

# **Understanding knowledge hiding behaviors in the workplace using a serious game data collection approach**

**Kaiyu Yang**, IKI-SEA – Bangkok University, Thailand, [karrieyoung@aliyun.com](mailto:karrieyoung@aliyun.com)

**Vincent Ribiere**, IKI-SEA – Bangkok University, Thailand, [vincent.r@bu.ac.th](mailto:vincent.r@bu.ac.th)

**Anne Bartel-Radic**, Université Grenoble Alpes, Grenoble INP, CERAG, France, [anne.bartelradic@iepg.fr](mailto:anne.bartelradic@iepg.fr)

## **Abstract**

*Knowledge hiding, knowledge hoarding, and knowledge withholding have drawn increasing research attention in recent decades. Most researchers approached this topic by collecting quantitative data using questionnaires with self-reported scales. However, the underreporting nature of self-report measurement, particularly when studying sensitive and socially undesirable behavior, has been identified as a prominent limitation in extant research, which shows the urgent need for less biased and more innovative research methods. Scenarios incorporating critical incidents that represent a simulation of actual working conditions appear to be a relevant technique to address the above-mentioned shortcoming. Hence, an experimental design, adopting meticulously crafted scenarios, is worth investigating. This paper presents the value of using serious games/simulations to collect data related to knowledge hiding behaviors as well as the design stages of a knowledge hiding serious game.*

**Keywords:** Knowledge hiding, research method, serious game.

## **Introduction**

Knowledge sharing has been one of the dominant research topics in knowledge management. However, constructs related to non-sharing of knowledge are quite recent, but have attracted increasing attention over the past decade. Researchers started to recognize that knowledge sharing and non-sharing of knowledge are separate behaviors (Kang, 2016; Pan & Zhang, 2018; Stenius et al., 2016) rather than the opposite sides of a coin (Arain et al., 2019) or positioning at the opposite poles of a same continuum (Connelly et al., 2012). Therefore, the non-sharing behavior deserves to be seen in its own light in research. Knowledge hiding, knowledge hoarding, and knowledge withholding are the most frequently researched topic words as the representatives of non-sharing of knowledge, with knowledge hiding, among which, has captured most research effort. Although consensus has not been fully reached concerned with the relationships and distinctions between these three constructs, a predominant perspective is to view knowledge withholding as an umbrella term comprising the intentional hiding and the unintentional hoarding of knowledge (Connelly et al., 2012; Das & Chakraborty, 2018; Kang, 2016; Webster et al., 2008). A request is mandatory in the case of knowledge hiding (Butt, 2020; Connelly et al., 2012; Silva

de Garcia et al., 2020; Webster et al., 2008), meaning that it involves more intentionality than knowledge hoarding. Therefore, the outcome of both behaviors could be very different in that the victim of knowledge hiding may harbor more negative thoughts than the target of knowledge hoarding: if they notice that the knowledge holder intentionally withholds the requested knowledge, they might be more likely to retaliate with similar conduct in the future. With due respect to the interrelations between the three non-sharing constructs and the potential of knowledge hiding to induce more harmful effects across organizations, the following discussion will proceed in the context of knowledge hiding research. This paper aims to explore the possibility of developing a data collection instrument involving game scenarios to study knowledge hiding, one of the non-sharing behaviors. The objectives are threefold. Firstly, it exhibits a systematic literature review that identifies a research gap in the methodology adopted by previous studies. Secondly, it highlights the potential and value of employing experimental design in knowledge hiding research involving the use of gamified scenarios. Thirdly, it presents a novel methodology and how we constructed it in different stages.

### **Systematic Literature Review on Knowledge Hiding**

A Systematic Literature Review (SLR) was conducted in an effort to capture the panorama of this non-sharing of knowledge research stream. An SLR satisfies the expectation of scholarly rigor and ensures comprehensiveness by including all relevant literature on a specific topic (Okoli & Schabram, 2010). To ensure transparency and completeness of reporting, a strict PRISMA process has been followed. Three academic journal databases: Scopus, Web of Science, and ProQuest, were used for retrieving relevant publications for their widely recognized credibility among the academic community. To achieve a precise search result, publications need to satisfy certain criteria, as presented hereafter, to be included for further analysis.

- Publications went through a peer review process,
- Were published in English,
- Encompass the search words "knowledge hid\*", "knowledge hoard\*", "knowledge conceal\*", or "knowledge withhold\*" in the full text,
- Including no such words as "data mining", "algorithm", "itemset", and "machine learning", considering their relevance to other subject areas than business and management (for example, computer science),
- Were not published in subject areas irrelevant to knowledge management, such as computer science, engineering, economics, biochemistry, environmental studies, and the like,
- Were published as either articles or in conference proceedings.

A query example demonstrating these criteria used for retrieving publications in Scopus is as follows:

```
TITLE-ABS-KEY(("knowledge hid*" OR "knowledge hoard*" OR "knowledge conceal*" OR "knowledge withhold*") AND NOT("data mining" OR "algorithm" OR
```

"itemset" OR "machine learning")) AND ( EXCLUDE ( SUBJAREA,"COMP" ) OR EXCLUDE ( SUBJAREA,"ENGI" ) ) AND ( EXCLUDE ( SUBJAREA,"ECON" ) OR EXCLUDE ( SUBJAREA,"MEDI" ) OR EXCLUDE ( SUBJAREA,"BIOC" ) OR EXCLUDE ( SUBJAREA,"ENVI" ) OR EXCLUDE ( SUBJAREA,"MATH" ) ) AND ( LIMIT-TO ( LANGUAGE,"English" ) ) AND ( EXCLUDE ( SUBJAREA,"EART" ) OR EXCLUDE ( SUBJAREA,"NURS" ) OR EXCLUDE ( SUBJAREA,"PHYS" ) ) AND ( LIMIT-TO ( DOCTYPE,"ar" ) OR LIMIT-TO ( DOCTYPE,"cp" ) )

Similar queries in accordance with the specific search settings in Web of Science and ProQuest were applied respectively to search publications in both databases.

