Applying a Gamification Approach to Knowledge Management in Higher Education Institutions

Nouf Almujally[1,2], Mike Joy[1]

[1]Department of Computer Science, University of Warwick, Coventry, UK
{n.almujally,m.s.joy}@warwick.ac.uk
[2]Department of Computer Science, Princess Nourah Bint Abdulrahman University, Riyadh, Saudi Arabia
naalmujally@pnu.edu.sa

***Abstract*—Many universities still struggle with the issue of how to facilitate the sharing of knowledge gained by instructors and maximize the value gained from all available such knowledge assets. Poor Knowledge Sharing (KS) can deter the successful implementation of teaching expertise, and this can affect instructors' teaching performance and may result in lower levels of learner achievement than could otherwise be achieved. Therefore, there is a need to implement a knowledge management (KM) initiative that facilitates the sharing of teaching practices among university instructors. In order to address this issue, this paper proposes a comprehensive and practical Computer-based Teaching Practices Management System (TPMS) which aims to foster instructors' participation in KS practices by employing a gamification approach. A design science research methodology is adopted in order to understand what would drive instructors to share their knowledge; this information is used in order to map their behavior to system features. A qualitative evaluation of users' experiences of utilizing the proposed features shows that the instructors express satisfaction with the motivational affordances and feel that they were motivated to participate in knowledge sharing activities.**

Keywords—Design science, knowledge sharing, knowledge management system, higher education institutions, motivational affordance, user experience.

I. INTRODUCTION

Knowledge-based theory [1] considers knowledge to be the most valuable resource an organization can possess in relation to achieving competitive advantage and accomplishing organizational objectives; hence, it is a resource worth managing and sharing effectively. In today's knowledge-based economy, Knowledge Management (KM) plays a vital role in any organization by facilitating the capture, storage, sharing and dissemination of knowledge [2]. Rowley [3] believes that Higher Education Institutions (HEIs) are part of the knowledge business, since they are involved in knowledge creation, dissemination and learning. KS is one of the vital but challenging processes of KM. The main reason for this is that its occurrence is influenced by several factors, such as people's motivation to share their knowledge [4], attitudes and intentions [5], and behavioral aspects [6]. Therefore, HEIs need to adopt a proactive approach to KS in order to enhance the sharing of teaching experience amongst their academics. Several benefits can be derived from the use of well-established KS practices in HEIs, such as teaching-productivity improvement, and enhancing organizational learning and innovation [7]. KS practices can also enhance the quality of the education offered to students by enabling instructors to exchange and share their teaching experiences.

While KS can offer many benefits, there is still a risk that universities fail in terms of supporting instructors in sharing their teaching expertise; this may result in severe issues for organizations [8]. An instructor's daily routine is typically a very busy one due to their involvement in teaching and administrative responsibilities. They (instructors) are usually working under time restraints, and their day to day activities are generally very demand-driven; hence, they rarely find sufficient time to devote to sharing their teaching practices with others. KS will not happen if instructors do not have an ongoing tendency to share their knowledge with their colleagues. In addition, managers cannot dictate that people share their knowledge because KS is considered as a voluntary behavior [9].

Reviewing the literature, we found that one of the most common barriers to the sharing of knowledge is the absence of motivational affordances [10]. Motivation is the force that shapes the desires of individuals to, e.g., share knowledge [11, 12]. Therefore, the establishment of an efficient and attractive professional development environment that can motivate instructors to voluntarily participate in the sharing of their teaching-related knowledge is required. Gamification is an approach that can be used in this context. The potential of gamification in relation to motivating people to share their knowledge has been recognized by a growing amount of studies conducted in recent years [13, 14]. The literature has mainly focused on theoretical research; investigating the practical impacts of gamification in the context of HEIs KM is still rare [9].

To close the gaps in the literature which are mentioned above, this study intends to answer the following question: *How can a gamification approach, applied to an actual educational environment, enhance instructors' inclinations to share their teaching-related knowledge?*

Hence, this paper investigates how two HEIs have employed gamification in order to foster their instructors' participation in, KS practices. This 'fostering' was undertaken through the design of a Teaching Practices Management System (TPMS) which includes facilities for motivating the sharing of teaching-related knowledge among instructors. Based on a gamification approach, the system employs motivational affordances which were designed on the basis of instructors' expressed requirements.

