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ARTICLE

Knowledge waste at the center of discussions in higher education institutions: a quantitative analysis

Leander Luiz Klein [1]
Desirée Prati Ribeiro [2]
Kelmara Mendes Vieira [1]
Taiane Keila Matheis [3]

[1] Universidade Federal de Santa Maria / Departamento de Administração, Santa Maria – RS, Brazil
[2] Universidade Federal de Santa Maria / Programa de Pós-Graduação em Administração Pública, Santa Maria – RS, Brazil
[3] Universidade Federal de Santa Maria / Programa de Pós-Graduação em Administração, Santa Maria – RS, Brazil

Abstract

This paper assesses the level of knowledge waste in HEIs. The theoretical outline of this work was guided by the knowledge waste scale validated by Klein et al. (2023), divided into four categories: explicit knowledge waste, tacit knowledge retention, overspecialization, and underutilized talent. Survey-type quantitative research was carried out through the application of a questionnaire. The target population of this study is the employees of HEIs. A sample of 837 responses was obtained. Data were analyzed using descriptive and multivariate statistics, applying t and ANOVA tests. The results highlight higher averages for the four categories of knowledge waste in public HEIs. It was found that the administrative technicians had higher averages in terms of overspecialization waste and underutilized talent.

Keywords: Knowledge Waste. Higher Education Institutions. Knowledge Management.

O desperdício de conhecimento no centro das discussões em instituições de ensino superior: uma análise quantitativa

Resumo

O objetivo deste artigo é avaliar o nível de desperdício de conhecimento nas instituições de ensino superior. O delineamento teórico deste trabalho foi orientado essencialmente pela escala de desperdício de conhecimento validada por Klein et al. (2023), divididos em quatro categorias: desperdício de conhecimento explícito, retenção de conhecimento tácito, superespecialização e talento subutilizado. Uma pesquisa quantitativa do tipo *survey* foi realizada por meio da aplicação de questionário. A população-alvo deste estudo são os funcionários das instituições de ensino superior. Obteve-se uma amostra de 837 respostas. Os dados foram analisados por meio de estatística descritiva e multivariada, aplicando-se testes t e análise de variância. Dentre os principais resultados desta pesquisa, pode-se destacar que nas instituições de ensino superior públicas há médias mais elevadas para as quatro categorias de desperdício de conhecimento estudadas. Quanto aos cargos ocupados nas instituições de ensino superior, constatou-se que os técnicos administrativos apresentaram médias mais elevadas em termos de desperdício de superespecialização e talentos subutilizados.

Palavras-chave: Desperdício de conhecimento. Instituições de ensino superior. Gestão do conhecimento.

El desperdicio de conocimiento en el centro de las discusiones en las instituciones de educación superior: un análisis cuantitativa

Resumen

El objetivo de este artículo es evaluar el nivel de desperdicio de conocimiento en las instituciones de educación superior (IES). El esquema teórico de este trabajo se guió esencialmente por la escala de desperdicio de conocimiento validada por Klein et al. (2023), dividida en cuatro categorías: desperdicio de conocimiento explícito, retención de conocimiento tácito, superespecialización y talento subutilizado. La investigación cuantitativa tipo encuesta se realizó mediante la aplicación de un cuestionario. La población objetivo de este estudio fueron los empleados de las IES. Se obtuvo una muestra de 837 respuestas. Los datos se analizaron mediante estadística descriptiva y multivariada, aplicando pruebas t y ANOVA. Entre los principales resultados de esta investigación se puede destacar que en las IES públicas existen promedios más altos para las cuatro categorías de desperdicio de conocimiento estudiadas. En cuanto a los cargos ocupados en las IES, se encontró que los técnicos administrativos tuvieron promedios más altos en términos de desperdicio de superespecialización y talento subutilizado.

Palabras clave: Desperdicio de conocimiento. Instituciones de educación superior. Conocimiento administrativo.

Article submitted on February 15, 2024 and accepted for publication on August 08, 2024.
[Original version]
DOI: https://doi.org/10.1590/1679-395120240030x

INTRODUCTION

The theme of knowledge waste in higher education institutions (HEIs) has gained relevance since the production, dissemination, and application of knowledge are essential for fulfilling these institutions' academic and social missions (Lemahieu et al., 2017). The conception of waste goes against the scope of these missions, and therefore, the knowledge management obtained by professors, managers, and administrative technicians must be a subject of evaluation among decision-makers. However, knowledge management is a significant challenge for HEIs, as they have many intellectual resources that are not always used and appropriately managed (Adhikari & Shrestha, 2023). They are generally responsible for creating, acquiring, storing, and sharing knowledge with society.

Waste can be defined as any activity or process that consumes resources but does not add value to a particular product or service (Womack & Jones, 2004). Knowledge, in turn, is a crucial resource for an organization to gain a competitive advantage and can be managed as a strategic asset (Nonaka & Takeuchi, 1995). Considering this, knowledge waste results from lacking existing knowledge or neglect to explore opportunities for use within an organization (Ferenhof et al., 2015). The lack of effective strategies for knowledge management can result in wasted resources and negatively impact the institution (Kazancoglu & Ozkan-Ozen, 2019). When the knowledge generated is not correctly recognized, shared, applied, or updated, it becomes an underutilized and wasted resource (Ferenhof et al., 2015).

Knowledge waste can occur in the various stages of a given process or activities, including acquisition, conversion, application, and transfer of existing or created knowledge. Nonaka and Takeuchi (1995) classify knowledge into two main categories, explicit and tacit, the first being that which can be formalized and communicated clearly and objectively; the second is embodied in individuals' experiences, skills, and values. The lack of mechanisms for adequate knowledge sharing or the simple fact that it is not used or is being retained by an individual are some aspects that generate waste (Klein et al., 2021). Another factor that can contribute to knowledge waste is the lack of socialization of learning obtained in training and qualifications of people, as well as employee turnover without transferring the knowledge obtained (Kazancoglu & Ozkan-Ozen, 2019) and underutilized talent (Douglas et al., 2015).