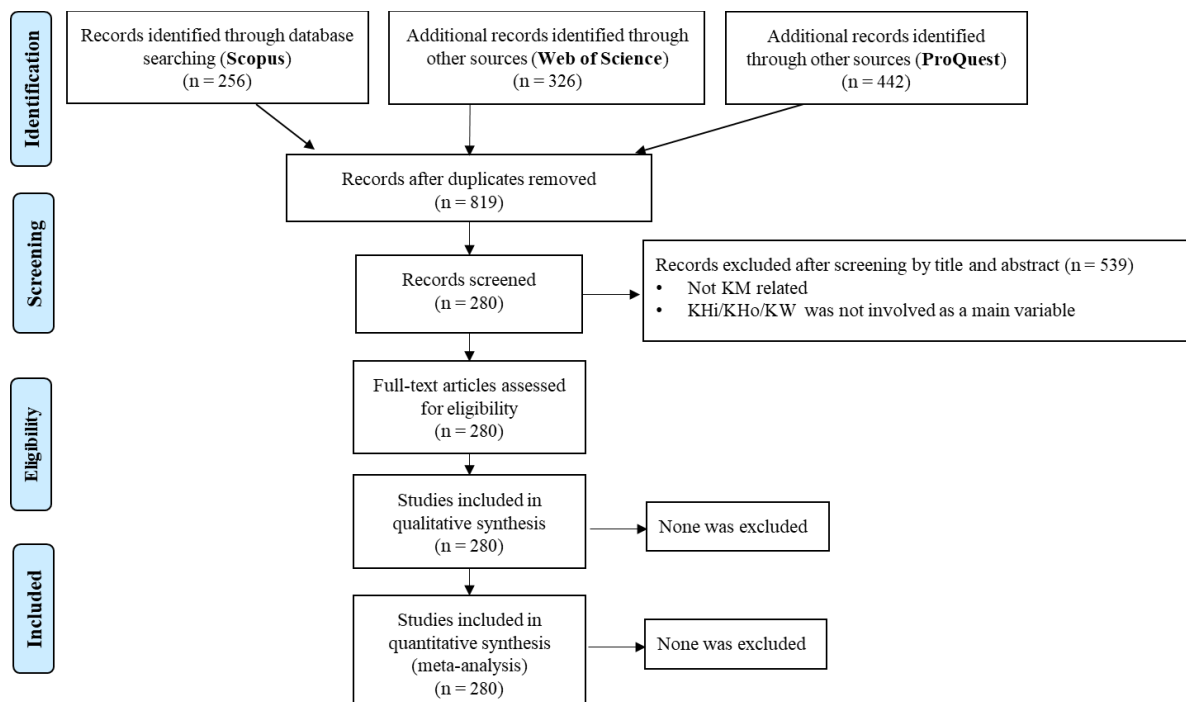
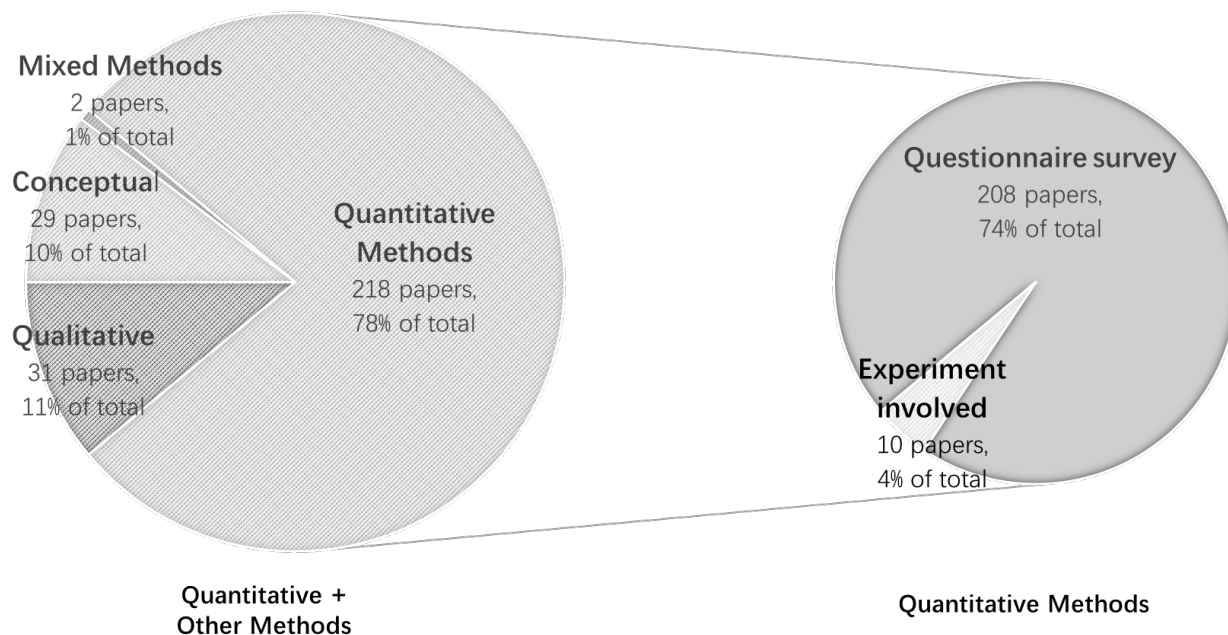


Figure 1. PRISMA Flow Diagram (Process of Article Selection)

The SLR was conducted in February 2022. In total, 1024 articles were retrieved, with 256 of them from Scopus, 326 from Web of Science, and 442 from ProQuest. After removing duplicates, the number was reduced to 819. The authors then screened the title, the abstract, and the full texts, and further excluded 539 papers that were not related to knowledge management, or pertinent to knowledge management but in which knowledge hiding, knowledge hoarding, or knowledge withholding was not involved as the main research variable, reducing the number to 280, which constituted the final dataset for further analysis. See Figure 1 for the PRISMA flow diagram, an evidence-based living document covering concepts and topics relevant to any systematic review (Moher et al., 2010), which demonstrates the flow of information through the phases of this systematic review. It maps out the number of research articles identified, included, and excluded and the criteria for exclusions. The SLR revealed that knowledge hiding studies dominated this research stream, with 247 publications out of the total 280 (88%). In the remaining 33 articles

(12%), knowledge withholding or knowledge hoarding was studied. It might be the likelihood of bringing about more detrimental effects to both individual employees and the organization as a whole that made knowledge hiding draw the most research attention among the three non-sharing behaviors. Among all the knowledge gaps identified through the systematic literature review, the authors will focus on the research methods adopted by previous studies – sticking to the theme of this current paper. An examination of the research methods of these articles (as seen in Figure 2) showed that of the final 280 articles, 29 were conceptual papers, occupying 10% of the total number; 218 could be categorized into quantitative research, accounting for 78%; 31 qualitative, constituting 11%; and the remaining two articles represented mixed-method researches, equaling less than 1%. It is worth mentioning that only ten articles of the total 280 papers, securing a tiny percentage of 4%, implemented an experimental research design. Given the unique advantage of experimental research design in providing evidence of cause-and-effect relationships rather than merely identifying correlation, such a proportion seems too small to stand in the knowledge hiding research context.



**Figure 2.** Research Methods Used in the 280 Publications

The overwhelming proportion of surveys and correlational studies may be attributed to the fact that by employing such approaches, the researcher is able to involve an extensive research sample and achieve more generalization of research results (Queirós et al., 2017), given that data collection can be faster and easier by administering via online surveys to reach a significant number of potential respondents. In addition, it is cost-effective to conduct survey studies in terms of budget and time, and it is easy to calculate the degree of association between variables using statistical methods (Queirós et al., 2017). However, the inherent shortcomings of correlational studies, such as the lack of ability to infer cause-effect correlation and provide a conclusive reason for the

existence of a correlation between two variables (Queirós et al., 2017), need to be taken into consideration when future studies dive into the topic.