This study went a step further than merely identifying the factors that affect knowledge sharing. The proposed motivational affordances can be used as a guide when designing and implementing any new KMS intended to promote knowledge sharing activities in academic institutions. In addition, the analysis and findings of the research expand an area relating to KMS in academic

978-1-7281-7303-0/20/$31.00 ©2020 IEEE
DOI 10.1109/COMPSAC48688.2020.0-209

institutions, particularly universities, which has hitherto not been adequately studied at a theoretical or empirical level. Additionally, only limited numbers of studies have investigated the results of using gamification in real educational contexts.

II. THE UNDERPINNING THEORETICAL FRAMEWORKS

A. The gamification approach

Based on an extensive literature study focused on the identification of KM-relevant motivational factors, we examine gamification as a method for offering incentives from within a KMS. Deterding, Dixon, Khaled and Nacke [15] described gamification as 'the use of game design elements in a non-game sense' to increase the motivation of the recipient. According to [16], gamification can be considered an important approach to driving behavioral change by increasing motivation through persuasive design. Therefore, a great deal of attention has been paid to gamification by KM researchers in recent years [14, 17]. Game-related mechanisms can strongly support an employee's motivation to change their behavior [18]. Some of the common mechanisms mentioned in the literature are points, rankings, or levels - implemented within a system. Moreover, gamification designers could usefully focus on evincing and satisfying participants' desires to participate in KS activities; some of these desires may be supported by rewards, status improvements, feelings of achievement, and/or competition [9].

III. RESEARCH METHODOLOGY

The primary goal of our research is to derive appropriate design features for a web-based system that aims to motivate the sharing of teaching practices among university instructors. To do this, according to Peffers, Tuunanen, Rothenberger and Chatterjee [19], Design Science Research (DSR) would be an appropriate approach. DSR is based on a paradigm focused on the designing of innovative, purposeful artefacts [20]. To carry out our study and build such an artifact, we follow the DSR methodology introduced by Peffers et al. (2007), as shown in Fig. 1.

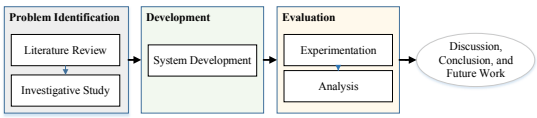

Fig. 1. DSR processes

The process employed the three research activities as defined in the Design Science Methodological framework of Offermann, Levina, Schönherr and Bub [21]:

- Problem Identification – the problem was defined via a study of the literature and also via an investigative study conducted with instructors.
- Design and Develop Artifact - the artifact design was based on a combination of the results of the study of the literature and the feedback from the investigative study
- Evaluation - the artifact was evaluated by conducting an experiment with instructors as participants.

A. Problem Identification

The gamification of a system by the implementing of incentives has to be done well, if it is to fulfill users' needs [22]. In order fulfill this requirement, as a first step, we identified the problem as accurately as possible by conducting a qualitative study using as participants instructors working in two universities in Saudi Arabia - in order to better understand academics' actual knowledge sharing behavior in relation to teaching practices. Conducting the study in many different educational institutions would be prohibitively costly and time-consuming and selecting the University of Princess Nourah and King Saud University assisted in terms of minimizing the time and cost constraints since the first author had access to information related to the study with regard to both Universities, such as the details of the e-learning systems, the make-up of the academic staff, and the universities structures and departments. The semi-structured interviews we carried out aimed at exploring the academics' requirements with regard to a new knowledge sharing tool. The interviews were conducted with 22 academics (five heads of department, five assistant professors, eight lecturers and four teaching assistants). These participants worked across various faculties and disciplines, but nevertheless, they represented a homogeneous participant group in that all of them were academics.

The interviews consisted of the asking of a number of open-ended questions; these were selected on a pragmatic basis and in order to facilitate interviewees reflections on their knowledge sharing experiences. The interviewees were asked: "how often do you participate in knowledge sharing activities?", "what motivates you to participate in knowledge sharing activities?", and "what could prevent you from participating in knowledge sharing activities?"

MaxQDA 2018 was used to analyze the transcripts via an eclectic coding procedure [23]. An inductive coding approach was employed to help the researcher extract themes which were mentioned by the interviewees.

The results from the interviews revealed that instructors often considered that there was a lack of motivation (on their part and on others') to share their teaching expertise others. They *"… do not share because they do not receive acknowledge in return for sharing of knowledge"*. The findings from the interviews also revealed that knowledge contributors placed more weight on social recognition than on any possible financial rewards. One participant stated that *"… if anyone says thank you for sharing your experience, since it helped me teaching the subject, I will be motivated to share more"*.