Another fact to be considered, however, is that most works that approach this theme focus on the loss of knowledge, which occurs when an employee leaves an organization due to retirement, change of company, or even resignation. Little is said about wasting knowledge, which occurs when the employee is still in the organization. Associated with this, there is difficulty in measuring knowledge and its waste, and few articles have addressed this gap. The exception is the study by Klein et al. (2023), in which the authors developed and validated a knowledge waste scale.

Additionally, little is known about how knowledge waste happens in the context of HEIs, institutions that have the generation and dissemination of knowledge among their main objectives (Huberman, 1983). In case, some situations of waste of knowledge occur when an employee knows the solution for a problem and does not share his idea or expertise; when they have training capabilities above the requirements of their position; or when the knowledge generated inside the institution is not incorporated into its activities and processes. How much do these waste of knowledge situations cost to those institutions? Those are simple situations that usually happen in HEIs and need to be considered and solved by decision-makers to have more efficiency.

In addition, different management characteristics between public and private HEIs can generate different challenges in knowledge management. For example, in the case of Brazil, Public HEIs have strict hiring rules, distinct career plans, and a greater focus on Research and Development (R&D) than private HEIs. Furthermore, training an employee in HEIs to develop daily activities consumes time and resources and is too expensive to waste his knowledge. Knowledge management can also change depending on the employee's position in the institution because the levels of waste may change depending on his position. Considering that, are institutions that generate more knowledge also capable of retaining more knowledge in their teaching, research, and extension activities? Are there differences in the levels of knowledge waste considering the employee's position? Are there differences in knowledge management between public and private HEIs? What is the level of knowledge waste perceived in HEIs?

This problematization and the research questions presented define the objective of this study, which is to assess the level of knowledge waste in HEIs in the Brazilian context. Brazil is considered a suitable location for conducting this research because it is an emerging country and, besides that, has many higher education institutions that promote the ideal conditions for

discussing and reflecting on knowledge waste in this type of educational organization. Additionally, that country concentrates most of its research production and development on HEIs, especially the public ones, which makes even more suitable and interesting the academic conversation about the subject of this paper.

Carrying out this work to achieve this objective generates contributions and theoretical and practical advances that can be considered in four main aspects. First, evaluating for the first time the knowledge waste in HEIs, can be done using a multidimensional scale, applying the proposition of a measurement and evaluation method (Klein et al., 2023). Second, by measuring the abstract discussion about knowledge waste and ascertaining differences between groups of respondents. Third, by outlining an opportunity for knowledge management while people are still in the organization (and not when they leave it, which refers to the loss of knowledge already extensively studied in the literature). And fourth, for being a pioneer in evaluating the theme in a broad sample of HEI employees in Brazil.

The relevance of such a study is quite related to the importance of identifying the waste of knowledge in a developing country whose percentages of the population with higher education are significantly lower than those of developed countries. In addition, due to the income inequality of the population, access to the higher education system in Brazil is conditioned to public investments. Considering that knowledge is a variable socially produced and developed in specific historical contexts (Annala, 2023), the waste of knowledge might represent poor management of public resources, which could contribute to reducing educational inequalities if better managed.

THEORETICAL BACKGROUND – DEFINITION OF KNOWLEDGE WASTE TYPES

Knowledge management is based on identifying, capturing, and disseminating relevant organizational knowledge to promote continuous learning and process improvement (Nonaka & Takeuchi, 1995). Knowledge management is essential to productive systems (Martins et al., 2019). Knowledge is considered a valuable and strategic resource for competitive advantage (Gamble, 2020). Thus, effective knowledge management is crucial to avoid waste and maximize the value of knowledge within an organization.

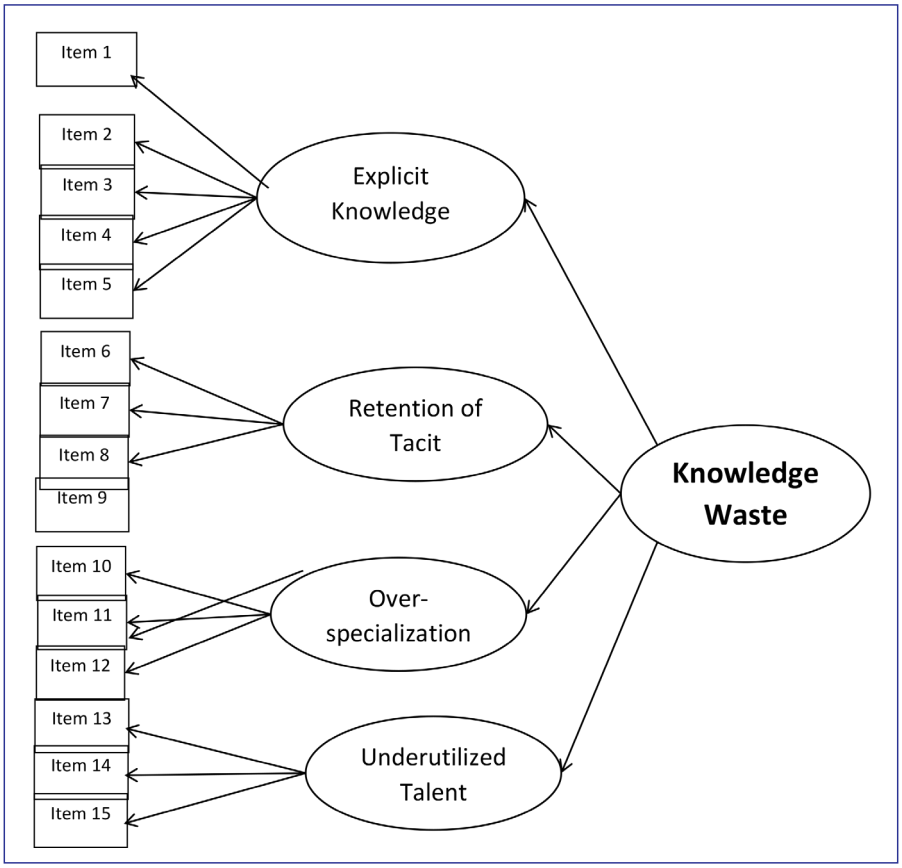
Organizations can drive innovation, learning, and continuous improvement by adopting practices and processes that promote knowledge creation, sharing, and use, increasing their adaptability and competitiveness in the market (Nonaka & Takeuchi, 1995). In this sense, one of the practices to be increasingly discussed and applied in organizational environments is the reduction or elimination of waste, conceived from the principles of the Lean philosophy (Womack & Jones, 2004). Waste is conceptualized as any activity or process that burdens the organization with resources but that does not contribute directly to the creation of value perceived by the customer in the final product or service (Ohno, 1998).