## **Wide Use of Self-report Scales in Knowledge Hiding Studies**

Extant studies generally measured knowledge hiding with self-report scales. Among the commonly used measurement scales of knowledge hiding, the three-dimensional 12-item scale developed by Connelly et al. (2012) flourished in previous literature. The scale was validated by numerous studies showing that it possesses good internal consistency. Two other repeatedly employed three-item scales are those developed by Serenko and Bontis (2016) as well as Peng (2013), with the latter originally designed to measure knowledge withholding. The involvement of intentionality in concealing knowledge makes it difficult to observe knowledge hiding behaviors. Due to the difficulty in observing and capturing knowledge hiding, which is a socially undesirable and hardly visible behavior, researchers claimed that self-report measurement would be the most appropriate method to study this behavior (Connelly et al., 2012). An optimistic viewpoint is that self-report instruments/data can reach a broader subset of knowledge hiding than those reported by others (Černe et al., 2014), and that they result in a more accurate evaluation compared with other-report data, because nobody is clearer about employees' attitudes and behaviors than themselves. Likewise, self-reports are claimed to measure intentions free from the challenge of obtaining accuracy through observation (Ford et al., 2015). However, single-source bias represents a prominent problem of self-report scales (Zhao et al., 2019). When all the data is collected from one single source, biases associated with common method variance and illusionary correlations become unavoidable. Additionally, the strong risk of under-reporting knowledge hiding behaviors because of their inherent social undesirability should be properly addressed. The underreporting nature of self-report measurement, particularly when studying socially undesirable behavior (e.g., knowledge hiding), was repeatedly addressed as a research limitation by previous studies (e.g., Hernaus et al., 2019). Extant literature documents the under-reporting of self-report instruments employed to rate knowledge hiding behavior: employees under-reported their own knowledge hiding behavior to appear more socially desirable, and they believed that they hid knowledge from their colleagues less often than their colleagues (Serenko & Bontis, 2016). Hence, the predominant employment of cross-sectional data across extant knowledge hiding literature landscape signals a knowledge gap to be filled in terms of methodologies. Cross-sectional data represents one of the most frequently noted limitations in the literature, for observation at one point in time fails to infer causality between variables. Most studies that addressed this shortcoming made a clear call for the need to use more experimental designs (e.g., Babič et al., 2018; Huo et al., 2016).

Furthermore, the recent increasing research effort devoted to issues like careless responding, insufficient effort responding, and random responding suggests another inadequacy of questionnaire-based surveys. Studies on these matters provide evidence supporting the argument that accurate and robust relations will not be obtained if the step of screening for these data is omitted (Credé, 2010; Goldammer et al., 2020; McGonagle et al., 2016). However, screening procedures were rarely reported in survey studies, even in some well-acknowledged journals like *Journal of Applied Psychology*, *Journal of Management*, and *Academy of Management Journal* (Ran et al., 2015).



## **Introducing Experimental Methodology into Knowledge Hiding Research**

Taking into account the indicated drawbacks of surveying knowledge hiding, a socially undesirable construct, via questionnaires and based on one-source data, we argue that randomized experimentation could be of significant value in knowledge hiding studies for its twofold advantage of high internal validity and identifiability of causality (Falk & Heckman, 2009; Spencer et al., 2005). Experimental design is particularly appropriate in the context of knowledge hiding research for at least two reasons. First, experimental research designs are particularly useful when the objective of the research is to establish the causal relationships between independent and dependent variable(s) (Podsakoff & Podsakoff, 2019). The purpose of an experiment is to examine the probability of a change in an independent variable causing a change in a dependent variable (Saunders et al., 2016). Second, it properly addresses the under-reporting nature of self-report instruments, thus helping achieve a more unbiased and accurate research result. Despite the overwhelming advantages that experimental designs allow to make inferences about the causality of the proposed relationship, reduce research noise, and ease the concerns of reverse causality, experimental designs represent rare cases in extant business and management studies (Van Witteloostuijn, 2015). In 2016, less than 1% of more than 900 empirical studies published in the *Journal of International Business Studies* used an experimental design (Zellmer-Bruhn et al., 2016). The small proportion in international business research is in striking contrast to that in certain fields such as economics, psychology, and marketing, where the use of experimental research designs is not just increasing but has become almost mandatory for top-level publications (Bartel-Radic, 2019). The systematic literature review on non-sharing knowledge concepts conducted by the authors revealed an unsurprisingly similar situation where only 10 out of the relevant total 280 published articles involved experimental designs, taking up a tiny percentage of 4%. However, given that experimental design allows the strongest statements of causality, such design could be very useful for assessing people's willingness to share information and measuring the resistance to others who modify their ideas (Webster et al., 2008). Experimental studies are repeatedly called for by numerous researchers working on knowledge hiding (e.g., Babič et al., 2018; Huo et al., 2016). Experimental research designs include laboratory experiments, also called clinical experiments, field experiments, and quasi-experiments. In both laboratory/clinical experiments and field experiments, participants are randomly assigned into either the experimental group, where they are exposed to some form of intervention(s), or the control group, where no intervention is made. Any change to the dependent variable will only be attributed to the intervention(s), with other external factors remaining constant. Field experiments occur in natural organizational settings, making them less susceptible to criticisms about artificiality. In other words, participants' awareness of the experimental conditions is not an issue, and their reactivity is more likely to be authentic. However, the lack of control over the external environment in field experiments raises concerns about the construct validity of the manipulations (Podsakoff & Podsakoff, 2019; Saunders et al., 2016). Another drawback of field experiments lies in their demanding requirement for time and resources in implementation, making them costlier (Bartel-Radic, 2019) and possibly chosen by even fewer researchers in business and management. Consequently, a laboratory setting comes as a satisfying option, creating a noise-minimizing

environment. As the term entails, a laboratory experiment is the one that operates in a dedicated place, usually an artificial reproduction of a real situation. A laboratory experiment enjoys greater internal validity than a field experiment, for it allows for controlling contextual variables, which is not possible in field experiments (Bartel-Radic, 2019). Figure 3 displays different experimental designs and the conditions to fulfill for “true” laboratory experiments.

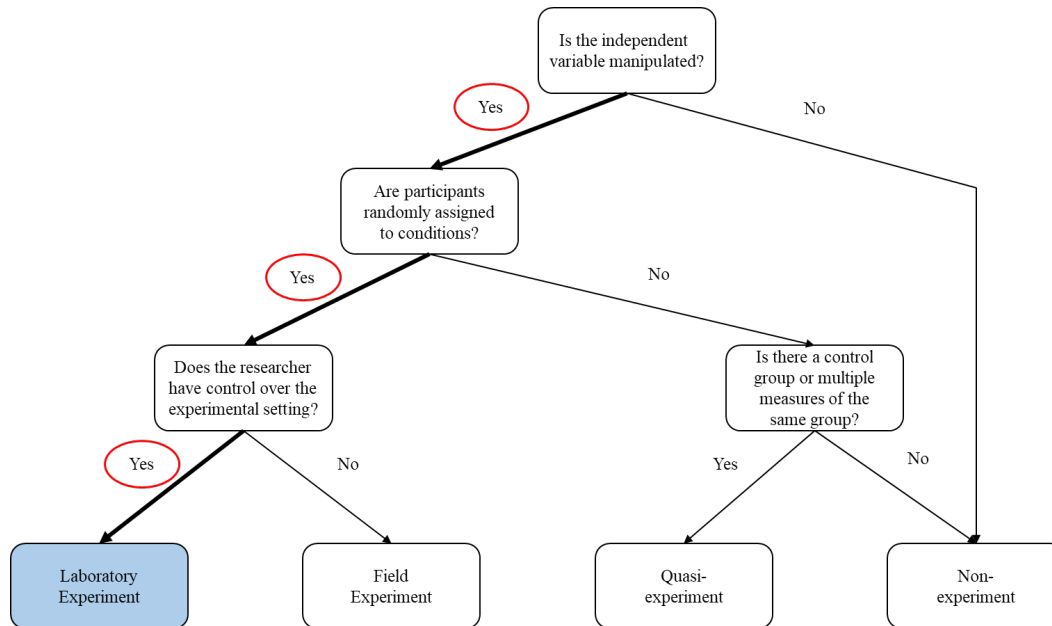


Figure 3. Decision Tree for Classifying Experimental Research Designs (Adapted from Podsakoff & Podsakoff, 2019)

