation: Lessons Learned and Recommendations for LIS Graduate Programs in Thailand Post-Pandemic

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ABSTRACT

This study aims to investigate the management of library and information science (LIS) graduate programs in Thailand during the COVID-19 pandemic and highlights the challenges faced by the programs' chairs, faculty members, and graduate students during these unsettling times. This study employed a qualitative approach and used semi-structured interview protocols for data collection. A total of fifty-five participants, comprising five LIS graduate program chairs, ten faculty members, and thirty-nine graduate students, actively participated in the study. Content analysis was then utilized to analyze the interview transcripts, and the results were subsequently summarized into several themes. Based on the results, this research proposes that hybrid learning is applicable for the advancement of LIS graduate programs in the post-pandemic era. Additionally, creating more effective online teaching and learning environments and expanding collaborative teaching and learning networks are essential for the success of the programs.

Keywords: library and information science graduate programs, library and information science education, COVID-19, teaching and learning, Thailand

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1. INTRODUCTION

The COVID-19 pandemic has significantly affected education at all levels, promoting a rapid shift to online learning. Many higher education institutions (HEIs) adopted fully online teaching and learning right from the beginning (Majanja, 2020; Marinoni et al., 2020; Panganayi, 2020). Subsequently, some institutions later opted for a blended or hybrid learning approach as a solution for delivering online teaching and learning during the second wave of the pandemic (Abdrasheva et al., 2022; Sukiman et al., 2022; United Nations Educational, Scientific and Cultural Organization, 2020). However, the International Association of Universities reported that, while 67% of HEIs successfully offered online teaching and learning, the remaining institutions encountered difficulties. In fact, 24% of HEIs had to suspend certain classes, and 7% reported a complete halt in teaching during this period. Only 2% of the participating HEIs stated that teaching and learning activities in their institutions remained unaffected by the pandemic (Marinoni et al., 2020).

The main challenges in transitioning from face-to-face classrooms to an online approach include the general lack of technical capabilities and infrastructure, the absence of necessary pedagogical approaches for online teaching, and the specific demands of individual disciplines due to their distinct requirements (Marinoni et al., 2020). Abdrasheva et al. (2022) comprehensively identified various challenges faced by educators in online learning environments, including instructors' technological unpreparedness, insufficient alternative pedagogical strategies, difficulties in online assessment, digital divide concerns, and students' adaptability and competence in the online learning environment. Several challenges also directly affect learners. Notable considerations include students' attitudes toward online learning, the scarcity of support and accessibility to academic resources, students' unfamiliarity with online learning technologies, and their struggle to maintain focus during online sessions (Patricia Aguilera-Hermida, 2020). It can be seen that, during the pandemic, both instructors and learners were abruptly forced to transition to an online learning environment without prior preparation, resulting in numerous challenges and issues.

Library and information science (LIS) schools worldwide have encountered significant disruptions due to the COVID-19 pandemic, a trend extensively documented in literature. A substantial volume of research in the LIS field has focused on the pandemic's impact and has been disseminated across various publications. Sheikh et al. (2023) have identified five research themes emerging over the past two years of the pandemic: libraries and services, library management, libraries and technology, libraries and information society, and libraries and education. Much of this research concentrates on LIS education and professions during the pandemic, generally examining experiences (Aslam et al., 2021; Craft, 2020; Landoy & Færevaag, 2020; Majanja, 2020; Willenborg & Withorn, 2021), perceptions (Boté-Vericad, 2021; Shastri & Chudasma, 2022), as well as challenges and opportunities encountered by LIS scholars, students, and professionals (Ocholla, 2021; Simpson, 2020). Furthermore, other research within the realm of LIS education has revolved around online teaching and learning, online pedagogical issues, and information and digital literacy, all of which are pivotal to the evolving learning landscape (Sheikh et al., 2023).

Despite the profound impact the pandemic has had on LIS education worldwide, it has also sparked a crucial discourse on LIS education and management amid these uncertain times. Engaging in this discourse is essential to address questions concerning the future of LIS schools and how they should navigate the challenges arising from the pandemic. In Thailand, Somabut and Tuamsuk (2021)'s study explicitly summarized and proposed factors for developing an online teaching and learning ecology in HEIs during the COVID-19 outbreak. However, their study primarily focused on the broader context, and specifically, research on the LIS education program is limited. Therefore, the objective of this study is to investigate the management of LIS graduate programs in Thailand during the COVID-19 pandemic. The goal is to gather pertinent information about the experiences and challenges faced by LIS graduate programs' chairs, faculty members, and graduate students amid the pandemic. Additionally, the study will present recommendations and potential solutions to assist LIS programs in managing unprecedented challenges triggered by the pandemic and in preparing for future management of LIS graduate programs.

2. LITERATURE REVIEW

The literature review in this study has covered topics regarding higher education in Thailand and the pandemic, and online learning and LIS education during the pandemic.

2.1. Higher Education in Thailand and the Pandemic

In Thailand, the initial case of COVID-19 was officially reported on January 13, 2020, which prompted the

government of Thailand to declare a state of emergency (World Health Organization, 2020). HEIs had to shift to a full online approach starting April 1, 2020 (Ministry of Higher Education, Science, Research, and Innovation, 2020). Studies during the pandemic focused on the readiness of faculty members and students in many disciplines to adopt online learning in the Thai context. Those studies revealed major challenges of online learning in higher education at the beginning of the transitional period (Imsa-ard, 2020; Puriwat & Tripopsakul, 2021; Saetae, 2021; Somabut, 2020; Somabut & Tuamsuk, 2021; Thanavisuth, 2021). For instance, Somabut and Tuamsuk (2021) addressed the difficulty that the majority of Thai universities lacked the necessary online infrastructure and facilities, leaving both instructors and students unprepared for a swift transition to online education. Universities were required to rapidly respond to this unexpected situation by upgrading technological infrastructure, procuring and developing online platforms, and providing online training for both instructors and students.

Many studies have uncovered differences in perspectives between faculty members and students concerning the abrupt transition to online learning. These studies primarily assess instructors' current statuses and their viewpoints on online tools and techniques in knowledge delivery. The findings of several studies reveal variations in faculty members' preferences and instructional approaches. While some instructors expressed a preference for conducting live online sessions through video conferencing and learning platforms, others chose to provide pre-recorded lessons (Imsa-ard, 2020; Puriwat & Tripopsakul, 2021; Saetae, 2021; Somabut & Tuamsuk, 2021; Thanavisuth, 2021). Additionally, some instructors adopted a combination of techniques for managing online classes and prominent online learning platforms, including Zoom, Google Meet, Microsoft Teams, and WebEx, and some faculty members used social media platforms, including Facebook and Line, to distribute lecture materials and communicate with students (Saetae, 2021; Somabut, 2020). Interestingly, one study asserts that pedagogy for online instruction closely resembles the traditional face-to-face approach, with faculty members continuing to rely on lectures and providing similar learning materials such as slides, handouts, and retrieved documents during virtual classes (Somabut & Tuamsuk, 2021).