The precepts of this management philosophy, although designed for manufacturing organizations (Aravindh et al., 2022; Jasti & Kota, 2021), have gained ground in service organizations (Caiado et al., 2020; Hadid, 2019) such as HEIs (Lima et al., 2023; Klein et al., 2023; Sfakianaki & Kakouris, 2019), since the concept of waste and its reduction is perfectly applicable in these organizational contexts. In HEIs, reducing knowledge waste ends up being a critical organizational practice. In contrast, knowledge is a central element in the promotion and execution of the core activities of these institutions.

Knowledge waste can occur from the low use or loss of work knowledge and existing “knowledge” in an organization (Santhiapillai & Ratnayake, 2023). Waste occurs when available knowledge is not adequately shared, documented, applied, or valued, resulting in missed opportunities, inefficiency, and/or lack of learning (Nonaka & Takeuchi, 1995). In other words, failures occur in generating, sharing, and incorporating knowledge (Lin et al., 2016).

One of the pioneering studies in evaluating and measuring knowledge waste in HEIs was the one by Klein et al. (2023). In their work, the authors developed a scale for measuring knowledge waste that is divided into four categories, namely: (i) explicit knowledge waste, (ii) tacit knowledge retention, (iii) overspecialization, and (iv) underutilized talent. Figure 1 exempts the final measurement model validated by the referred authors.

Figure 1
Knowledge Waste Measurement Model



Source: Klein et al. (2023).

The first category refers to explicit knowledge waste, which is a type of knowledge that can be articulated, formalized, and communicated in a clear, direct, and objective way through documents or computer programs (Al Ahbabi et al., 2019; Fryczynska & Ciecierski, 2020). It is generally organized and recorded in a systematic and accessible, and universal way, making it available for consultation and learning, and thus can be easily shared between individuals and organizations. However, the fact that there is explicit knowledge does not necessarily imply or guarantee that it will be absorbed and processed by the recipient (Desouza et al., 2006). Considering this perspective, explicit knowledge waste occurs when this knowledge does not result in better organizational practices, is not incorporated into teaching activities, or is used to generate benefits and value for society (Klein et al., 2023). That is, there is a need for more implementation and integration of the knowledge generated and communicated in the activities and strategies of organizations, as well as there may be limited production and renewal of this type of knowledge.

The second category concerns tacit knowledge, also known as implicit or non-formalized, which refers to personal and intuitive knowledge (Chuang et al., 2016), which is difficult to articulate or transmit explicitly and is not established under any tangible format (Gamble, 2020). It is constituted through general and personal experiences, intuitions, and practical skills, highlighting its personal and subjective nature (Polanyi, 1966). This knowledge is crucial in areas where human judgment and expertise are needed (Pérez-Luño et al., 2019) and it is considered a core source of value creation (Boamah et al., 2023). Waste in this category happens when the individual retains the acquired tacit knowledge for himself and can occur from not sharing organizational experiences, exchanging people in positions, or lack of management and sharing of this knowledge (Klein et al., 2023).

Another category is overspecialization, which occurs when employees have training and knowledge superior to that required for their position. This can lead to a disconnection from organizational objectives and employee demotivation (Douglas et al., 2015). Overspecialization is common in cases where the employee works in a position other than his/her area of training or in positions with lesser requirements than his/her expertise. In some situations, there are training or qualifications that the institution itself funds. However, after taking them, the employee continues to perform activities whose minimum requirements are lower than the knowledge that the person has acquired (Kazancoglu & Ozkan-Ozen, 2019; Klein et al., 2021).

The last category is underutilized talent which refers to the situation in which an individual's skills, experiences, and capabilities are not fully utilized and valued in their work (Klein et al., 2023). In addition to the waste that occurs in these situations, there may be negative consequences both for the individual, such as demotivation and frustration, and for the organization, by missing opportunities for innovation, creativity, continuous improvement, and performance (Kazancoglu & Ozkan-Ozen, 2019). Specifically, the higher education sector is underutilized by its highly educated and talented workforce (LeMahieu et al., 2017).

Klein et al.'s scale (2023) advances the literature on knowledge waste and allows the assessment of waste in different contexts. Their study has already been mentioned by Salvadorinho et al. (2024) who researched talent management lift in Portugal. Additionally, in her doctoral thesis, Silva (2023) explored the unused creativity of healthcare professionals. The waste of knowledge and its results/effects may be better analyzed by application of this scale in different countries and other types of organizations. However, its application in HEIs may generate special issues and reflections, once this type of institution deals directly with knowledge production and/or sharing (Al-Kurdi et al., 2018). Finally, the employees of any organization concentrate almost all of the "know-where", "know-how" and "know-why" and so are considered the real knowledge assets of organizations (Cattani et al., 2013). Therefore, wasting their knowledge would probably imply negative aspects and results for various organizations.