### Extant Studies on Knowledge Hiding Involving Experiments

In our systematic literature review, we found ten knowledge hiding studies that included experimental designs, among which (Kim, 2021) was not accessible. Table 1 provides an overview of the previous experiments conducted to study knowledge hiding. All nine accessible studies used vignettes or scenarios. They are usually presented in the form of a written description to the participants or improvised by the participants assigned with a particular role following the manipulation strategy (explained verbally or through written instructions). While the participants mainly rely on their imagination or interpretation to reproduce the event or incident described, the realism, the immersiveness, and the consistency of the scenarios may be subjected to suspicion. Another noteworthy limitation lies in the composition of the samples, predominantly consisting of undergraduate students. Recruiting participants who lack working experience in natural work settings to study organizational behavior (e.g., knowledge hiding) is frequently outlined as a strong drawback. To address such limitations and relieve research bias, eight out of the nine accessible studies adopted a quantitative multi-study research design, combining experiments with a field study with an additional sample of organizational employees (Arendt et al., 2021, where three experiments were conducted, makes an exception). In the nine studies, scenarios were used to describe the context of knowledge hiding, including factors that might induce knowledge hiding.

However, knowledge hiding itself was rated through a self-reported follow-up survey. While the superiority of hypothetical scenarios in eliciting emotional responses to situation-recall inductions should be well acknowledged (Steiner, 2009), there seems to be room for improvement in terms of participants' involvement and engagement in the study.

**Table 1.** Overview of Experiments in Knowledge Hiding Studies

KH Experimental Research	Research Technique	Sample Size	Sample Source Country	Type of Participants	How Knowledge Hiding was Studied
Arendt et al., 2021	Senario-based with participants reading written descriptions	455	Germany	the majority of which (96.3%) were German and were university students (51.9%)	studied as dependent variable and tested with scale
Bogilović et al., 2017	Senario-based with participants acting out a given role	104	Slovenia	international undergraduate (83%) and graduate (16%) students who attended an elective course	studied as independent variable and scale rating result used as manipulation checks
Burmeister et al., 2019	Senario-based with participants reading written descriptions	156	U.S.	employees from the platform Amazon Mechanical Turk	studied as independent variable and presented in written descriptions
Černe et al., 2012	Senario-based with participants acting out a given role	86	Slovenia	first-year undergraduates within a management course	studied as independent variable and manipulated
Černe et al., 2014	Senario-based with participants acting out a given role	132	Slovenia	second-year undergraduates within an HRM course	studied as independent variable and scale rating result used as manipulation checks
Babič et al., 2019	Senario-based with participants reading written descriptions	115	Slovenia	second-year undergraduate students taking a human resource management course	studied as dependent variable and tested with scale
Škerlavaj et al., 2018	Senario-based with participants acting out a given role	60	Slovenia	second-year undergraduates (plus 60 more as confederates)	studied as dependent variable and tested with scale
Zhao & Liu, 2021	Senario-based with participants reading written descriptions	80	China	part-time MBA students	studied as dependent variable and tested with scale
Zhu et al., 2019	Senario-based with participants reading written descriptions	210	China	undergraduate students	studied as dependent variable and tested with scale

### Use of Game Scenarios as Part of Experimental Research Designs

Generally, scenarios are embodied through written narratives given to participants when surveying. Using written narratives for constructing scenarios is a widely utilized approach in decision-making research (Vermillion et al., 2017). In a typical manner, the participants are asked to make scenario-based decisions after reading a written description of the scenario, as manifested in the experiments performed to study knowledge hiding. More experimental control can be achieved through this method in comparison to other ones, which results in more reliable causal inferences (Vermillion et al., 2017). Vermillion et al. (2017) showed that interactive stimuli enhanced processing fluency, served better to activate deeper meaning than text stimuli, and held



more realism to generate more genuine responses. Their study revealed no significant difference in participant responses between written narrative and scenario-based games. However, they consider that games induce noisy data (Vermillion et al., 2017). Despite the benefits it provides, a written summary could be too simple to be stimulating and immersive enough to simulate reality. Vermillion et al. (2017) argued that the limitations of written narratives might open up a potential for the application of games to the research context, because games allow the players to immerse in the scenarios and discover relevant information through a more interactive process (Koster, 2013). In contrast with previous experimental studies, the research design we propose is based on an interactive serious game where the participants are immersed in a scenario that ensures consistency of the participants' experience.

### **Serious Games**

When referring to games as a data collection instruments in the research context, we allocate serious games a proper position. Serious games manifest the application of games and simulation technologies to domains that are not for entertainment purposes (Zyda, 2005). Serious games have been widely applied to various domains, including education, well-being, advertising, cultural heritage, interpersonal communication, and health care. The combination of the three components – experience, entertainment, and multimedia of serious games differentiate this term from such terminologies as training simulation, computer game, and sports and board game (Laamarti et al., 2014). Games enable the involvement of costly, dangerous, difficult, or impractical activities in classrooms, capable of functioning as a feasible medium for learning (Greitzer et al., 2007). Computer games create an immersive experience for players owing to their capability of providing fun, challenge, and instant feedback, and the rich visuals of computer games make them enticing and engaging to players (Greitzer et al., 2007). As economists have suggested, virtual environments in video games may serve as efficient and cost-effective substitutes for laboratory settings in conducting economics research (Castronova, 2008; Chesney et al., 2009).

Simulation is a type of modeling that is a simplification of some structure or system (Gilbert & Troitzsch, 2005). Akin to an experimental methodology, simulation can be used for the purposes of understanding, prediction, business forecasting, substitution, training, and entertainment (Gilbert & Troitzsch, 2005). The latter two purposes are well aligned with that of serious games. The involvement of pedagogy is a prominent feature that distinguishes serious games from general ones (Greitzer et al., 2007; Zyda, 2005). In other words, it is the characteristic of imparting knowledge or skills that makes a game “serious” – the involvement of activities that educate or instruct is an indispensable component of a serious game (Zyda, 2005). Therefore, in addition to creating realistic simulations of the real condition to make the game immersive and entertaining, it is equally important for a serious game to provide the players with learning experiences. However, debates remain between the learning and gaming camps of serious games as to the golden rule in defining the order and ratio of learning and gaming (Ravyse et al., 2017). Furthermore, interactivity sets serious games apart from other forms of edutainment (Ravyse et al., 2017). Therefore, the straightforwardness of the game interface is essential, in terms of the player providing input to the game as well as communicating messages to the player (Ravyse et al., 2017). As prescribed by the constructivist learning theory, the players' cycle of mastery should be continuously challenged, which sets requirements for gradually increasing difficulty in game

tasks (Ravyse et al., 2017). Hence, a qualified serious game developer should have knowledge of storytelling, interface design, gaming engines and tools, and learning theory (Greitzer et al., 2007) while giving due respect to rather than impeding the players' hunger for fun (Ravyse et al., 2017).