This may indicate that HEIs should develop a system which rewards faculty members by socially/symbolically recognizing their efforts when they have participated in knowledge sharing.

B. Design and Development

In order to find ways of inspiring and improving the motivation of instructors with regard to participating in the sharing of teaching practices, we have combined the results of the interviews with ideas arising from the gamification approach and a further, targeted literature review. The results of this combination are the design principles and features of our Teaching Practices Management System (TPMS), as shown in Table 1.

TABLE I. DESIGN PRINCIPLES AND FEATURES OF TPMS

Functional Requirement	Design Principle	Design Feature
The system should motivate knowledge contributors.	Provide incentives for contributing teaching knowledge based on explicit feedback.	**Game mechanics:** • Status ranking • Vote-up rating • Written feedback

Gamification provides various different forms of mechanisms which affect users experiences of a system. On the one hand, displaying points based on user participation in knowledge sharing activities provides a form of feedback through rewards [24]. Mekler, Brühlmann, Tuch and Opwis [25] showed that the visibility of achievements, as represented in the form of status levels, had a positive influence on the level of contributions made by individuals [9, 17]. Hence in this study, the level of a user's participation is monitored by the system and is measured by the number of contributions they make, weighted according to type (contribute knowledge, asked questions, posted answers); this monitoring is intended to motivate instructors to share their knowledge, as illustrated in the system screenshots of Fig. 2.

Additionally, providing explicit feedback is a powerful and useful mechanism which enabling users to express their interest in particular knowledge objects. Appropriate feedback from the community will enable academics to understand that sharing their knowledge helps others, this, in turn, will increase their sense of self-worth and self-efficacy [26, 27]. The evaluation of a contributor's reputation, which is made as a result of public feedback, has a significant positive effect on the quality as well as the quantity of KS that a contributor makes [28]. Therefore, in this study, we have implemented facilities which allow for explicit public feedback in the form of written comments and voting-up ratings; again, this is intended to motivate instructors to share their knowledge, as illustrated in the system screenshots of Fig. 3.

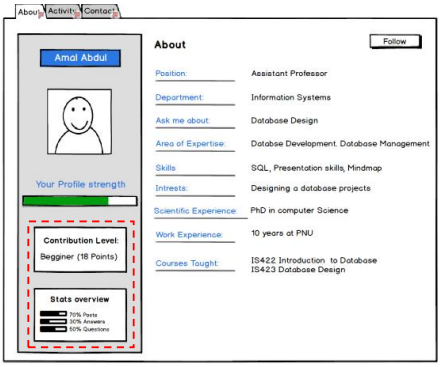

Fig. 2. Status ranking

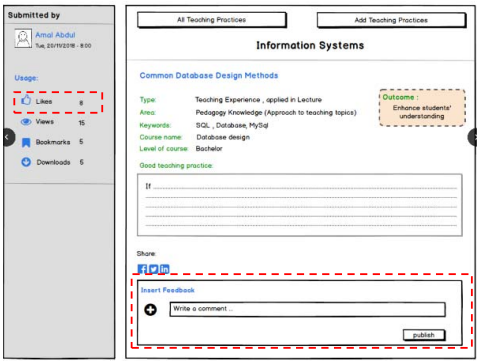

Fig. 3. Vote-up rating and written feedback functions

IV. EVALUATION

In order to evaluate the proposed gamification elements' applicability as incentives for KS, an experiment was conducted involving the assistance of 20 participant academics from the Department of Computer Science at the University of Princess Nourah in Saudi Arabia. The method used to select the study sample was convenience sampling [29]. The reason for using this method was because the researcher had limited time and money to spend on this study.

The sample covered the complete range of experience from novices to very experienced academics. It included faculty members who had PhD degrees, lecturers with Masters degrees and teaching assistants with Bachelor degrees.

The participants were invited via email to participate in the research experiment voluntarily. They were asked to reply to the email by signing a consent form if they agreed to participate. Then, the participants were sent an email which asked them to use the system for the duration of the experiment - which was conducted during the first semester of the 2019/2020 academic year. The email contained a general overview of the system and also of the concept of managing teaching experiences. The email also contained detailed information about the steps required to register with the system, and a guidance sheet on how to use it.

At the end of the experimental period, the participants who registered with the system were invited by email to further participate in a focus group discussion. Scholars have identified focus groups as an appropriate method for DSR artefact evaluations, in particular for enhancing the artefact design, and demonstrating the artefact's utility [30].