METHOD

The present study was carried out through survey-type quantitative research in Brazil. For Hair et al. (2019), this type of research is the most appropriate strategy in studies involving a large population of individuals. Therefore, the research strategy included applying a questionnaire for data collection.

Target population and sample

The target population of this study covers employees (professors, staff people, and managers) of HEIs in Brazil, including those of public, private, and community nature. To make it clear for the readers, we comparatively characterize these three types of HEIs in Brazil.

The public ones have as its main characteristic the public funding investments for 100% of their activities, which means that the government funds all the teaching, research, and extension activities developed by those HEIs. In other words, students are free of payment to study in such HEIs. On the other hand, this characteristic is the main aspect that differentiates public HEI from those with private and community nature. These, in turn, are mainly characterized by the fact that the students themselves need to fund their studies. They need to invest financially in their studies in those HEIs by paying (installments) for their academic activities. Finally, the main difference between private and community HEIs in Brazil relies on the fact that community HEIs are those that have non-profit purposes and reinvest all results in the educational activity itself.

Responses were obtained from a total of 33 different institutions. To obtain the sample, a non-probabilistic convenience sampling technique was adopted, which involves selecting available elements from the target population that can provide the necessary information to achieve the research objectives. In addition, this sampling technique allows for the quick and economical collection of many questionnaires (Hair et al., 2019).

The sample size is considered one of the most essential requirements in the application of a survey, as it directly affects the statistical power and the tests of significance. Hair et al. (2019) guidance was followed to determine the minimum sample size, which recommends having at least ten respondents for each observable variable of the data collection instrument. Additionally, we calculate the sample size using G*Power software (version 3.1 for Windows) and using the following criteria:

effect size = 0,25; ∞ err prob. = 0,05; power (1 – β err prob.) = 0,95; and allocation ratio = 1. The total sample size result calculated by the software was 694 respondents. The final valid sample we obtained for this study consists of 837 participants, which fit the minimum sample suggested by the G*Power result.

Research questionnaire and data analysis procedures

The questionnaire was elaborated based on the study by Klein et al. (2023), which consists of 15 questions organized into four dimensions/categories, as shown in Figure 1. To measure the respondents' perception, each item was evaluated using a 5-point Likert scale (1= strongly disagree, 2= partially disagree, 3= neutral, 4= partially agree, 5= strongly agree). In addition to the scale questions, the questionnaire also contained questions related to the profile of the participants.

For the application of the research instrument (the questionnaire), it was added to an online version of Google Forms, making sending the survey to the target population easier. Data collection was then performed by sending the questionnaire to the public e-mails available on the page of the courses of the researched HEIs. In this way, those e-mails were sent directly to the professors, managers, and staff people (target population of the study) to ensure that they responded to the survey, and so we reduced the chances that a secondary person (for example, a secretary) answered the questionnaire. Furthermore, by proceeding so, the phenomenon could be understood from the viewpoint of all these different employees, once in all of their positions may happen waste of knowledge. The collected data were automatically organized in an electronic spreadsheet, which was exported to an Excel spreadsheet and later added to the SPSS® v.23 software, which was used for the data analysis procedures.

Among the data analysis procedures performed, descriptive statistics were first applied to characterize the sample and analyze the frequency of responses to the questionnaire variables. Secondly, we carried out an exploratory factor analysis and verified that the results indicated the maintenance of the factor structure of the variables as proposed by Klein et al. (2023). Furthermore, we verified that the values of all factor loadings of the variables were greater than 0.5 and that the results of Cronbach's Alpha were also satisfactory (> 0.7).

Subsequently, the methodology for standardizing the application of the waste scale used in this research was applied. This methodology allows for evaluating the level of waste for each dimension of the questionnaire and performing a general analysis of knowledge waste. Here it is important to highlight that Klein et al. (2023) had carried out in their article many enhanced scale testing methods including exploratory factor analysis, confirmatory factor analysis, and convergent and discriminant analysis, which validates the scale and makes it ready to be applied. That's why we do not perform these tests again. In addition, the ranking can be used to understand an employee's perception and assess the perception of a group of employees, the work sector, or an institution. For that, we used the classification described in the article by Klein et al. (2023), whose occurrence of knowledge waste can be classified as "Very Low," "Low," "Medium," "High," and "Very High." Details of the methodology are described in Appendix A.

Finally, statistical analyses between groups were applied by applying the Student's t-test and analysis of variance (ANOVA). Student's t-test is a parametric statistical method used to compare the mean between two groups (Anderson et al., 2003). The variance test (ANOVA), in turn, is a statistical technique used to assess whether there are significant differences in means between three or more groups (Hair et al., 2019).

RESULTS AND ANALYSIS

Scenario of the Brazilian HEI Field and System

The higher education system in Brazil is characterized by being made up of public, private, and community HEIs. Brazil has 2574 HEIs, most universities (55.4%) are public, while among private and community institutions, Faculties predominate (81.0%). The main characteristic of public HEI is free education, as they are financed by public investment. The public institution is part of the administrative structure of the government and receives funding from the government to provide its services to the public. In addition, the hiring of professors and staff people only takes place through public tenders and the rules for career progression are strict.

The private ones are for-profit and charge monthly fees from students. They have management autonomy for selecting and hiring professors and defining career plans. Community ones are a special type of HEI with characteristics very similar to private ones, but they do not have lucrative purposes. Both private and community HEIs have greater freedom to define the structure of courses and the objectives of action with regard to teaching, research, and extension (when compared to public ones).