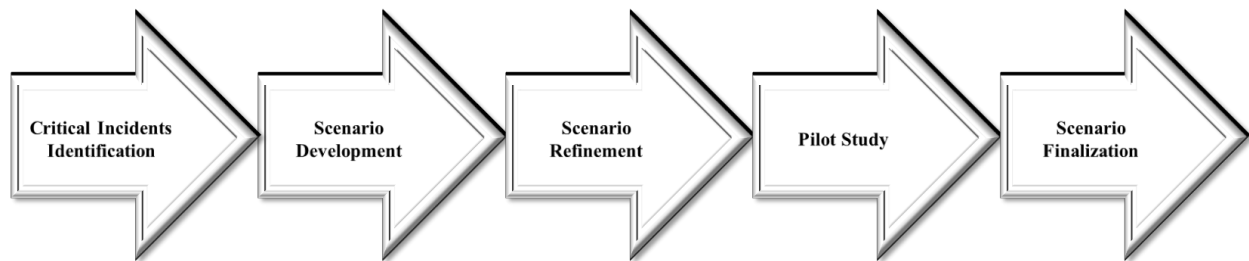
While they have been rarely utilized in international management so far, serious games are now drawing ever-growing research attention as innovative and effective implementation of learning and management knowledge (Bartel-Radic, 2019). Beyond its overwhelming application to educational and training contexts, employing serious games in research can also be meaningful because of its facilitating effect on study distribution and data collection (Vermillion et al., 2017).

### **Design of a Serious Game for Knowledge Hiding Research**

Previous literature has established the existence of a mimesis effect – when players are explicitly given a role, there is a significant relationship between their role and their in-game actions (Domínguez et al., 2016). In the serious game we are proposing for knowledge hiding research, the players who participate in the game play the part of knowledge holders who are confronted with requests from their colleagues for specific knowledge. Additional possibilities would be situations where the player is the knowledge seeker (i.e., makes requests for a specific piece of knowledge from their coworker), or even a bystander who witnesses the occurrence of knowledge hiding. However, for the purpose of obtaining a high degree of immersion, the players play their own person in terms of age, gender, and nationality throughout the game. For scenario development, the critical incident technique (Flanagan, 1954) is recommended as a valuable means to identify and formulate critical incidents concerning the context where a knowledge request is forwarded and knowledge hiding occurs. Initial face validity can be achieved by crafting scenarios depicting factual work issues. Interviews with working professionals from various industries, particularly those with a knowledge management background, appear as very relevant to identify such critical incidents.

Our game scenario is based on a series of collected critical incidents, with each scene putting the spotlight on a specific facet or variable. Interviewing working professionals with relevant knowledge backgrounds from diverse fields also helps enhancing the realism of the scenario by identifying what type of knowledge is usually requested in work settings. It is suggested that only knowledge which is of a certain value to the knowledge holder is worth the researcher's focus and effort. It will be of least meaning if researchers dig into the knowledge that can be easily given away, requiring no second thought from the knowledge holder, as well as knowledge that will never be shared, under any circumstance. Considering the novelty of using game scenarios as a means to collect data for knowledge hiding research, it is necessary to validate the scenarios incorporating these critical incidents before administering the game to the intended research targets. Collaborative workshops involving experts from knowledge management and management at large are essential to help sustaining the validity of this data collection instrument. Acquiring feedback and suggestions on the realism and representativeness of the scenes from those subject matter experts who are "working in the field" ensures face validity (Garson, 2013), particularly when the inclusion of subject matter experts has been identified as valuable in developing serious games (Ravyse et al., 2017). Subsequently, a pilot study helps detecting any deficiency or flaw of the instrument before circulating it on a large scale. The objective of a pilot

study is to further refine and validate the scenario and the game on the whole, including the logic of scenes distribution and sequence, the format of the game, and the clarity and the wording of the instruction presented to the players. Not causing confusion to participants further secures the instrument's face validity (Saunders et al., 2009) and thus facilitates documentation of the data collection. Meanwhile, a preliminary analysis of the data collected from the pilot study can provide the researcher with an initial assessment of the validity and the likely reliability of the data before circulating the instrument among a larger sample. Figure 4 specifies the serious game development process.

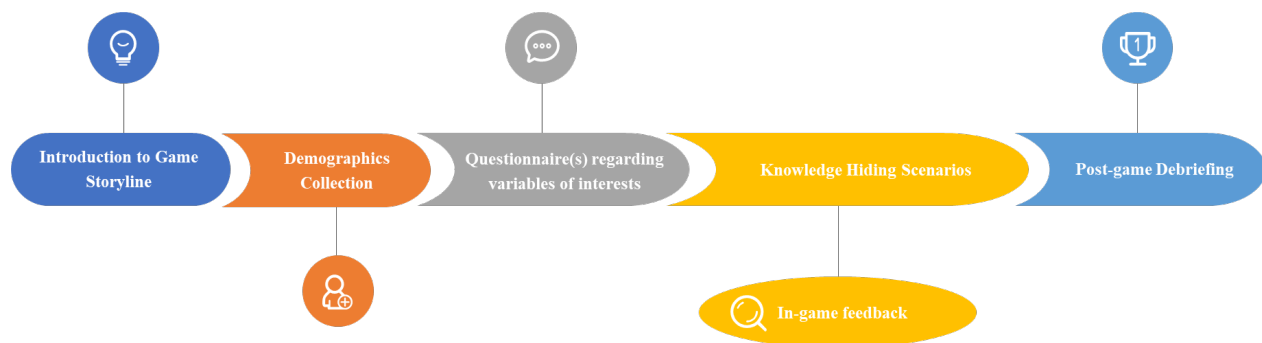


**Figure 4.** Knowledge Hiding Serious Game Development Process

The game we propose for further use as a research instrument is structured into five phases (see Figure 5). In phase one, the players are introduced to the game storyline and get aware of the game world they are to interact with. They are presented with the context they will be immersed in throughout the game. It is closely coupled with the “learning material” (Ravyse et al., 2017), i.e., knowledge regarding knowledge hiding, knowledge sharing, and knowledge management, provided during the game. In phase two, the players need to report their demographics, which allows further investigation of such control variables. Take seniority, for instance: a previous study exhibited that the propensity to hide knowledge is set in by the seniority of the individuals who have moved up to the top position within the organizational hierarchy (Issac et al., 2020). Therefore, players’ age, tenure, or position at work are worth being documented for subsequent inspection of the possible correlations between these demographic variables and knowledge hiding behaviors. Thirdly, before presenting the scenes regarding the main content of knowledge hiding, questionnaires concerning specific constructs of interest can be incorporated into the game procedures, such as emotional intelligence or personality traits scales, just to name some. This proposition is made out of two considerations. First, previous knowledge hiding studies have revealed the impact of personality traits on individuals’ knowledge hiding behavior. For example, employees who scored high on Machiavellianism would be more likely to engage in knowledge hiding under a low level of ethical leadership (Belschak et al., 2018), and those who scored high on neuroticism were also more prone to reciprocate uncivil treatment with knowledge hiding (Arshad & Ismail, 2018). Since these findings were concluded by a survey method based solely on questionnaires, it will be interesting and meaningful to investigate if similar results will be replicated via an experimental method. Second, laboratory experiments have been proven useful in examining how personality traits are related to attitudes, behaviors, decisions, and outcomes relevant to international business (Van Witteloostuijn, 2015). After the “warming-up” process, the game players then experience a series of scenes in phase four, devised to collect data regarding