The focus group discussions started with face-to-face semi-structured interviews which were aimed at gaining a broader knowledge and a deeper understanding of the participants' experiences with the system. The interview included questions relating to the participants' overall satisfaction with the gamification mechanisms and concerning whether the instructors believed that the gamification mechanisms implemented in the system were useful in terms of motivating them to share their teaching practices. The participants were given access to the system during the interview session in order to help inform their responses and so that they did not have to rely on memory. The interviews were recorded with two different devices: an iPhone and a recording device (recorder), transcribed as text

files, and then stored anonymously. To maintain confidentiality, all the names of the people and organizations involved in the focus group have been replaced with code names throughout the documentation. The qualitative data resulting from the academics' responses were uploaded to the MaxQDA software application and analyzed via a thematic analysis.

A. Results

From a knowledge contributor perspective, the responses were interesting; all the participants reported that the quality and amount of knowledge they shared strongly depended on the feedback they obtained from the gamification mechanisms which were provided.

They all agreed that receiving feedback as a result of other users either commenting on or rating the knowledge that they had shared was a positive in terms of motivating them (academics) to participate in knowledge sharing activities using the system. One of the participants was totally in agreement with this, stating that: "*Receiving timely feedback on my teaching practices means that academics are interested about my experience. This will encourage me to add more*". Our analysis also showed that the more comments online participants received from their peers, the more likely they would be to contribute to the community. One of the participants added that she had never received any feedback on her teaching practices when these had been shared using a face-to-face approach. She valued receiving comments from peers and stated that: "*It is beneficial to* get *feedback from people who apply my teaching practi*ce*. This feedback gives me an insight for how my teaching practice solves others problem and makes me feel motivated to contribute more knowledge*". The academics also agreed that receiving constructive feedback on their teaching practices would lead to further continuous learning and consequent improvements in their teaching performance. One of the participants expressed a strong interest in receiving feedback from his colleagues and added: "*positive comments on my knowledge will motivate me to post more, while negative feedback will help me improve the quality of my knowledge*".

Although comments from other users generally helped the contributors to acquire new insights and further develop their knowledge contributions, being the recipient of too many comments could also signal a mismatch between the participant's knowledge level and that required by the community. One participant argued that: "*Receiving too many negative comments could make me feel of being detached from the community and decrease the willingness to further engage in the knowledge community*". However, the rating-based mechanism provided by the system can be used to moderate the effects of negative commenting on knowledge contribution to more strongly promote continued contribution by community members.

The participants (knowledge contributors) reacted positively to the voting-based mechanism. It is interesting to note that if a knowledge contributor feels that their knowledge is exceptional, he/she may contribute more knowledge in order to bolster their own self-image regarding their expertise. Indeed, one of the participants, a professor and a former dean, reported that: "*Received high ratings on my posted knowledge will encourage me to contribute more knowledge because I believe that this can establish and improve my individual reputation. I will be well-known by other academics*". Another instructor concurred with what her colleagues said: "*Being recognized is likely to lead to being motivated and consequently more engaged in the system*".

Furthermore, the majority of the participants highlighted the usefulness of the status level mechanism provided by the system. The status level function implemented for this study provided the participants with information regarding the number of contributions made, and published in their profile, by each and every participant. The interviewed participants reported that they were more likely to contribute even more knowledge when their reputation status had increased. One of the participants explained that this immediate reward for good performance was important to him. He stated that: "*Publish reputation level on my public profile makes me feel honoured, I experience some pleasure. It is something for me to take home*". Additionally, it was found that when an instructor's status increased, the quality of his or her contributions also increased, as one participant explained: "*I will feel pleased adding more content with high quality because I will be acknowledged by my peers*".

On the other hand, a few participants noted an unintended side effect of the status level mechanism. They indicated that the maintenance of a status level could lead to the creation of a competitive environment which could cause them to feel pressured, controlled or observed instead of that they were taking part in an activity which was fun.

The above results imply that when instructors feel that knowledge sharing might elevate their reputation, they will be more inclined to share their expertise. Therefore, it can be concluded that gaining in online reputation signifies that one's contribution has been publicly acknowledged; thus, this can increase one's sense of self-worth and self-esteem - which should lead to being more motivated and, consequently, more engaged in using the system. This all suggests that the gamification mechanisms implemented in the system, voting up ratings, written comments, and status levels, are likely to keep employees' spirits higher, so positively impacting their performance and their motivation in relation to share their teaching practices. These results are consistent with those found in [28, 31, 32] who all discovered that instructors are likely to want to demonstrate, online, to their peers and others, the expertise they possess in relation to their professional fields and that they can be motivated to do this via the promise of reputational rewards.