About the workforce, in public HEIs, 77.1% of professors are PhDs; while in private and community HEIs, the highest percentage of professors only have a master's degree (46.3%) — professors caring PhD represent 32.5% (INEP, 2023). In addition, in public HEIs, professors predominantly work on an exclusive dedication basis, while in private and community institutions, a partial regime prevails.

Analysis of the Respondents' Profile

With the accomplishment of the research and consequent obtaining of the results collected concerning the number of participants, 837 responses were obtained from employees of HEIs in Rio Grande do Sul, whether private, public, or community. Table 1 specifies the frequency and percentage obtained regarding the questions about the participants' profiles.

Table 1
Respondents' profile

Variables	Alternative	Frequency	Percentage (%)
Gender	Male	411	49.1
	Female	426	50.9
Age range	From 22 to 32 years old	73	8.8
	From 33 to 39 years old	222	26.6
	From 40 to 49 years old	242	29.0
	From 50 to 58 years old	202	24.2
	Over 58 years old	95	11.4
Marital Status	Single	178	21.3
	Married or stable relationship	580	69.3
	Separated	66	7.9
	Other	13	1.6
Education	High School	2	0.2
	1st Cycle – Undergraduate	21	2.5
	2nd Cycle Diploma	69	8.2
	2nd Cycle – MSc	166	19.8
	3rd Cycle – PhD	579	69.2
Job position	Professor	512	61.2
	Administrative technician	110	13.1
	High Manager (Director, pro-rector, dean, or vice-dean)	32	3.8
	Low Manager- Professor or Technician with a management position (course coordination or department head)	183	21.9
Service time	Up to 5 years	177	21.1
	Up to 10 years	257	30.7
	More than 10 years	403	48.1
Type of HEI	Comunitary	102	12.2
	Private	125	14.9
	Public	610	72.9

Note: HEI – higher education institution.
Source: Research data (2023).

In Table 1, it can be seen that women had the highest number of responses, with 50.9%. As for age, it is observed that 29% of the participants are aged between 40 and 49 years old, followed by the age category between 33 and 39 years old (26.6%). As for marital status, 69.3% are married or have a stable relationship, followed by the single group, 21.3%. The level of education can be considered high, with 69.2% having a doctorate and 19.8% having a master's degree. Faculty members represent 61.2% of the sample, followed by professors or technicians in management roles with 21.9%. Regarding length of service, 48.1% have more than ten years of service, and 30.7% have 5 to 10 years of work. Servants from public institutions represent 72.9% of the participants, 14.9% from private and 12.2% from community institutions, which can provide information about possible differences in the management and sharing of knowledge in different types of institutions, which can help to identify best practices to avoid wasting knowledge in each type of environment.

The profile of this sample, despite presenting different characteristics from the general Brazilian population, such as higher educational levels, is appropriate to the context of this study because, in HEIs, hiring criteria generally require higher levels of education. It is also worth highlighting that this profile is similar to the profile identified for other HEI works in the Brazilian context, such as Borges & Klein (2023), Alves et al. (2024), Ledic et al. (2022) and Neto et al. (2024).

Descriptive Analysis of Knowledge Waste Dimensions

To understand the perception of the respondents about the researched constructs (explicit knowledge waste, tacit knowledge retention, overspecialization, and underutilized talent), descriptive statistics of the frequency of the items of the scale used in this study were performed. In this sense, Table 2 demonstrates the results regarding the explicit knowledge waste.

Table 2
Descriptive statistics of the explicit knowledge waste dimension

Items	Percentage of answers					
	Mean	1	2	3	4	5
ITEM 1- There are professors with doctoral degrees who do not work in graduate school, wasting part of their knowledge.	3.81	6.8	8.4	18.6	29.2	37.0
ITEM 2- Most of the knowledge generated by research produced by professors is not incorporated into the HEI management.	3.45	5.5	13.0	32.3	29.4	19.8
ITEM 3- The knowledge of employees is little explored for extension activities.	3.46	6.6	14.3	24.5	35.0	19.6
ITEM 4- The knowledge generated by the institution is little used to generate benefits for the community and companies.	3.12	12.8	20.4	23.5	28.3	14.9
ITEM 5- The knowledge generated by research, for the most part, is not incorporated into undergraduate teaching activities.	3.12	10.3	21.3	27.2	28.4	12.8

Note: 1 – strongly disagree; 2 – partially disagree; 3 – neutral; 4 – partially agree; 5 – strongly agree.
Source: Elaborated by the authors (2023).

It can be seen that this dimension is assessed basically through items that assess how the professor contributes to research and postgraduate studies, in addition to how the knowledge generated in research is incorporated into teaching, management, and extension activities. The data collected shows that the most frequent answer was "partially agree" (4). This indicates that there is a perception that there is a certain level of use of knowledge generated by professors in HEIs, but there is still room for improvement.

Table 2 demonstrates that item 1 has the highest average of this dimension. At the same time, most respondents agree, either wholly or partially, that there are professors with a doctorate who do not work in graduate school, which can lead to a waste of their knowledge. This indicates that the perception is that some professors waste knowledge, which can harm the quality of teaching and research carried out at the institution.

On the other hand, items 4 and 5 have the lowest means (3.12). In item 4, it is also possible to observe that 35% of the participants opted for the option "partially agree" regarding the statement that the knowledge of the servants is little explored for extension activities. This may indicate the need to establish strategies and actions to ensure better use of this knowledge in extension activities, aiming to increase the effectiveness of actions carried out by the institution and promote greater

integration between academia and society. As for item 5, it is observed that most respondents wholly or partially agree that the knowledge generated by research, for the most part, is not incorporated into undergraduate teaching activities. The "partially agree" answer was the most frequent, with 28.4% of the participants, which suggests that there is a perception that the institution could better use the knowledge generated by its research and incorporate it into undergraduate teaching activities, as well there is a specific acknowledgment that this already occurs. The result points to the importance of strengthening the relationship between research and teaching to enrich students' training and expand the institution's impact on society.