knowledge hiding. Each scenario represents a meticulously designed combination of variables of interest that collectively form a dedicated environment aiming to reduce research noise. Motivations and outcomes of knowledge hiding behavior are two of the major concerns in this research stream. While motivations like workplace incivility (Arshad & Ismail, 2018; Shah & Hashmi, 2019) or interpersonal conflicts (Akhlaghimofrad & Farmanesh, 2021) can be properly built into scenarios with low effort, by simply including actors who play such incidents in the scenario. However, investigating knowledge hiding outcomes might require longer time endurance and involve more scenes. For instance, to demonstrate outcomes like innovative work behavior (Cai & Wen, 2018; Černe et al., 2017), extra-role behavior (Alnaimi & Rjoub, 2019), or any other variables the researcher vote for as a possible consequence of knowledge hiding behavior, will at least double the design effort of crafting scenarios regarding both knowledge hiding and the outcome variables. To give a more concrete and specific example, let us zoom in on social exchange – one of the most frequently drawn-on theories in knowledge hiding studies (see for example Serenko & Bontis, 2016). According to social exchange theory, the quality of past interpersonal interactions between individuals creates the tone for their future interactions (Holten et al., 2016). Therefore, reciprocity could be a potential predictor of knowledge hiding behavior. While positive reciprocity can be hypothesized to decrease knowledge hiding occurrence, negative reciprocity is likely to induce knowledge hiding. In this regard, individual game scenarios could be created to simulate and demonstrate positive reciprocity, negative reciprocity, or different knowledge hiding strategies such as playing dumb, evasive hiding, and rationalized hiding (Connelly et al., 2012). By having participants experience scenarios where the variable of interest is manipulated and then analyzing their decisions, the researchers will be able to identify any causal relationships between reciprocity and knowledge hiding.

To make game scenarios more engaging and more realistic, incorporating multimedia components (texts, voice messages, videos, etc.) in scenarios appears to be relevant. For example, the knowledge requests can be forwarded through different media channels, which helps ensuring the realism and the interactiveness of the game, hence making it more enticing to the players. Additionally, such incorporation should generate interesting findings considering the different degrees of information load conveyed by these various communication channels. Along with the background storyline, in-game feedback is recommended to highlight the learning material as a serious game element (Ravyse et al., 2017). Therefore, post-game debriefing that elucidates the learning material is placed at the end of the game, offering the players an opportunity to reflect and consolidate their in-game activities (Crookall, 2014). Feedback material includes information about knowledge hiding and, more generally, about knowledge management, in order to deepen the participants' insights into this topic. It also gives suggestions on how to better phrase and respond to a knowledge request from coworkers, in order to help satisfying the pedagogical purpose of serious games.



**Figure 5.** Phases of Knowledge Hiding Serious Game

Prior studies of knowledge withholding addressed the issue that respondents might tend to give socially desirable responses, resulting in an inaccurate research conclusion, and highlighted the valuableness of online approach/web-based reporting in gathering sensitive information in that it assures anonymity (Webster et al., 2008). To properly address this concern, we suggest administering the game online, which will also allow the participants to play the game at the time and the place of their preference. So far, we have discussed the design, development, and application of serious games to knowledge hiding studies. However, it is worth mentioning that this data collection instrument can also be utilized in knowledge sharing studies or studies involving both knowledge sharing and knowledge hiding behaviors. Comparing both concepts has been an emerging research trend coming to the fore, particularly over the last two years, as our systematic literature review shows. Combining knowledge hiding and knowledge sharing will further contribute to game realism, since it is unrealistic for an individual to engage continuously in hiding behavior when requested for knowledge. Bearing this in mind, and regarding our earlier proposition of crafting social exchange and reciprocity and knowledge hiding into scenarios, we can also incorporate knowledge-sharing scenes into the game scenario. Thereby, the mechanisms behind both related but different behaviors could be unveiled, thus facilitating our understanding of the distinctions and overlaps (if there exist any) of those working mechanisms.

### **Limitations**

This paper mainly discussed the potential of implementing a serious game as a data collection instrument in an experimental research design dedicated to knowledge hiding research, and outlined the steps followed to develop a game scenario concerned with knowledge hiding. Insights from practitioners who have the expertise and experience in developing serious games might make a meaningful contribution to this discussion. In a similar vein, analysis of feedback based on the end-users' game experience will be highly relevant and contribute to this serious game development. Likewise, feasible strategies to devise game-generated progress-tracking reports of in-game learning events to enhance debriefing are worth further discussion. Moreover, additional investigation of existing online tools where serious games are available should inform researchers where they can head for when they intend to follow the proposed path. Last but not least, more suggestions seem necessary in terms of promoting the gaming effect beyond research purposes, in addition to the proposition made by Ravyse et al. (2017) – “Involving a homogenous target player



group from early in the design and play-testing phases will ensure that the game will be enjoyed” (p. 12).

## Conclusion

This paper started with a systematic literature review regarding research methods in existing studies on knowledge hiding that showed that the vast majority of publications are questionnaire-based quantitative studies. We argued that experimental research designs might be a more useful and meaningful approach to knowledge hiding behavior. By revisiting the sensitivity and social undesirability of the knowledge hiding construct, we highlighted the strong fit of experimental designs and knowledge hiding theory. We proposed a serious game as a data collection instrument concerning knowledge hiding behavior, and specified the stages to craft it. Despite its novelty as a data collection instrument, the validity of the game is ensured by scrutiny by subject matter experts in knowledge management and more generally in management. However, the reliability of this instrument requires further consideration that will partly rely on empirical data from its application in future studies. Advocating Van Witteloostuijn (2015) argument that online tools can enhance an experimental tradition, promote further progress in business research and advance the effectiveness and entertainability of (international) business teaching, we embrace great confidence in crafting serious games as a promising tool for research and training regarding knowledge hiding, and knowledge management at large. We, therefore, call for more research efforts dedicated to this promising avenue, and we expect to see new generations of more sophisticated and immersive serious games develop and flourish in the Metaverse over the next years.

## References

- Akhlaghimofrad, A., & Farmanesh, P. (2021). The association between interpersonal conflict, turnover intention and knowledge hiding: The mediating role of employee cynicism and moderating role of emotional intelligence. *Management Science Letters, 11*(7), 2081-2090. <https://doi.org/10.5267/j.msl.2021.3.001>
- Alnaimi, A. M. M., & Rjoub, H. (2019). Perceived organizational support, psychological entitlement, and extra-role behavior: The mediating role of knowledge hiding behavior. *Journal of Management and Organization, 27*(3), 507-522. <https://doi.org/10.1017/jmo.2019.1>
- Arain, G. A., Bhatti, Z. A., Hameed, I., & Fang, Y. H. (2019). Top-down knowledge hiding and innovative work behavior (IWB): A three-way moderated-mediation analysis of self-efficacy and local/foreign status. *Journal of Knowledge Management, 24*(2), 127-149. <https://doi.org/10.1108/jkm-11-2018-0687>
- Arendt, J. F. W., Kugler, K. G., & Brodbeck, F. C. (2021). Conflicting relational models as a predictor of (in)justice perceptions and (un)cooperative behavior at work. *Journal of Theoretical Social Psychology, 5*(3), 183-202. <https://doi.org/10.1002/jts5.85>
- Arshad, R., & Ismail, I. R. (2018). Workplace incivility and knowledge hiding behavior: Does