Online learning offers undergraduate students certain advantages, such as the convenience of staying at home, the ability to record class sessions for later review, and the flexibility to learn at their own pace (Thanavisuth, 2021). However, this mode of education comes with its own challenges. Students have reported encountering technical difficulties, distractions during online classes, communication obstacles, feelings of isolation, limited interaction with peers and instructors, and struggles with motivation when studying online (Imsa-ard, 2020; Thanavisuth, 2021). Importantly, students emphasize the importance of accessible instructors who provide effective feedback and guidance during and after online sessions (Imsa-ard, 2020; Puriwat & Tripopsakul, 2021; Thanavisuth, 2021). To enhance the quality of online learning and establish an efficient virtual classroom, it is crucial to develop well-designed course content, provide adequate administrative and technical support, and consider the unique characteristics and competencies of both learners and instructors (Puriwat & Tripopsakul, 2021).

During the pandemic, although several studies have been carried out to outline the readiness of faculty members and students in many disciplines to adopt online learning platforms, there are limited research regarding the management of LIS education and LIS faculty members' and students' perspectives on online learning during the pandemic in Thailand.

2.2. Online Learning and LIS Education

Online learning is a mode of instruction delivered through electronic means over the Internet, utilizing various digital platforms. Nguyen (2015) categorizes this educational approach into two formats: purely online learning, and hybrid or blended learning, which combines traditional face-to-face classes with online components. Notably, online learning has a well-established presence in LIS education, particularly in developed countries such as the United States, the United Kingdom, and European nations (Chowdhury & Chowdhury, 2006; Oguz et al., 2015). This pedagogical method has been integrated into LIS education for many years, as underscored by the Association for Library and Information Science Education (2021), with nearly all LIS schools in their study offering some forms of online instruction. Remarkably, 20% of American Library Association accredited schools in the United States and Canada have already integrated fully online classes into their curriculums.

In Thailand, there are nine LIS graduate programs offered by six universities, comprising five autonomous universities and one open university. The master's programs consist of four masters of arts (M.A. in information studies) and two masters of information science. Meanwhile, the doctoral programs include two Ph.D. programs, with

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two focusing on information studies and one on information science. Before the onset of the COVID-19 pandemic, all LIS graduate programs in Thailand primarily operated through face-to-face instruction.

However, the pandemic has forced a major shift in content delivery methods. In response to the Thai Government's directive for HEIs at the time to transition to fully online operations, online learning, whether synchronous or asynchronous, emerged as the predominant pedagogical approach across all levels of LIS education. Notably, online learning extended beyond traditional teaching and learning activities, encompassing professional development initiatives within the LIS field. During the pandemic, numerous national and international online conferences and webinars in various topics were organized by LIS schools, libraries, and professional organizations. These endeavors aimed to promote lifelong learning and information literacy, bolster professional development, and nurture professional networks, fostering the growth of LIS initiatives during the pandemic. For instance, since September 2020, International Federation of Library Associations and Institutions (IFLA) has conducted a series of webinars on various topics related to how libraries respond to and facilitate access to information during the pandemic (Gigabit Libraries Network, 2020; IFLA, 2020). In Thailand, the Thai Library Association and other professional networks and libraries have actively conducted a multitude of online activities encompassing a wide range of topics on online services, promoting relearning and reskilling, assessing the roles of libraries in online distance learning, and offering support to both professional development and online learning endeavors.

Online learning has emerged as a valuable and appropriate instructional method, both during the pandemic and beyond. Its merits encompass cost-effectiveness, flexibility, convenience, time-saving features, and the potential for collaborative learning. Moreover, the availabilities of synchronous and asynchronous teaching methods grant 24/7 online access to learning platforms (Almahasees et al., 2021; Ibna Seraj et al., 2022). According to Ibna Seraj et al. (2022), most teachers and students across various disciplines worldwide have had positive experiences with online learning. Similarly, studies conducted within the LIS field also reveal a preference for online learning among both faculty members and students. For instance, Bankole (2022) investigated the adoption of online learning among LIS undergraduate students in Nigeria, finding that the majority of students expressed high levels of satisfaction. Students particularly appreciated the flexibility of learning anytime and anywhere, as well as the effective time management facilitated by online education. Additionally, LIS faculty members in some regions have reported positive feedback regarding the benefits of delivering practical courses online. For instance, in Indonesia, faculty members found that the digital hands-on experience not only promoted learning but also enhanced digital competency among students. This was achieved through the application of digital skills, online presentation skills, and online event management skills in showcasing online cultural exhibitions (Zain et al., 2022). Besides this, several studies have highlighted the potential of online learning to foster collaborative learning environments (Mustakim et al., 2021; Zain et al., 2022).

Online distance learning is widely recognized as a prevalent mode of education today. However, it presents distinct challenges, including technical infrastructure limitations, insufficient technological proficiency among both instructors and students, difficulties related to hands-on training and practicum experiences, and emotional stress associated with self-directed learning. Notably, issues with technology and inadequate skills are frequently observed in online learning environments, as highlighted in various studies (Abdrasheva et al., 2022; Igwela & Nsirim, 2020; Ocholla, 2021; Priyanto & Cahyaningtyas, 2021). For instance, Igwela and Nsirim (2020) found that while LIS educators expressed positive viewpoints towards e-learning at the beginning of the pandemic, they have been facing many challenges, including a lack of technical infrastructure, limited Internet connectivity, absence of pertinent policies and guidelines for implementing e-learning, and inadequate IT skills of both educators and students. Additionally, Ocholla (2021) and Poole and Zhang (2021) reported concerns among faculties regarding the feasibility of teaching practical courses in online learning environments, especially for fields of archival education where hands-on experiences are crucial and challenging to replicate virtually.

The abrupt shift in pedagogical methods has heightened stress levels across the educational spectrum, particularly for educators and learners less accustomed to online teaching and learning. Several studies have documented increased stress in both educators and learners within the online learning context (Dey & Kumar, 2022; Ocholla, 2021; Poole & Zhang, 2021; Priyanto & Cahyaningtyas, 2021). This stress is not limited to LIS education but extends to related fields, such as archival science. For example, faculty members in the LIS field in the sub-Saharan African region reported increased workloads

and longer hours when transitioning to remote teaching, which resulted in burnout and frustration. These challenges were further compounded by limited interpersonal communication and social support, such as mentoring and guidance, as noted by Ocholla (2021). Similarly, the archival educators who shifted to fully online delivery faced increased workloads in monitoring online discussions and adapting content. Some educators noted that their students struggled with online platforms such as Zoom (Poole & Zhang, 2021).

LIS graduate students have also experienced frustration and difficulty concentrating on lessons in online settings, expressing a strong need for interaction and socialization with instructors and peers compared to traditional face-to-face classrooms (Priyanto & Cahyaningtyas, 2021). Moreover, concerns about family health, uncertain examination schedules, and fear of falling short of teacher expectations have contributed to stress levels, with more than 80% of students reporting that academic stress negatively impacted their performance (Dey & Kumar, 2022).

The success of online learning in LIS education is contingent upon a range of factors. These factors include the readiness of both faculty members and students, the availabilities of adequate technological infrastructure, the utilization of effective pedagogical approaches, and the willingness of both faculty members and students to embrace this mode of education. Comprehending the challenges faced during the pandemic and discerning the preferences of stakeholders can provide valuable insights for developing strategies to better manage LIS graduate programs in the future.

3. RESEARCH METHODOLOGY

This study employed a qualitative approach to investigate two primary aspects: 1) the management of LIS graduate programs in Thailand during the COVID-19 pandemic, and 2) the challenges encountered by LIS chairs, faculty members, and students of LIS graduate programs during the pandemic.