The next dimension analyzed refers to the tacit knowledge retention. Table 3 displays the results obtained.

Table 3
Descriptive statistics of the tacit knowledge retention dimension

Items	Percentage of answers					
	Mean	1	2	3	4	5
ITEM 6- There is a lot of tacit knowledge that ends up being lost when there is a change of people in positions.	3.68	3.6	10.9	23.4	37.3	24.9
ITEM 7- When a new employee occupies a certain position, the tacit knowledge of the previous "occupant" is hardly shared.	3.21	7.9	18.5	30.2	30.8	12.5
ITEM 8- There is a lot of tacit knowledge that ends up being lost due to the lack of adequate knowledge management.	3.56	5.4	10.0	27.2	37.3	20.1
ITEM 9- Tacit knowledge is poorly shared among employees of my sector.	3.31	6.1	16.8	31.7	30.1	15.3

Note: 1 – strongly disagree; 2 – partially disagree; 3 – neutral; 4 – partially agree; 5 – strongly agree.
Source: Elaborated by the authors (2023).

This construct is composed of items that address the possibility of a loss of tacit knowledge in HEIs, due to job rotation, lack of knowledge management, and lack of knowledge sharing among servants. It can be seen that item 6 has the highest average (3.68) since 62.2% of respondents agree that much tacit knowledge is lost during the change of people in positions. This is the most frequent waste in this dimension and can harm HEIs, as this knowledge is valuable and can take time to be acquired again.

The overspecialization dimension was the next to be analyzed. The results are shown in Table 4.

Table 4
Descriptive statistics of the overspecialization dimension

Items	Percentage of answers					
	Mean	1	2	3	4	5
ITEM 10- There are administrative technicians in education working in positions different than their area of expertise.	3.38	9.0	12.2	32.0	25.0	21.9
ITEM 11- There are employees working in positions that require skills much lower than their training or education levels.	3.49	9.0	14.0	23.2	26.6	27.2
ITEM 12- The academic backgrounds of many employees are higher than the skill levels required by their activities, which leads to a waste of knowledge.	3.49	8.8	12.9	22.3	31.9	24.0

Note: 1 – strongly disagree; 2 – partially disagree; 3 – neutral; 4 – partially agree; 5 – strongly agree.
Source: Elaborated by the authors (2023).

The formation of this construct is composed of items that refer to the adequacy of the servants' training for the positions they perform. In this dimension, item 10 had the lowest average (3.38), which means that it is the item in which less waste occurs, considering the respondents' perception. Even so, 46.9% of the respondents partially or strongly agree with the statement, suggesting that many public servants perceive a discrepancy between their training and the demands of their positions. Referring to item 11, it can be seen that 53.8% partially or strongly agree with the fact that some civil servants are in positions that require much lower skills than their training, indicating that there is an underutilization of the civil servants' potential, which could be exercising more complex and challenging functions, thus contributing to the achievement of institutional objectives.

Furthermore, servants may feel that their potential is being wasted. In summary, they suggest that there is a perception that the training of civil servants is not always appropriately used in the positions they perform.

Finally, the underutilized talent dimension was analyzed, the results of which are shown in Table 5.

Table 5
Descriptive statistics of the underutilized talent dimension

Items	Percentage of answers					
	Mean	1	2	3	4	5
ITEM 13- Employee experiences are not fully explored.	3.27	8.2	21.9	20.8	32.5	16.6
ITEM 14- Employee capabilities are not fully utilized.	3.16	9.3	21.9	24.1	32.6	12.1
ITEM 15- Employee skills are not fully utilized.	3.27	7.9	22.9	20.2	32.1	16.8

Note: 1 – strongly disagree; 2 – partially disagree; 3 – neutral; 4 – partially agree; 5 – strongly agree.
Source: Elaborated by the authors (2023).

This dimension refers to the underuse of personal experiences and skills and the failure to take advantage of employees' capabilities. It is noticed that the average of the items is the lowest among the analyzed dimensions. However, there are still opportunities for improvement regarding the analyzed items. Regarding item 15, what can be analyzed is that 44.7% agree that the servants' capacities are not fully used, suggesting a trend toward the need for improvements in the use of these capacities. As for the two other items, almost 50% of the respondents agree that the skills and experiences of the servants are not fully used, indicating that there is room for a better allocation and use of these in the workspaces. These perceptions may have implications for employee motivation, engagement, and performance and reinforce the importance of the people management sector in allocating and optimizing employee skills.

Complementarily, to carry out an analysis of the knowledge waste according to each of the studied dimensions, the calculation procedures and application of the scale described in the study by Klein et al. (2023) were conducted. This results in a waste classification on a scale ranging from 0 to 1. The results of the mean, standard deviation, and response frequency for each of the dimensions studied are shown in Table 6.

Table 6
Descriptive statistics of means, standard deviation, and classification

Constructs	Mean	Standard deviation	Very low	Low	Medium	High	Very high
Explicit Knowledge Waste	0.59	0.23	5.9	15.4	27.6	32.2	18.8
Retention of Tacit Knowledge	0.62	0.23	4.1	11.6	27.3	34.2	22.8
Overspecialization	0.62	0.26	8.3	12.8	25.8	24.0	29.1
Underutilized Talent	0.56	0.27	10.2	18.4	26.1	27.9	17.4
Scale of Knowledge Waste	0.60	0.19	3.2	11.9	32.2	38.0	14.7

Source: Elaborated by the authors (2023).