- personality matter? *Journal of Organizational Effectiveness*, 5(3), 278-288.  
<https://doi.org/10.1108/JOEPP-06-2018-0041>
- Babič, K., Černe, M., Škerlavaj, M., & Zhang, P. (2018). The interplay among prosocial motivation, cultural tightness, and uncertainty avoidance in predicting knowledge hiding. [Preučitev vpliva trojne interakcije med prosocialno motivacijo, kulturno togostjo in nagnjenostjo k tveganju na pojav skrivanje znanja]. *Economic and Business Review for Central and South - Eastern Europe*, 20(3), 395-422,443.  
<https://doi.org/http://dx.doi.org/10.15458/85451.71>
- Bartel-Radic, A., Mouillot, P., & Taylor, D. (2019). Experimental methods in international management research. In Bartel-Radic, Anne (coord.), *Méthodes de recherche innovantes et alternatives en économie et gestion / Innovative and alternative research methods in economics and Business Administration* (pp. 61-75). European Institute for Knowledge & Value Management.
- Belschak, F. D., Den Hartog, D. N., & De Hoogh, A. H. B. (2018). Angels and demons: The effect of ethical leadership on Machiavellian employees' work behaviors. *Frontiers in Psychology*, 9(JUN). <https://doi.org/10.3389/fpsyg.2018.01082>
- Butt, A. S. (2020). Mitigating knowledge hiding in firms: An exploratory study. *Baltic Journal of Management*, 15(4), 631-645. <https://doi.org/10.1108/BJM-01-2020-0016>
- Cai, F. Q., & Wen, N. (2018). The influence of individual goal orientation on innovation behavior from the perspective of knowledge hiding. In J. Liu & K. L. Teves (Eds.), *Proceedings of the 2018 2nd International Conference on Education, Economics and Management Research*, 182, 671-676.
- Castronova, E. (2008). Synthetic worlds: The business and culture of online Games. *University of Chicago Press*.
- Černe, M., Nerstad, C. G. L., Dysvik, A., & Škerlavaj, M. (2014). What goes around comes around: Knowledge hiding, perceived motivational climate, and creativity. *Academy of Management Journal*, 57(1), 172-192. <https://doi.org/10.5465/amj.2012.0122>
- Černe, M., Hernaes, T., Dysvik, A., & Škerlavaj, M. (2017). The role of multilevel synergistic interplay among team mastery climate, knowledge hiding, and job characteristics in stimulating innovative work behavior. *Human Resource Management Journal*, 27(2), 281-299. <https://doi.org/10.1111/1748-8583.12132>
- Chesney, T., Chuah, S.-H., & Hoffmann, R. (2009). Virtual world experimentation: An exploratory study. *Journal of Economic Behavior & Organization*, 72(1), 618-635.  
<https://doi.org/10.1016/j.jebo.2009.05.026ff>
- Connelly, C. E., Zweig, D., Webster, J., & Trougakos, J. P. (2012). Knowledge hiding in organizations. *Journal of Organizational Behavior*, 33(1), 64-88.  
<https://doi.org/10.1002/job.737>
- Crookall, D. (2014). Engaging (in) gameplay and (in) debriefing. *Simulation & Gaming*, 45,

- 416–427. <https://doi.org/10.1177/1046878114559879>
- Das, A. K., & Chakraborty, S. (2018). Knowledge withholding within an organization: The psychological resistance to knowledge sharing linking with territoriality. *Risus-Journal on Innovation and Sustainability*, 9(3), 94-108. <https://doi.org/10.24212/2179-3565.2018v9i3p94-108>
- Domínguez, I. X., Cardona-Rivera, R. E., Vance, J. K., & Roberts, D. L. (2016). *The mimesis effect: The effect of roles on player choice in interactive narrative role-playing games*. Paper presented at the Proceedings of the 2016 CHI Conference on Human Factors in Computing Systems, 3438–3449. <https://doi.org/10.1145/2858036.2858141>
- Falk, A., & Heckman, J. J. (2009). Lab experiments are a major source of knowledge in the social sciences. *Science*, 326, 535-538. <https://doi.org/10.1126/science.1168244>
- Flanagan, J. C. (1954). The critical incident technique. *Psychological bulletin*, 51(4), 327–358. <https://doi.org/10.1037/h0061470>
- Gilbert, N., & Troitzsch, K. (2005). *Simulation for the social scientist* (2<sup>nd</sup> Ed.) Open University Press.
- Greitzer, F. L., Kuchar, O. A., & Huston, K. (2007). Cognitive science implications for enhancing training effectiveness in a serious gaming context. *Journal on Educational Resources in Computing (JERIC)*, 7(3), 2-es. <https://doi.org/10.1145/1281320.1281322>
- Hernaus, T., Cerne, M., Connelly, C., Poloski Vokic, N., & Škerlavaj, M. (2019). Evasive knowledge hiding in academia: When competitive individuals are asked to collaborate. *Journal of Knowledge Management*, 23(4), 597-618. <https://doi.org/10.1108/JKM-11-2017-0531>
- Holten, A.-L., Hancock, G. R., Persson, R., Hansen, A. M., & Hogh, A. (2016). Knowledge hoarding: Antecedent or consequent of negative acts? The mediating role of trust and justice. *Journal of Knowledge Management*, 20(2), 215-229. <https://doi.org/10.1108/jkm-06-2015-0222>
- Huo, W., Cai, Z., Luo, J., Men, C., & Jia, R. (2016). Antecedents and intervention mechanisms: A multi-level study of R&D team's knowledge hiding behavior. *Journal of Knowledge Management*, 20(5), 880-897. <https://doi.org/10.1108/JKM-11-2015-0451>
- Issac, A. C., Baral, R., & Bednall, T. C. (2020). Don't play the odds, play the man: Estimating the driving potency of factors engendering knowledge hiding behaviour in stakeholders. *European Business Review*, 32(3), 531-551. <https://doi.org/10.1108/EBR-06-2019-0130>
- Kang, S. W. (2016). Knowledge withholding: Psychological hindrance to the innovation diffusion within an organisation. *Knowledge Management Research and Practice*, 14(1), 144-149. <https://doi.org/10.1057/kmrp.2014.24>
- Khalid, M., Bashir, S., Khan, A. K., & Abbas, N. (2018). When and how abusive supervision leads to knowledge hiding behaviors: An Islamic work ethics perspective. *Leadership and Organization Development Journal*, 39(6), 794-806. <https://doi.org/10.1108/LODJ-05->

[2017-0140](#)