3.1. Participants

The study population encompassed graduate program chairs, LIS faculty members, and graduate students from six universities in Thailand, comprising five autonomous universities and one open university that offer LIS graduate programs, as listed in Table 1. Key informants were chosen through purposive sampling, employing specific criteria for selection, which encompassed individuals serving as current faculty members or graduate students at the time when the researchers gathered the data. While the invitations were sent to all of the graduate programs, only small numbers of LIS graduate program chairs, faculty numbers, and graduate students accepted participation in this research project. In total, there were nine chairs overseeing LIS graduate programs; nevertheless, only five of them (55.55%) took part in this study. The LIS faculty members were selected from 10 out of 29 (34.48%) LIS graduate program committees, and these individuals also undertake teaching responsibilities for their program. The total cohort comprised 221 LIS graduate students from nine universities, encompassing 28 Ph.D. students and 193 master's students. A minority of these individuals (39 LIS graduate students, 17.65%) from six universities agreed to serve as key informants.

3.2. Data Collection and Data Analysis

This study employed a qualitative approach and used semi-structured interview protocols for data collection. Three distinct semi-structured interview protocols were developed and utilized for data collection, corresponding to each group. The interview protocol for the program chairs primarily centered on the management of LIS graduate programs. Conversely, the interview protocols for LIS faculty members and graduate students focused more on the challenges they encountered and their strate-

Table 1. Overview of universities offering graduate programs in library and information science

Name of the university	Master's degree program	Doctoral degree program
Chiang Mai University	M.A. (Information Studies)	-
Chulalongkorn University	M.A. (Information Studies)	Ph.D. (Information Studies)
Khon Kaen University	M.I.S (Information Science)	Ph.D. (Information Studies)
Mahasarakham University	M.I.S (Information Science)	-
Srinakharinwirot University	M.A. (Information Studies)	-
Sukhothai Thammathirat Open University	M.A. (Information Studies)	Ph.D. (Information Science)

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gies for managing the situation. A pilot test was conducted with a small number of test participants to evaluate the semi-structured interview protocol, ensuring the credibility and dependability of this study. In order to optimize participants' time, the interview questions were sent to them in advance via email, allowing them sufficient time to contemplate the questions before the actual interview. The interviews were conducted in January 2022. Content analysis was utilized to thoroughly scrutinize the interview transcripts, subsequently organizing them into distinct thematic categories. As this study entailed translating interview transcripts from Thai to English, multiple researchers participated in reviewing both the transcripts and the identified themes to ensure the reliability of the findings. This process of researcher triangulation aimed to bolster the validity and credibility of the research findings by mitigating potential biases and errors that might arise from a singular researcher's perspective. To ensure confidentiality, the identities of both the participants and their respective institutions have been kept anonymous in the findings of this study.

4. RESEARCH FINDINGS

This section presents the study's findings in alignment with both the characteristics of the respondents and the study's objectives, encompassing:

1. The management of LIS graduate programs in Thailand during the COVID-19 pandemic.
2. Experiences and challenges of the participants during the pandemic.
3. Guidelines for managing LIS graduate programs in the post-pandemic.

The following descriptions provide details of these findings.

Table 2 presents the characteristics of the participants. The participants consisted of five chairs of LIS graduate programs from five universities and ten faculty members from six universities. The majority of both the LIS graduate program chairs and faculty members held Ph.D degrees (10, 66.67%), while a few chose not to disclose their educational qualifications. Regarding sex, the majority were female (7, 46.67%), followed by males (4, 26.67%). Four faculty members opted not to specify their sex.

Among the graduate student participants, 24 (61.54%) were doctoral students and 15 (38.46%) were master's students. Most of the doctoral students, 21 (53.85%), were engaged in their dissertations, followed by 10 (25.64%) master's students enrolled in coursework, 5 (12.82%) master's students involved in theses, and 3 (7.69%) doctoral students pursuing coursework. The distribution of the respondents by sex indicates that the highest number of responses (25, 64.10%) were from females, whereas 7 (17.95%) respondents were male, and the other 7 (17.95%) respondents preferred not to answer.

Table 2. Characteristics of the respondents

Characteristic	n (%)
LIS graduate program chairs and faculty members	
Position	
LIS graduate program chairs	5 (33.33)
Faculty members	10 (66.67)
Educational qualifications	
Ph.D	10 (66.67)
N/A	5 (33.33)
Sex	
Female	7 (46.67)
Male	4 (26.67)
N/A	4 (26.67)
Graduate students	
Educational qualifications	
Doctoral students	24 (61.54)
Dissertation	21 (53.85)
Coursework	3 (7.69)
Master's students	15 (38.46)
Thesis	5 (12.82)
Coursework	10 (25.64)
Sex	
Female	25 (64.10)
Male	7 (17.95)
N/A	7 (17.95)

LIS, library and information science; N/A, not answer.

4.1. The Management of LIS Graduate Programs in Thailand During the COVID-19 Pandemic

The findings regarding the management of LIS graduate programs during the COVID-19 pandemic were derived from interviews conducted with five chairs of LIS graduate programs. Participants disclosed that the

challenges they encountered during the pandemic were primarily related to technological infrastructure. In particular, respondents expressed concerns about adapting to the new mode of learning and the effectiveness of communication between faculty members and students. Four main themes emerged, encompassing technological infrastructure, policies for teaching and learning, learning platforms and communication channels, and extracurricular activities.

4.1.1. Technological Infrastructure

Technological infrastructure generally includes Internet connectivity, devices, and online learning tools. All of the program chairs mentioned that their universities and respective faculties were responsible for providing this infrastructure. Furthermore, they emphasized the importance of access to assistance and support when users encountered IT issues. The most common problems reported were unstable Internet connections, outdated computers, and insufficiently supported systems and licenses for large numbers of students. The following information provides more detailed explanations about the infrastructure.

"Some learning activities used to be organized on-site. Initially, some faculty members encountered difficulties in adapting to the online learning environment. Surprisingly, when we shifted to online activities, a significant number of graduate students displayed heightened interest in online activities compared to on-site ones." – LIS graduate program chair 2

"Readiness for both lecturers and students is imperative. Lecturers must improve their online teaching skills and encourage active engagement in online classes. The university lacks remote information technology (IT) support services; so students must address IT issues on their own. Maintaining a positive attitude towards online learning is essential for students." – LIS graduate program chair 4

4.1.2. Policies for Teaching and Learning

The findings unveiled that certain LIS graduate programs in Thailand had previously incorporated elements of blended or hybrid learning prior to the pandemic. Nevertheless, the predominant mode of instruction for most programs had been entirely face-to-face, with online learning used as a supplementary tool. In response to the pandemic, all of the universities temporarily closed their physical campuses and shifted to comprehensive online education. Due to the fluctuating nature of COVID-19 outbreaks, universities frequently updated their policies for resuming on-site instruction, sometimes reversing decisions. All of the chairs of LIS programs (5, 100%) agreed unanimously that the pandemic had impacted their programs, leading to changes in teaching and learning policies. These policies allowed instructors flexibility, enabling them to choose between on-site and online teaching. In cases of on-site teaching, both instructors and students were mandated to adhere strictly to the health and safety guidelines set by the Ministry of Public Health, Thailand. Some chairs of LIS graduate programs provided additional insights:

"The department's policy is in alignment with the university's policy, requiring approval from both the LIS program committees and the graduate school committees. At my university, all teaching and learning activities are required to be conducted entirely online." – LIS graduate program chair 2

"In March 2020, my university adopted a policy for 100% online teaching due to COVID-19. This policy addressed social distancing, safe measures, on campus protocols, and work-from-home guidelines. It underwent frequent revisions in line with circumstances and government directives." – LIS graduate program chair 3

4.1.3. Learning and Extracurricular Activities

LIS graduate programs in Thailand had consistently organized onsite extracurricular activities even prior to the COVID-19 pandemic. All of the LIS program chairs (5, 100%) indicated a shift towards online formats for both learning activities and extracurricular events. This transition included various activities such as online orientations, counseling sessions, proposal defenses, and thesis and dissertation defenses, as well as professional development events including online seminars and conferences. Due to the outbreak, many onsite extracurricular activities, including study visits to other LIS schools and information organizations on both national and international levels, had to be canceled. Two of the program's chairs provided further explanation:

"Postgraduate students are now required to enroll in a seminar course and submit progress reports for their postgraduate studies and/or doctoral dissertation, all of which have transitioned to online formats. Furthermore,

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consultations for dissertations and theses are also being conducted online." – LIS graduate program chair 5

"One of my graduate students received acceptance to present his paper at a national conference. Initially, I had concerns about his ability to attend the conference due to the ongoing outbreak. However, the conference eventually shifted to an online format conducted through Zoom." – LIS graduate program chair 3

4.1.4. Learning Platforms and Communication Channels

Various online learning platforms were adopted by LIS graduate program for both learning and communication between lecturers and students. The choice of platform varied among programs based on the available facilities and the preferences of both lecturers and students. Key platforms universally used included Microsoft Teams, Zoom, Google Classroom, and Facebook Messenger. Some programs subscribed to new online learning platforms, while others had already incorporated platforms such as Google Classroom, Google Meet, and Facebook Messenger (5, 100%) and Blackboard (2, 40.00%). Additionally, programs mentioned the use of other platforms such as Line Meeting, Webex Meet, Jamboard (Google), and Moodle. Certain learning platforms, such as Microsoft Teams, Zoom, and Google Meet served not only as virtual classroom tools but also for occasional lectures, seminars, and other academic activities. Below are examples of statements from the chairs of LIS graduate programs explaining their choices of learning platforms and communication channels during the COVID-19 pandemic.

"Before the pandemic, our university used Blackboard for teaching and learning. However, when the outbreak began, we implemented online exams using the Blackboard platform and obtained a Zoom subscription for delivering lectures and hosting online conferences." – LIS graduate program chair 3

"At my university, we offer access to Microsoft Teams, Zoom, and Jamboard (Google) for online learning and collaboration. However, the decision on which programs to be use is left to the discretion of the lecturers, taking into account their expertise and convenience." – LIS graduate program chair 4

4.2. Experiences and Challenges of the Participants During the Pandemic

The results for this section are organized according to participant groups, which consist of the chairs of LIS graduate programs, faculty members, and graduate students. The experiences and challenges faced by each group are outlined below.

4.2.1. The Chairs of LIS Graduate Programs and Faculty Members

The analysis of interview transcripts with the graduate program chairs and faculty members reveals several major themes, including technological issues and online learning challenges, as well as personal challenges, as presented in Table 3. These themes are elaborated upon, and illustrative quotes from the interview transcripts are provided in the following sections.

4.2.1.1. Technological Issues and Online Learning Challenges.

All of the program chairs and faculty members in this study reported that their LIS programs and graduate schools consistently provided training and online courses to familiarize them with online tools for teaching and learning purposes. These classes helped them to be acquainted with online tools. In accordance with the universities' policies during the COVID-19 outbreak, the faculty members were given flexibility to choose between on-site or online teaching. For onsite teaching, the faculty members were required to adhere to the health and safety standards established by the Ministry of Public Health. Moreover, they were able to use online learning tools that they were familiar with. They also had the option to use online learning tools they were comfortable with. Despite the provision of computer laboratories, computers, Internet connectivity, and IT technical support by all the universities in our study for both online and on-site teaching, program chairs and faculty members encountered several technological and online learning challenges. The top three issues mentioned by both groups were low quality of Internet connections (10, 66.67%), followed by preferring face-to-face instruction for practical courses (6, 40.00%), and insufficient IT infrastructure and equipment (5, 33.33%). The following quotes provide insight into the experiences of program chairs and faculty members regarding these challenges.

"Despite the university's ongoing efforts to enhance IT infrastructure in support of online learning and examina-

Table 3. Challenges and issues of the chairs and faculty members (n=15)

Theme	Chairs (n=5)	Faculty members (n=10)	Frequency	%
Technological issues and online learning challenges				
Low quality of Internet connection	5	5	10	66.67
Preferring face-to-face for practical courses	3	3	6	40.00
Insufficient IT infrastructure/equipment	2	3	5	33.33
Additional costs for high-capacity equipment and software licenses	2	2	4	26.67
Lack of skills to create instructional media	0	4	4	26.67
Unfamiliar with online learning technology/equipment	0	2	2	13.33
Lack of supporting academic resources	0	1	1	6.67
Insufficient IT skills	1	0	1	6.67
Difficulties adjusting to working and teaching online	0	1	1	6.67
Personal challenges				
Increased workloads	4	4	8	53.33
Lack of opportunities for social interactions with peers, students, and other LIS professionals	2	5	7	46.67
Experiencing a lack of student motivation to complete their thesis/dissertation	4	1	5	33.33
Time management issues	2	1	3	20.00
Health and mental issues: office syndrome	2	1	3	20.00
Difficulty maintaining work/life balance	2	1	3	20.00
Budget constraints	2	0	2	13.33
Inability to contact master's or doctoral students for supervision or guidance	1	1	2	13.33
Decline in research productivity	0	1	1	6.67
Lack of motivation to do research	0	1	1	6.67

IT, information technology; LIS, library and information science.

tions, issues related to online exams have been reported over the past two years." – LIS graduate program chair 2

"The faculty policies for graduate education at my institution grant the faculty members to teach both online and onsite. For online learning, while I have the option to conduct online classes using Cisco Webex and Google Classroom, I personally prefer to teach certain practical courses, such as research methodology, in an on-site format." – Faculty member 3

4.2.1.2. Personal Challenges.

The majority of participants (8, 53.33%) mentioned increased workloads as their primary challenge, followed by a lack of opportunities for social interactions with peers, students, and other LIS professionals (7, 46.67%), and students experiencing a lack of motivation to complete their theses/dissertations (5, 33.33%). Most program chairs and faculty members attributed their increased workloads to the transition to remote work and online working environments. Consequently, some of them (3, 20.00%) reported experiencing issues with time management, health concerns such as "office syndrome," and difficulty in maintaining a healthy work-life balance. The participants provided some explanations as follows:

"As a program chair, I often find myself managing teaching preparation, university board meetings, and online webinars simultaneously, which leads to increased stress. This stress is further compounded by the need to

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accommodate additional meetings with graduate students in my already packed schedule." – LIS graduate program chair 5

"In-person meetings with students are crucial for discussing complex research topics, as certain concepts and theories can be challenging to explain thoroughly online. The pandemic's social distancing measures have reduced my social interactions with colleagues and students, which is a significant concern. Moreover, not being able to reach one of my students has been a source of great distress." – Faculty member 10

"Amid the crisis, one of my students contracted the virus. She expressed a lack of motivation to continue in the program, citing her full-time job and health-related issues as significant challenges. Convincing her to complete her research and prepare for the final defense has proven to be a daunting task." – Faculty member 7

4.2.2. Graduate Students

The results for this section were derived from the interview scripts of 39 graduate students. An analysis of these transcripts uncovered three significant themes that participants encountered during the pandemic: technological issues and challenges with online learning, personal struggles, and challenges related to thesis and dissertation work, all detailed in Table 4. Each of these themes will be elaborated on in the subsequent sections, with supporting quotes from the interview transcripts.