From Table 6, it is identified that all factors obtained results with an average above 0.50, signaling that most of the correspondents consider that there is an occurrence of that waste in HEIs. Among all the factors that resulted in the highest overall average were "Tacit Knowledge Retention" and "Overspecialization", being considered the factors with the highest occurrence within the HEIs in the view of the study respondents. In turn, the "Underutilized Talent" factor was the one with the lowest average and can be flagged as the one with the lowest occurrence within the HEIs.

Regarding the dimension "Explicit Knowledge Waste", the frequency distribution indicates that there is a considerable proportion of "Medium" (27.6%) and "High" (32.2%) values, which demonstrates the need for actions to make better use of this type of knowledge. The non-use of existing explicit knowledge becomes costly for an organization (Ferenhof et al., 2015) since resources are spent on its production that is not fully utilized.

The "Tacit Knowledge Retention," the "High" (34.2%), and "Low" (22.8%) categories have higher frequencies suggesting that there is a problem of lack of sharing of tacit knowledge and knowledge management in HEIs, which may impair work efficiency. Tacit knowledge is intrinsically linked to the individual and their experiences. It may be forgotten or lost if it's not shared with the organization and its team (Pérez-Luño et al., 2019).

Regarding "Overspecialization," the distribution of responses shows a relatively high proportion of "Very High" (29.1%) and "High" (24.0), indicating that there is a perception that the training of public servants is not always used correctly in the positions they hold. Different situations occur for this type of waste to occur, such as cases in which the servant works in a position different from his/her training or with lesser requirements than the expertise he/she has; often, the employee qualifies through training funded by the institution but does not receive new assignments and continues to perform activities whose basic requirements are lower than the qualification he/she acquired (Kazancoglu & Ozkan-Ozen, 2019; Klein et al., 2021).

Finally, the "Underutilized Talent" dimension presents the highest frequency distributions in the "High" (27.9%) and "Medium" (26.1%) categories, which explains the lowest average of this dimension (0.56). However, these results still reveal opportunities to better utilize employees' experiences, abilities, and skills in their work environments. Without considering that the underutilization of people can, in certain situations, generate negative consequences for the individual, such as demotivation and frustration, and also for the organization by missing opportunities for innovation, creativity, and performance (Klein et al., 2021).

Comparative Analysis Between Groups Regarding Knowledge Waste

In this work subsection, some tests of the mean difference between groups are performed to assess the different perceptions among respondents and provide better insights for analysis and direct contributions to the literature on the subject.

The first of these tests considered the type of HEI in which the respondent worked, contemplating public, private, and community alternatives. These three types of HEIs present notable differences in their nature, as it was already explained in the method section of this paper. However, given some similar characteristics between the last two (private and community HEIs), mainly regarding the payment of monthly fees, it was decided to group the responses of these two into a single group. Therefore, the t-test for independent samples was used to verify significant differences in the means of responses for the two groups formed. The results are shown in Table 7.

Table 7
t-Test for the type of HEI group

Constructs	Public		Private/Community		t-Test	
	Mean	Standard deviation	Mean	Standard deviation	Value	Sig.
Explicit Knowledge Waste	3.56	1.10	3.05	1.14	5.79	0.00
Retention of Tacit Knowledge	3.71	1.05	3.31	1.11	4.65	0.00
Overspecialization	3.75	1.17	2.93	1.30	8.61	0.00
Underutilized Talent	3.30	1.22	3.08	1.25	2.25	0.02

Note: HEI – higher education institutions; Sig. – significance.

Source: Elaborated by the authors (2023).

The analysis of Table 7 shows that all factors showed significant differences in means (significance < 0.05) for the two groups analyzed. It can also be seen that for all dimensions, explicit knowledge waste (3.56), tacit knowledge retention (3.71), overspecialization (3.75), and underutilized talent (3.30), the averages of respondents belonging to the group of public HEIs is higher. This means that the perception of knowledge waste studied here is higher in these HEIs compared to the group formed by private and community institutions. Generally, some additional elements contribute to these differences observed in Table 7, such as a) the way in which employees are hired (in public HEIs, there is a need for a public contest); b) career progression plans; c) the focus given by the HEIs (whether teaching, or research, or extension); d) institutional and governmental bureaucracy. So, this result demonstrated in Table 7, in addition to its theoretical contribution, generates necessary evidence that public HEIs must improve their procedures and practices related to knowledge management, focusing on reducing the waste explored in this article.

The t-test for independent samples was also used to analyze whether there are differences in means in participants' perceptions concerning the education variable. To this end, it was decided to unite participants with specialization and master's degrees in a single group to compare them with the group of doctors. The other education categories were not included in the analysis due to the small number of participants in each of them, which would make it impossible to carry out a valid test.

The reason for testing the difference in perception between these groups relies on the fact that there are investments made (ex. time and money) in professionals with higher levels of education. Furthermore, the higher the level of education, the more specific the knowledge with which those professionals work, and so, it is very costly for the institution if there is more wasted knowledge in this group of workers. The results of this test are presented in Table 8, demonstrating the means and standard deviation of the dimensions.

Table 8
t-Test for the groups defined by the education variable

Constructs	2nd Cycle Diploma and MSc		3rd Cycle - PhD		t-Test	
	Mean	Standard deviation	Mean	Standard deviation	Value	Sig.
Explicit Knowledge Waste	3.35	1.09	3.46	1.15	-1.19	0.23
Retention of Tacit Knowledge	3.47	1.08	3.66	1.09	-2.29	0.02
Overspecialization	3.53	1.24	3.53	1.27	0.04	0.96
Underutilized Talent	3.31	1.20	3.21	1.25	0.98	0.32

Note: Sig. – significance.

Source: Elaborated by the authors (2023).