V. Conclusion

Although the importance of gamification in terms of modifying and indeed directing people's behavior has been inferred in the past, no previous study has investigated this effect in relation to the KM domain within the HEIs sector. Therefore, this study has investigated the question: how can gamification mechanisms can be used via a real-world system to improve HEIs teaching practices sharing?

To answer this question, a solution to the underlying issues was sought. In this paper, we have used the DSR methodology to propose a system called TPMS - which aims to improve the motivation of instructors in relation to sharing their teaching expertise; this system is based on a gamification approach. We proposed design principles and design features targeted at gamification mechanisms. An experiment was undertaken to assess whether the use of the system was useful in terms of establishing a motivational environment with regard to sharing teaching practices.

The insights gleaned from the interviews indicated that, despite the one reported negativity, most participants were satisfied with the gamification mechanisms implemented in the system. It can be concluded, therefore, that the adopted rating-based, written comments and status level mechanisms have the potential to support knowledge sharing activities by increasing both the quantity and quality of contributions. The availability of such mechanics can be fruitful in terms of encouraging academics to document their teaching practices using TPMSs.

This study extends the current literature on knowledge sharing in online communities by providing evidence that gamification mechanisms can be important affordances in the setting of online communities that focus on knowledge building in higher education institutions.

The primary limitation of this research is that the qualitative approaches used in the evaluation phase may limit the generalizability and applicability of the findings to other settings. However, this situation also represents a strength because contextualized and detailed insights are provided from which a unique set of practices using gamification approaches in the KM domain were derived. But nevertheless, in terms of a recommendation for future research, gamification should be examined quantitatively in order to enhance the generalizability of the study.

REFERENCES

[1] R. M. Grant, "Toward a knowledge‐based theory of the firm," *Strategic management journal,* vol. 17, pp. 109-122, 1996.

[2] N. K. Agarwal, D. C. Poo, and J. M. Goh, "Managing quality of information retrieval for effective knowledge management," in Proceedings of the 3rd World Conference for Software Quality (3WCSQ), 2005, pp. 205-214.

[3] J. Rowley, "Is higher education ready for knowledge management?," *International journal of educational management,* vol. 14, no. 7, pp. 325-333, 2000.

[4] G. Suder, A. Birnik, N. Nielsen, and M. Riviere, "Extreme case learning: the manager perspective on rare knowledge and capabilities development," *Knowledge Management Research & Practice,* vol. 15, no. 1, pp. 130-145, 2017.

[5] M. R. Dehghani, A. A. Hayat, J. Kojuri, and K. Esmi, "Role of organizational citizenship behavior in promoting knowledge sharing," *Journal of Health Management & Informatics,* vol. 2, no. 4, pp. 126, 2015.

[6] L. C. Hsien, N. F. Pei, P. C. Yung, and C. T. Sheng, "A study on the correlations between knowledge sharing behavior and organizational citizenship behavior in catering industry: the viewpoint of theory of planned behavior," *The Anthropologist,* vol. 17, no. 3, pp. 873-881, 2014.

[7] Z. Tohidinia, and M. Mosakhani, "Knowledge sharing behaviour and its predictors," *Industrial Management & Data Systems,* vol. 110, no. 4, pp. 611-631, 2010.

[8] L. Wen-bao, "The effect of knowledge sharing model expert system with application," *Journal of Technology Transfer,* vol. 34, no. 2, pp. 508-1521, 2007.

[9] J. Friedrich, M. Becker, F. Kramer, M. Wirth, and M. Schneider, "Incentive design and gamification for knowledge management," *Journal of Business Research,* vol. 106, pp. 341-352, 2020.

[10] S. Paroutis, and A. Al Saleh, "Determinants of knowledge sharing using Web 2.0 technologies," *Journal of knowledge management,* vol. 13, no. 4, pp. 52-63, 2009.

[11] W. E. Davis, N. J. Kelley, J. Kim, D. Tang, and J. A. Hicks, "Motivating the academic mind: High-level construal of academic goals enhances goal meaningfulness, motivation, and self-concordance," *Motivation and Emotion,* vol. 40, no. 2, pp. 193-202, 2016.