4.2.2.1. Technological Issues and Online Learning Challenges.

The major challenges for most participants were technological issues and online learning challenges. Despite 21 participants (53.85%) reporting sufficient IT skills, slightly over half of them still favored face-to-face learning over online learning. Five participants pointed out that online learning was more suitable for theoretical courses, while they believed practical courses and other interactive learning activities should be conducted in-person. Issues with low quality of Internet connections were a common concern, mentioned by 18 students (46.15%) and 11 participants (28.21%) cited insufficient IT infrastructure and equipment as problematic, emphasizing the critical role of Internet quality and IT resources in effective online teaching and learning. Participants stated that these technological limitations had a distracting impact on their learning experiences. The following are some explanations about the problems associated with online learning.

"At first, I was struggling with the online learning system. Participating in online class and meeting via Zoom and MS Team was harder than being in face-to-face classes." – Graduate student 1

"It is easy to get distracted in online classes because of a low quality of Internet connection, which results in poor audio and picture quality. Sometimes, I cannot hear the lecturers well." – Graduate student 18

"The technical issues did not allow me to catch up with the lessons during online learning." –Graduate student 23

4.2.2.2. Personal Challenges.

The majority of participants (20, 51.28%) identified issues with time management as their primary challenge, followed by health and mental issues (12, 30.77%), lack of opportunities for social interactions with academic advisers, supervisors, and peers (11, 28.21), as well as difficulties in maintaining a work/life/school balance (9, 23.08%). Most graduate students in this study were working full-time. As a result, they reported that time management and health and mental issues as their major concerns. They also had to maintain their work/life balance, particularly those employed in hospitals or serving as university-level lecturers. These groups of students also mentioned additional situational challenges, such as difficulties concentrating while learning at home and increased workloads. Those who mentioned time management asserted that:

"I was faced with time management issues since I was working fulltime in a hospital. Therefore, I could not make learning and dissertation as my first priority." – Graduate student 1

"I work in a hospital and my workload during the pandemic burdened my study. Consequently, I could not pay attention to my thesis, particularly for data collection." – Graduate student 9

"I am a lecturer, who not only has to teach online but also provides community services during the COVID-19 outbreak to meet the university's key performance indicators. Working from home felt like a 24/7 job. Therefore, these duties affected my time management." – Graduate student 24

Table 4. Challenges and issues of library and information science graduate students (n=39)

Theme	Frequency	%
Technological issues and online learning challenges		
Preferring face-to-face for practical courses	21	53.85
Low quality of Internet connection	18	46.15
Insufficient IT infrastructure/equipment	11	28.21
Unfamiliar with online learning technology/equipment	7	17.95
Additional costs for high-capacity equipment and software licenses	7	17.95
Lack of supporting academic resources	7	17.95
Insufficient IT skills	6	15.38
Quality of online learning resources	5	12.82
Personal challenges		
Time management issues	20	51.28
Health and mental issues	12	30.77
Office syndrome	6	
Stress and anxiety related to work/study	3	
Burnout	3	
Lack of opportunities for social interactions	11	28.21
Difficulty maintaining work/life/school balance	9	23.08
Concentration difficulties learning at home	7	17.95
Increased workloads	7	17.95
Being distracted during online class	6	15.38
Financial distress	5	12.82
Thesis and dissertation-related challenges		
Limited access to library physical space	8	20.51
Minor change to research	5	12.82
Inability to collect data for thesis/dissertation	4	10.26
Lack of motivation to do research	4	10.26
Inability to contact research subjects directly	4	10.26
Lack of supervisor support due to communication issues	3	7.69
Ineffective time management for thesis/dissertation writing	2	5.13
Inability to finish thesis/dissertation on time	1	2.56

IT, information technology.

Additionally, some graduate students reported that they faced with health and mental issues, which encompassed the body pains and fatigue known as "office syndrome," stress and anxiety related to work and study, and burnout. The quotes below provide details of students' health issues.

"I frequently found myself grappling with anxiety during online learning, primarily because I had limited control over my learning environment. This loss of control contributed to a decline in my enthusiasm and motivation for learning. Additionally, I had concerns about the quality of IT equipment and its potential influence on the overall quality of online learning and examinations, which further compounded my worries." – Graduate student 5

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"Online learning required me to sit in front of the computer screen for several hours, which caused inflammation in my neck and back pain." – Graduate student 6

"Engaging in prolonged online classes resulted in visual impairment. Furthermore, full-time employment and nocturnal dissertation work have engendered heightened levels of stress and anxiety. Sometimes, I feel that I experienced burnout." – Graduate student 19

"I get stressed out because of online learning and examinations due to the low quality of IT devices and unstable Internet signal." – Graduate student 22

4.2.2.3. Thesis and Dissertation-Related Challenges.

Given that the majority of participants (26, 66.67%) were in the stages of conducting their theses and dissertations, several of them have reported encountering challenges pertaining to these academic endeavors. Specifically, 11 participants (28.21%) underscored the lack of opportunities for social interactions with academic advisers, supervisors, and peers as a prominent concern. This was followed by limited access to library physical spaces (8, 20.51%), relatively minor research adjustments (5, 12.82%), and inability to collect data for thesis/dissertations, lack of motivation to do research, and inability to contact research subjects directly (4, 10.26%). These results were supported by the following quotes.

"Contacting my advisor and peers was difficult during that time. I couldn't consult with them during the daytime due to my full-time work commitments. Sometimes, I had to work on my thesis during the night without any support. This situation created additional tension and a lack of motivation." – Graduate student 2

"I had worked on my dissertation before the pandemic. When the second wave of COVID-19 struck, I had to change my data collection method from face-to-face semi-structured interviews to online interviews. This was very challenging because I could not directly contact my research subjects. Consequently, I had to extend my data collection period." – Graduate student 35

This study also discovered that graduate students heavily depended on online learning resources, particularly online databases offered by libraries and handouts provided by their instructors. It seems that a few of them still found it necessary to visit libraries in person for various reasons. In fact, eight graduate students (20.51%) reported that academic libraries had temporarily closed during the pandemic. Although these libraries offered book delivery services by mail and provided online access to many databases, some students continued to prefer accessing the libraries in the usual manner, as evidenced by the following quotes.