- Kim, H. (2021). Generalized vs. dyadic reciprocity: How will my knowledge hiding affect my creativity in a work team? *Korean Journal of Management*, 29(1), 113-141. <https://doi.org/10.26856/kjom.2021.29.1.113>
- Koster, R. (2013). *Theory of fun for game design*. ACM Digital Library.
- Laamarti, F., Eid, M., & El Saddik, A. (2014). An overview of serious games. *International Journal of Computer Games Technology*, 2014, 1-15. <https://doi.org/10.1155/2014/358152>
- Moher, D., Liberati, A., & Tetzlaff, J. (2010). Preferred reporting items for systematic reviews and meta-analyses: The PRISMA statement. *International Journal of Surgery*, 8(5), 336-341. <https://doi.org/10.1016/j.ijsu.2010.02.007>
- Okoli, C., & Schabram, K. (2010). A guide to conducting a systematic literature review of information systems research. *Sprouts: Working Papers on Information Systems*, 10(26). <http://sprouts.aisnet.org/10-26>
- Pan, W., & Zhang, Q. (2018). Withholding knowledge in teams: An interactionist perspective of personality, justice, and autonomy. *Social Behavior and Personality*, 46(12), 2009-2024. <https://doi.org/10.2224/sbp.7390>
- Peng, H. (2013). Why and when do people hide knowledge? *Journal of Knowledge Management*, 17(3), 398-415. <https://doi.org/10.1108/JKM-12-2012-0380>
- Podsakoff, P. M., & Podsakoff, N. P. (2019). Experimental designs in management and leadership research: Strengths, limitations, and recommendations for improving publishability. *The Leadership Quarterly*, 30(1), 11-33. <https://doi.org/10.1016/j.leaqua.2018.11.002>
- Queirós, A., Faria, D., & Almeida, F. (2017). Strengths and limitations of qualitative and quantitative research methods. *European Journal of Education Studies*, 3(9), 369-387. <https://doi.org/10.5281/zenodo.887089>
- Ran, S., Liu, M., Marchiondo, L. A., & Huang, J. L. (2015). Difference in response effort across sample types: Perception or reality? *Industrial and Organizational Psychology: Perspectives on Science and Practice*, 8(2), 202–208. <https://doi.org/10.1017/iop.2015.26>
- Ravyse, W. S., Seugnet Blignaut, A., Leendertz, V., & Woolner, A. (2017). Success factors for serious games to enhance learning: A systematic review. *Virtual Reality*, 21(1), 31-58. <https://doi.org/10.1007/s10055-016-0298-4>
- Saunders, M., Lewis, P., & Thornhill, A. (2016). *Research methods for business students*: Pearson education.
- Serenko, A., & Bontis, N. (2016). Understanding counterproductive knowledge behavior: Antecedents and consequences of intra-organizational knowledge hiding. *Journal of Knowledge Management*, 20(6), 1199-1224. <https://doi.org/10.1108/JKM-05-2016-0203>

- Shah, M., & Hashmi, M. S. (2019). Relationship between organizational culture and knowledge hiding in software industry: Mediating role of workplace ostracism and workplace incivility. *Pakistan Journal of Commerce and Social Sciences*, 13(4), 934-952. <http://hdl.handle.net/10419/214259>
- Silva de Garcia, P., Oliveira, M., & Brohman, K. (2020). Knowledge sharing, hiding and hoarding: How are they related? *Knowledge Management Research and Practice*, 20(3), 339-351. <https://doi.org/10.1080/14778238.2020.1774434>
- Spencer, S. J., Zanna, M. P., & Fong, G. T. (2005). Establishing a causal chain: Why experiments are often more effective than mediational analyses in examining psychological processes. *Journal of Personality and Social Psychology*, 89(6), 845–851. <https://doi.org/10.1037/0022-3514.89.6.845>
- Steiner, J. (2009). *Understanding the behavioral responses corresponding with the emotions guilt and shame*. Carnegie Mellon University, Pittsburgh, USA. [https://kithub.cmu.edu/articles/thesis/Understanding\\_the\\_Behavioral\\_Responses\\_Corresponding\\_with\\_the\\_Emotions\\_Guilt\\_and\\_Shame/6686642](https://kithub.cmu.edu/articles/thesis/Understanding_the_Behavioral_Responses_Corresponding_with_the_Emotions_Guilt_and_Shame/6686642)
- Stenius, M., Hankonen, N., Ravaja, N., & Haukkala, A. (2016). Why share expertise? A closer look at the quality of motivation to share or withhold knowledge. *Journal of Knowledge Management*, 20(2), 181-198. <https://doi.org/10.1108/JKM-03-2015-0124>
- Van Witteloostuijn, A. (2015). Toward experimental international business: Unraveling fundamental causal linkages. *Cross Cultural Management: An International Journal*, 22(4), 530-544. <https://doi.org/10.1108/CCM-06-2015-0075>
- Vermillion, S. D., Malak, R. J., Smallman, R., Becker, B., Sferra, M., & Fields, S. (2017). An investigation on using serious gaming to study human decision-making in engineering contexts. *Design Science*, 3. <https://doi.org/10.1017/dsj.2017.14>
- Webster, J., Brown, G., Zweig, D., Connelly, C. E., Brodt, S., & Sitkin, S. (2008). Beyond knowledge sharing: Withholding knowledge at work. In J. J. Martocchio (Ed.), *Research in Personnel and Human Resources Management*, 27, 1-37. [https://doi.org/10.1016/S0742-7301\(08\)27001-5](https://doi.org/10.1016/S0742-7301(08)27001-5)
- Zellmer-Bruhn, M., Caligiuri, P., & Thomas, D. C. (2016). From the editors: Experimental designs in international business research. *Journal of International Business Studies*, 47, 399-407. <https://doi.org/10.1057/jibs.2016.12>
- Zhao, H., Liu, W., Li, J., & Yu, X. (2019). Leader–member exchange, organizational identification, and knowledge hiding: The moderating role of relative leader–member exchange. *Journal of Organizational Behavior*, 40(7), 834-848. <https://doi.org/10.1002/job.2359>
- Zyda, M. (2005). From visual simulation to virtual reality to games. *Computer*, 38(9), 25-32. <https://doi.org/10.1109/MC.2005.297>



## Authors Biographies

**Kaiyu Yang** is a Ph.D. candidate at the Institute for Knowledge and Innovation Southeast Asia (IKI-SEA), Bangkok University, Thailand. She is a faculty member in School of Foreign Languages at Baise University, China. Her research interest is in knowledge management and organizational behavior. She is endeavoring to explore knowledge hiding behavior in organizational settings with the assistance of serious games.



**Vincent Ribiere** is an enthusiastic and creative International Professor and Consultant with a passion for helping organizations solving their organizational knowledge and innovation management challenges. He is the Founder and Managing Director of the Institute for Knowledge and Innovation Southeast Asia (IKI-SEA), a center of Excellence at Bangkok University. He is the founder and Program Director of the Ph.D. in Knowledge Management and Innovation Management (Ph.D. KIM) at Bangkok University. Vincent is regularly invited to deliver keynote speeches and workshops at various International Professional and Academic conferences, and he is the author of numerous academic publications. He is the recipient of the KM Leadership Award (2014), he was listed among the top 100 thought leaders in Knowledge Management (2021) and he received the Lifetime Academic Achievement Award (2022) by the International Institute for Applied Knowledge Management (IIAKM).



**Anne Bartel-Radic** is full professor of management and dean of research at Sciences Po Grenoble, Univ. Grenoble Alpes, in France, and a researcher at CERAG. Her research focuses on the collaboration of individuals and organizations across national, cultural and language boundaries. She is leading the InterCCom project for development of serious games for training and research on soft skills. She has published numerous articles in journals such as *Management International – MI*, *European Management Journal* and *Management International Review*.