[12] Q. Tang, X. Zhao, and S. Liu, "The effect of intrinsic and extrinsic motivations on mobile coupon sharing in social network sites: the role of coupon proneness," *Internet Research,* vol. 26, no. 1, pp. 101-119, 2016.

[13] K. H. Kwon, A. Halavais, and S. Havener, "Tweeting badges: User motivations for displaying achievement in publicly networked environments," *Cyberpsychology, Behavior, and Social Networking,* vol. 18, no. 2, pp. 93-100, 2015.

[14] M. Silic, and A. Back, "Impact of gamification on user's knowledge-sharing practices: Relationships between work motivation, performance expectancy and work engagement," in Proceedings of the 50th Hawaii International Conference on System Sciences, 2017.

[15] S. Deterding, D. Dixon, R. Khaled, and L. Nacke, "From game design elements to gamefulness: defining" gamification"," in Proceedings of the 15th international academic MindTrek conference: Envisioning future media environments, 2011, pp. 9-15.

[16] A. Matallaoui, P. Herzig, and R. Zarnekow, "Model-driven serious game development integration of the gamification modeling language gaml with unity," in 2015 48th Hawaii International Conference on System Sciences, 2015, pp. 643-651.

[17] A. Suh, and C. Wagner, "How gamification of an enterprise collaboration system increases knowledge contribution: an affordance approach," *Journal of Knowledge Management,* vol. 21, no. 2, pp. 416-431, 2017.

[18] J. Hamari, and V. Eranti, "Framework for Designing and Evaluating Game Achievements," in Digra conference, 2011.

[19] K. Peffers, T. Tuunanen, M. A. Rothenberger, and S. Chatterjee, "A design science research methodology for information systems research," *Journal of management information systems,* vol. 24, no. 3, pp. 45-77, 2007.

[20] A. R. Hevner, "A three cycle view of design science research," *Scandinavian journal of information systems,* vol. 19, no. 2, pp. 4, 2007.

[21] P. Offermann, O. Levina, M. Schönherr, and U. Bub, "Outline of a design science research process." pp. 1-11.

[22] M. Sailer, J. U. Hense, S. K. Mayr, and H. Mandl, "How gamification motivates: An experimental study of the effects of specific game design elements on psychological need satisfaction," *Computers in Human Behavior,* vol. 69, pp. 371-380, 2017.

[23] J. Saldaña, *The coding manual for qualitative researchers*: Sage, 2015.

[24] G.-W. Bock, R. W. Zmud, Y.-G. Kim, and J.-N. Lee, "Behavioral intention formation in knowledge sharing: Examining the roles of extrinsic motivators, social-psychological forces, and organizational climate," *MIS quarterly,* vol. 29, pp. 87-111, 2005.

[25] E. D. Mekler, F. Brühlmann, A. N. Tuch, and K. Opwis, "Towards understanding the effects of individual gamification elements on intrinsic motivation and performance," *Computers in Human Behavior,* vol. 71, pp. 525-534, 2017.

[26] L. Chen, A. Baird, and D. Straub, "Why do participants continue to contribute? Evaluation of usefulness voting and commenting motivational affordances within an online knowledge community," *Decision Support Systems,* vol. 118, pp. 21-32, 2019.

[27] T. Zhang, W. Y. C. Wang, and A. A. Techatassanasoontorn, "User's feedback contribution to enhance professional online community: a motivational process," *VINE Journal of Information and Knowledge Management Systems,* vol. 49, no. 3, pp. 307-326, 2019.

[28] S.-Y. Hung, A. Durcikova, H.-M. Lai, and W.-M. Lin, "The influence of intrinsic and extrinsic motivation on individuals' knowledge sharing behavior," *International Journal of Human-Computer Studies,* vol. 69, no. 6, pp. 415-427, 2011.

[29] M. Denscombe, *The good research guide: for small-scale social research projects*: McGraw-Hill Education (UK), 2014.

[30] D. W. Stewart, and P. N. Shamdasani, *Focus groups: Theory and practice*: Sage publications, 2014.

[31] M. M. Wasko, and S. Faraj, "Why should I share? Examining social capital and knowledge contribution in electronic networks of practice," *MIS quarterly,* vol. 29, no. 1, pp. 35-57, 2005.

[32] H.-J. Kang, J. Han, and G. H. Kwon, "An integrated success factor model of professional virtual communities: Incorporation of the operators, members, and life cycle perspectives," *International Journal of Human–Computer Interaction,* vol. 35, no. 14, pp. 1312-1330, 2019.