"Though the libraries provided home delivery services during COVID-19, the number of books that could be borrowed was limited. I preferred to access the library onsite because I could explore books, especially for theses and dissertation and research reports on shelves. Not all of them are available electronically. This helped me formulate idea for my research." – Graduate student 1

"It is true that we can access and use online databases for our study and research. However, I need space for collaborative work, especially for brainstorming and doing group assignments." – Graduate student 6

"Accessing the library databases from home is quite difficult because I cannot deal with the process of using virtual private network (VPN) for remote access." – Graduate student 18

"The book delivery service via mail from the academic libraries is too slow, and I cannot use the material in a timely manner." – Graduate student 20

In addition to the challenges and issues experienced by graduate students, several key themes have emerged, highlighting the advantages and positive aspects arising during the pandemic. Although the graduate student participants reported many challenges, 25 of them (64.10%) indicated that online learning offered various advantages, especially a reduced risk of infection (20, 51.28%), the convenience of online learning (5, 12.82%), and the opportunity to gain new experience from a variety of free online courses (5, 12.82%). The following quotes are examples of graduate students' explanations regarding the advantages of online learning during the COVID-19 outbreak.

"Online learning is not problematic; on the contrary, it represents a shift in the learning format that allows learners to enhance their IT skills. Furthermore, it offers convenience in handling and managing time for my dissertation." – Graduate student 7

"I recognize the significance of online learning and have a preference for it, as it mitigates the risk of infection during outbreaks." – Graduate student 21

"I could be able to effectively manage my study time. This granted me ample time to prepare for classes and complete assignments punctually." – Graduate student 33

Fifteen graduate student participants (15, 38.46%) mentioned that the online learning environment during the pandemic gave them opportunities to maintain online collaboration with peers and other LIS professionals and gain new skills. For instance, two participants asserted that:

"Over the past years of the pandemic, I attended various online webinars and conferences, and I have maintained contact with several LIS professionals. I believe that such interactions would have been less feasible in a typical situation." – Graduate student 35

"I was a second-year master's student when the COVID-19 pandemic hit. Initially, I struggled to keep up with coursework, especially in subjects that were new to online learning. After seeking guidance from my academic advisor, I enrolled in several Massive Open Online Courses (MOOCs) such as Thai MOOC and other platforms. These help to improve my digital literacy, research skills, and English proficiency." –Graduate student 34

4.3. Recommendations for the Management of LIS Graduate Programs (Post Pandemic)

The LIS graduate program chairs, faculty members, and graduate students in this study provided pertinent recommendations for managing the LIS graduate programs in the post-pandemic era. The recommendations can be synthesized into three themes as follows:

4.3.1. Developing a Hybrid Curriculum for LIS Graduate Programs

The chairs of LIS graduate programs, faculty members, and graduate students have recognized the advantages of online learning, particularly during the COVID-19 outbreak. However, the majority of them still prefer face-to-face instruction for practical courses. As a result, all of the chairs and faculty members (15, 100%), along with most of the graduate students (25, 64.10%), have suggested that their respective universities should develop hybrid curricula for LIS programs. This integration would combine synchronous classrooms with online or virtual learning, which offer benefits to both faculty members and students by fostering spontaneous and immediate social interaction. This is especially critical for graduate-level programs, as progress and achievements often depend on close collaboration with advisors. Additionally, online or virtual learning supports various learning formats and facilitates the establishment of regional, national, and international LIS networks. Hybrid learning also eliminates barriers that might hinder international graduate students from studying remotely, making it a suitable approach for LIS graduate programs in the post-pandemic era.

The majority of graduate students (22, 56.41%) also recommended that the lecturers consistently adopt new technologies and utilize suitable learning materials throughout their teaching. This approach aims to attract, encourage, and enhance student engagement. One graduate student emphasized this by stating:

"An advantage of online learning is that I can review the lectures anytime I want and learn at my own pace. It would be great if the lecturers could provide more interactive learning media, rather than just using PowerPoint and assigned reading lists." – Graduate student 28

4.3.2. Creating an Effective Online Teaching and Learning Environment

Twenty graduate student (20, 51.28%) agreed that an effective learning environment is vital for the management of LIS graduate programs in the post-pandemic period. Therefore, universities and LIS departments should facilitate online teaching and learning environments, especially by providing effective learning platforms to support teaching and learning activities. These platforms should include functions to track students' progress and facilitate online collaboration. Additionally, these learning platforms should be connected to and integrated with other systems, such as the enrollment system. Furthermore, some graduate students highlighted the necessity of effective research tools to assist with their research processes. For instance, a graduate student mentioned:

"Online learning platforms like Microsoft Teams and Zoom were helpful for lectures; however, additional research tools, such as Qualtrics and other data analysis software, are also necessary for completing research. The department should provide these tools to support graduate students both online and on-site." – Graduate student 7

 https://doi.org/10.1633/JISTaP.2024.12.4.6

Although only seven of the graduate students (17.95%) mentioned a lack of academic support, a greater number of them (15, 38.46%) emphasized the significance of university libraries as important sources of information during the pandemic. These students also suggested that libraries should provide more accessible electronic resources for graduate students (8, 20.51%), offer online training courses (5, 12.82%), and provide online research support (4, 10.26%). Two graduate students explained that:

"At the start of the pandemic, I was worried as universities and libraries closed. I needed books for my thesis not available online. Luckily, my university library offered book delivery by mail, which was a great help." – Graduate student 15

"I primarily relied on online information during the pandemic, but accessing university databases was often hindered by VPN issues. I believe it's essential for the university library to regularly maintain its VPN service and provide guidance on Open Access resources. Additionally, offering online training and research consulting support would be highly valuable." – Graduate student 23

4.3.3. Expanding Collaborative Teaching and Learning Networks

All the LIS graduate program chairs and faculty members, along with 22 graduate students (56.41%), shared the consensus that collaborative teaching and learning networks are essential for effectively managing and improving LIS graduate programs following the pandemic. Online learning environments allow LIS programs the flexibility to establish collaborative networks for teaching and learning, particularly in terms of national and international partnerships and exchange programs. Such collaborations with universities, libraries, and other information organizations worldwide can provide valuable opportunities. Consequently, both faculty members and graduate students have the chance to broaden their experiences and knowledge through these collaborations. These findings were not only confirmed by the LIS graduate programs' chairs and faculty members, but also by graduate students who have benefited from online collaboration, as evidenced in the following explanations:

"An online environment offers opportunities to establish online learning and teaching networks and collaborations, both at the national and international level. During the pandemic, I participated in various international online conferences and served a guest lecturer for several online classes, experiences that were not possible normally. Therefore, this online collaboration should be sustained as a regular teaching and learning activity in the new normal." – LIS graduate program chair 3

"A positive aspect of the pandemic is the ability to engage in multiple online activities simultaneously, if you can manage your schedule effectively. For example, I could attend an online webinar during a department meeting. Additionally, I had the opportunity to present my paper at an international conference co-organized by multiple LIS schools and professional organizations in different countries, which might not have been possible in normal circumstances." – Faculty member 7

"My lecturers have extended invitations to guest speakers who are experts in various fields, including qualitative research and data curation. This teaching approach has been highly effective, as it offers students insights from researchers in diverse organizations. Personally, I greatly benefited from these online sessions and was able to generate numerous ideas for my thesis as a result." – Graduate student 19

5. DISCUSSION

The analysis of interview transcripts from LIS graduate program chairs, faculty members, and graduate students revealed their challenges and perspectives on LIS education during the pandemic. Participants navigated a rapid transition to fully online learning, coping with the challenges of adapting to this new environment. The key findings and guidelines for the managment of LIS education post-pandemic are discussed below.

5.1. Issues Relating to Online Learning in LIS Education and Suggestions

Similar to studies of other academic disciplines and LIS institutions worldwide, this study found that technology infrastructure is a critical factor that presents challenges for both educators and learners on a global scale. Inadequate technology resources and subpar Internet connectivity have adverse effects on online teaching and learning, as well as the overall administration of LIS programs. These findings align with previous research and are consistent with the outcomes of the present study. All groups of key informants in this research identified these

technological challenges as fundamental and of significant concern. For example, the chairs of LIS graduate programs emphasized that technology infrastructure, including Internet connectivity, was not only indispensable for supporting online learning, but also crucial for facilitating effective communication between faculty members and students. Faculty members in this study echoed these concerns, expressing apprehensions regarding technology infrastructure issues such as unstable Internet connections, outdated devices, and online learning management systems. Earlier research likewise revealed that despite initially holding positive attitudes toward the adoption of e-learning at the onset of the pandemic, LIS educators encountered numerous challenges, including the lack of adequate technical infrastructure and limited Internet access (Igwela & Nsirim, 2020; Somabut & Tuamsuk, 2021).

This study affirms the critical importance of technology infrastructure and Internet connectivity within online learning environments. The graduate students who participated in this study overwhelmingly concurred that inadequate infrastructure and unreliable Internet connections significantly impeded their learning experiences. These findings align with a body of research conducted during the pandemic (Almahasees et al., 2021; Bestiantono et al., 2020; Muthuprasad et al., 2021). For instance, Almahasees et al. (2021) observed similar challenges among undergraduate students, including issues related to IT proficiency, limited opportunities for interaction, and technical difficulties stemming from the cost of network access. Furthermore, the abrupt transition from traditional face-to-face instruction to fully online learning across various platforms and devices introduced additional complexities not only for graduate students but also for faculty and staff (Wang et al., 2020).

Given that technology infrastructure, including Internet connectivity, hardware, and software, plays an indispensable role in online learning environments, both universities and LIS graduate schools must ensure its availability. This is essential for managing LIS graduate programs in the post-pandemic era, where online learning is prominent. LIS administrators should prioritize cutting-edge technology infrastructure, reliable Internet connectivity, and robust learning tools and systems, such as Microsoft Teams, Zoom, Blackboard, Google Classroom, and Google Meet, which are essential components for the successful adoption of online learning. Additionally, the participants in this study suggested adopting new technologies and utilizing suitable learning materials, such as interactive media and learning management systems supporting both synchronous and asynchronous learning activities. Similar results were also confirmed in literature. For example, Sukiman et al. (2022) discovered that Zoom supports real-time learning, enhances the efficiency of online education, and improves engagement between instructors and students, including those pursuing doctoral studies. Hence, providing such essential tools can greatly facilitate effective teaching and learning in this environment.

The lack of IT skills appears to be a major challenge in online learning during the pandemic (Igwela & Nsirim, 2020; Nimavat et al., 2021). This study confirms that it is also one of the major issues challenging LIS educators in the Thai context. It addresses the importance of IT skills and the necessity for developing IT skills among both educators and learners. Our findings show that LIS faculty members expressed concerns about their IT skills for online learning, while graduate students in the study felt confident in their IT skills. It is practical for LIS graduate schools to offer support and training to prepare both faculty and students for the online learning environment. Topics could include using online tools (Zoom, Microsoft Teams, Google Meet, Webex), assessment tools (Socrative, Google Forms, Quizizz), research tools (Survey Monkey, Qualtrics, Google Forms), and creating online interactive instructional media and tools (Nimavat et al., 2021).

Alongside technological challenges, the participants in this study expressed concerns about various personal challenges. These included time management, health and mental well-being, and a lack of social interaction. Additionally, the graduate students also addressed thesis and dissertation related issues as their primary concerns, including limited access to physical library space and minor research adjustments. These concerns align with findings from prior studies (Almahasees et al., 2021; Imsa-ard, 2020; Nimavat et al., 2021; Patricia Aguilera-Hermida, 2020; Thanavisuth, 2021). Patricia Aguilera-Hermida (2020) found that college students faced difficulties concentrating while learning at home, struggled to balance life-related stress, lacked motivation, and found online learning challenging. Contacting professors was also challenging. Understandably, these issues can impact students' performance in an online learning environment. To prevent and resolve these types of problems, LIS graduate programs should provide online support and counseling on educational and health related issues, catering to both faculty and students.

5.2. Hybrid Learning As the Key for Post-Pandemic LIS Education

This study underscores the suitability of hybrid curricula and collaborative teaching and learning networks as strategies for transitioning beyond the pandemic. Hybrid learning, as evidenced, amalgamates the advantages of both face-to-face and online instructional modalities. It affords students the benefit of flexibility and self-paced learning, complemented by convenient 24/7 access to learning materials asynchronously. Simultaneously, it facilitates the maintenance of social interaction among students and faculty members during in-person activities. These findings align with prior research conducted by Romaniuk and Łukasiewicz-Wieleba (2022), and Sukiman et al. (2022), which similarly affirmed the appropriateness of hybrid learning as a post-pandemic educational paradigm. For instance, Romaniuk and Łukasiewicz-Wieleba (2022) and Sukiman et al. (2022) substantiate the proposition that hybrid learning remains a pertinent educational approach in the post-pandemic era. Sukiman et al. (2022) specifically accentuate the effectiveness of online learning at the doctoral level, both in terms of the learning process and its outcomes. While doctoral students in their study acknowledged the advantages of hybrid learning during the pandemic, they expressed a preference for face-to-face instruction in certain contexts. Consequently, the researchers recommended a balanced approach that considers the interplay between online and offline learning. For a master's degree, a suitable proportion might be 40-50% offline and 50-60% online. However, for more advanced students such as doctoral students and candidates, Sukiman et al. (2022) find it prudent to reduce the offline component to 20%, allocating the majority—approximately 80% of the learning time—to online modalities. Our present study expands on this by suggesting that the 20% allocation for offline activities could encompass practical exercises and hands-on experiences, as indicated not only by faculty members but also by graduate students in our study.

When designing blended and hybrid learning for LIS online degree programs, administrators must consider content and communication in both synchronous and asynchronous modes (Franks, 2012; Romaniuk & Łukasiewicz-Wieleba, 2022). The absence of a social element can hinder hybrid learning success (Romaniuk & Łukasiewicz-Wieleba, 2022; Sukiman et al., 2022). Therefore, prioritizing social interaction is crucial. Hybrid learning should foster collaboration through online and on-site methods, cultivating a community of practice. For example, it can involve internship opportunities, inviting guest speakers or lecturers, and engaging in project-based learning. Furthermore, interdisciplinary collaboration is essential due to LIS's intersection with other disciplines such as social sciences, humanities, archival studies, education, and management (Poole & Todd-Diaz, 2022). Integrating diverse perspectives fosters students' knowledge and skills expansion. Additionally, for hybrid curriculum success, instructors should pay special attention to the curriculum's objectives, strike a balance between online and in-person activities, and provide effective feedback, as well as evaluation and assessment. These factors offer opportunities for students to develop and showcase their achievements (Center for Teaching Innovation-Cornell University, 2022). Within a hybrid learning environment, a shift from a teacher-centered to a learner-centered approach is imperative. This transformation empowers students as independent learners, with instructors assuming the role of facilitators, guiding and supporting students in achieving their educational objectives.

6. CONCLUSION

The teaching and learning of LIS graduate programs in Thailand have transitioned to fully take place in an online environment since the COVID-19 pandemic, similar to other institutions worldwide. The chairs of these programs, faculty members, and graduate students in this study acknowledged both advantages and disadvantages of online teaching and learning during the pandemic. Despite the support provided by the universities in the form of technology infrastructure, including devices, tools, and improved Internet connections, program members still encountered numerous challenges. As discussed earlier, the most common issues were related to problems with unstable Internet connections and outdated devices and applications, which impeded the teaching and learning process. Additionally, personal challenges such as increased workloads, time management, and a lack of social interaction posed barriers to delivering high-quality education. To enhance the effective management of LIS graduate programs, the chairs, faculty members, and graduate students in this study recommended that universities develop hybrid curricula, establish effective online teaching and learning environments, and expand collaborative teaching and learning networks.

The recent pandemic has had a profound impact on education and content delivery worldwide. It has not only disrupted education in a general sense but has also altered the management of educational programs, methods of

knowledge transfer, communication, and collaboration. While the pandemic introduced various challenges to the academic world and, to some extent, brought education systems to a halt, it also opened doors to new opportunities and led to innovations and efficiencies along the way. This crisis has highlighted flaws and shortcomings related to technology infrastructure and IT-related skills that need addressing to prepare for future events. As we move beyond the recent pandemic and enter a new era of education, it is imperative to reflect on the lessons learned and focus on areas that require improvement.

7. LIMITATIONS

Our findings offer valuable insights into the management of LIS graduate programs in Thailand amid the pandemic, shedding light on the challenges faced by LIS chairs, faculty members, and students within these programs during this period. Additionally, the principal findings furnish essential guidelines for the management of LIS education in the post-pandemic era. The following research limitations require consideration. Initially, data were gathered from a sample of only 54 key informants. Furthermore, the majority of our participants were graduate students. Hence, the generalizability of our findings to encompass all LIS graduate programs in Thailand is limited. Secondly, our study was conducted towards the end of 2021, and we conducted interviews with key informants in January 2022, during a period following the initial outbreak when cases were declining. Therefore, the results obtained may not be directly comparable to research conducted at the peak of the outbreak. Finally, due to the exclusively Thai origin of our participants, the applicability of the outcomes to different nations is restricted. Nevertheless, despite these constraints, the researchers posit that the findings from our study could prove beneficial for administrators of LIS graduate programs in various countries, aiding them in transcending the challenges posed by the recent pandemic and transitioning into a novel educational phase.

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CONFLICTS OF INTEREST

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

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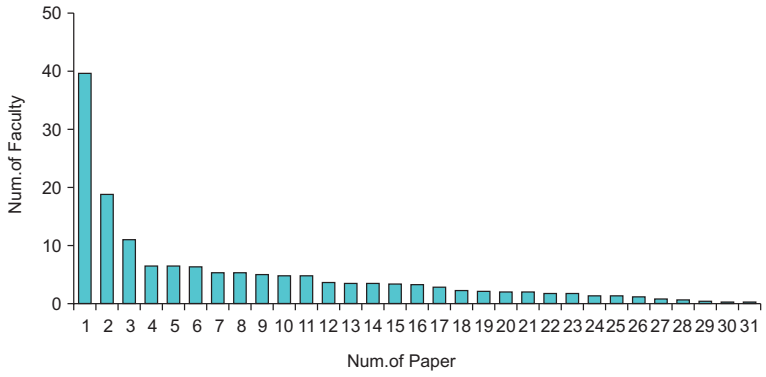


Fig. 1. Distribution of authors over publication count.

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.
- Smith, K., Jones, L. J., & Brown, M. (2012). Effect of Asian citation databases on the impact factor. *Journal of Information Science Practice and Theory*, 1(2), 21-34.

Book

- Author, A., & Author, B. (Year). *Book title*. Publisher Name.
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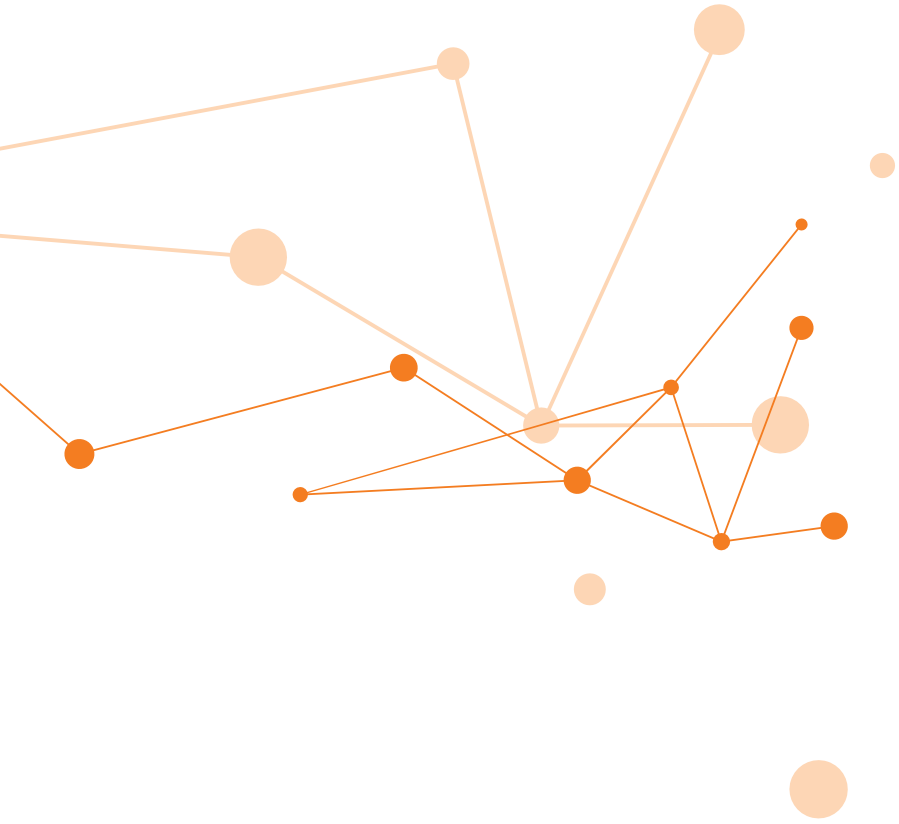
- Author, A., & Author, B. (Year). Chapter title. In A. Editor, B. Editor, & C. Editor (Eds.), *Book title* (pp. xx-xx). Publisher Name.
- Smith, K. & Brown, M. (2012). Author impact factor by weighted citation counts. In G. Martin (Ed.), *Bibliometric approach to quality assessment* (pp. 101-121). Springer.

Conference paper

- Author, A., & Author, B. (Year, Month Day). Article title. In A. Editor & B. Editor (Eds.), *Conference title* (pp. xx-xx). Publisher Name.
- Lin, H., Sun, B., Wu, J. & Xiong, H. (2016, June 24-26). Topic detection from short text: A term-based consensus clustering method. In B. Yang (Ed.), *2016 13th International Conference on Service Systems and Service Management (ICSSSM 2016)* (pp. 1-6). IEEE.

Online document

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