Table 8 identifies that one of the four factors presented a significant mean difference (significance < 0.05): tacit knowledge retention. For this dimension, the average for the group of doctors is higher (3.66), which means that individuals with a doctorate retain more of the tacit knowledge they possess or acquire. A possible explanation is that some management positions in HEIs are assumed only by professors who generally are doctors (e.g., course coordination, head of department, and direction of centers). They do not share the acquired knowledge with the successor when they leave these positions. So, this gives us a reason to think there is no adequate knowledge management in these situations. Another possible explanation is that the staff, who generally have a lower level of education (specialization or master's degree), carry out more operational and routine activities than the professors. Thus, passing on and transferring the acquired tacit knowledge is more accessible.

The next test of analysis between groups involved the variable age of respondents. Carrying out an analysis based on the age variable can demonstrate other important aspects such as the perception of waste between younger and older employees, difficulties between these groups in absorbing knowledge and new technologies to promote it, and the use (or non-use) of knowledge and "talents" obtained given the age they possess and the experiences and knowledge obtained so far.

The respondents were divided into two groups, as shown in Table 9. The age limit for defining the groups was defined among the researchers and based on mean and median calculations. The T-test was applied for independent samples, whose mean and standard deviation results are also shown in Table 9.

Table 9
t-Test for the groups defined by the age variable

Constructs	Up to 40 years old		More than 41 years old		t-Test	
	Mean	Standard deviation	Mean	Standard deviation	Value	Sig.
Explicit Knowledge Waste	3.50	1.18	3.37	1.11	1.50	0.13
Retention of Tacit Knowledge	3.62	1.10	3.58	1.06	0.58	0.55
Overspecialization	3.67	1.27	3.34	1.25	2.46	0.01
Underutilized Talent	3.33	1.24	3.16	1.22	2.05	0.04

Note: Sig. – significance.
Source: Elaborated by the authors (2023).

Based on the results presented in Table 9, it can be seen that the factors of overspecialization and underutilized talent presented a significant mean difference (significance < 0.05). It can be seen that the average of responses for respondents aged up to 40 years is higher than the other group, which means that the perception of waste in terms of overspecialization and underutilized talent is higher in this group. This is mainly because younger people are undergoing qualifications and training to differentiate themselves in the selection processes or to achieve progression in their positions. However, they continue to carry out activities whose requirements to carry them out do not follow the learning, skills, and knowledge obtained in the courses they take.

Next, another ANOVA test was carried out to analyze differences in perception between the groups formed from the positions occupied by the research participants: professors, technical-administrative, and individuals who occupy management positions (managers). This is also an essential analysis because it can demonstrate specific differences for each of the knowledge waste categories studied based on the positions that the respondents occupy and, consequently, the activities they carry out. For example, in which position there is more waste given overspecialization or underutilized talent? Is this difference statistically significant? If yes, what are the reasons?

So, this group analysis based on the respondent's positions may give a good reflection and allow specific decisions to try to diminish knowledge waste. The results of this test are shown in Table 10.

Table 10
ANOVA test for groups of positions held at the institution

Constructs	High and low managers		Professor		Administrative technician		ANOVA	
	Mean	Standard deviation	Mean	Standard deviation	Mean	Standard deviation	Value	Sig.
Explicit Knowledge Waste	3.37	1.14	3.41	1.15	3.64	1.06	2.20	0.11
Retention of Tacit Knowledge	3.50	1.07	3.65	1.08	3.57	1.11	1.41	0.24
Overspecialization	3.49	1.23	3.41	1.28	4.17	1.02	16.83	0.00
Underutilized Talent	3.14	1.19	3.21	1.25	3.60	1.16	5.57	0.00

Note: ANOVA – analysis of variance; Sig. – significance.
Source: Elaborated by the authors (2023).

The results show a significant mean difference (Sig < 0.05) in overspecialization and underutilized talent dimensions. Through Tukey's post hoc analyses, it was identified that a significant difference occurs in the group formed by administrative technicians for both dimensions. This group of respondents has a more excellent perception of overspecialization and underutilized talent. The fact is that many of these employees end up qualifying (by taking master's and doctoral courses). However, when they finish these courses, they continue to perform the same functions and activities they performed before starting them. In many cases, no improvement was implemented in their work sectors, or a new attribution and responsibility were transferred to them given the knowledge they acquired.

This indicates that these employees have experiences, skills, and knowledge that go beyond the requirements demanded of their current functions, having a level of expertise and competence that is not being fully used in their positions (Douglas et al., 2015; Kazancoglu & Ozkan-Ozen, 2019). The HEI is also financially burdened because the employee receives salary progression but does not repay the investment made in him/her. This is a central institutional challenge to be resolved in many HEIs.

DISCUSSION AND FINAL CONSIDERATIONS

The objective of this study was to evaluate the level of knowledge waste in HEIs. For that, a survey-type study was carried out with employees of public, private, and community HEIs in the state of Rio Grande do Sul, Brazil. This research showed that knowledge waste can be classified as medium, considering the scale proposed by Klein et al. (2023). However, for some categories, such as tacit knowledge retention and overspecialization, their occurrence can be considered high and more pronounced in some groups of respondents.

The results of this research also led to the conclusion that in public HEIs, there are higher averages for all categories of knowledge waste studied. Considering the respondents' education level, the participants with a doctorate had higher averages of retention of tacit knowledge. As for the positions held in the HEIs, it was found that the administrative technicians had higher averages in terms of overspecialization waste and underutilized talent. All of these situations generate important insights for managers and decision-makers regarding the design of strategies and ways to reduce knowledge waste while the employee is still working in the institution (Klein et al., 2023). As the discussion described in the results section, there are several different reasons and causes for the differences in knowledge waste presented and can be managed more appropriately based on an assessment of knowledge like this carried out in the present paper. The waste of knowledge generated is associated with the institution's failures in properly capturing, sharing, and incorporating knowledge (Lin et al., 2016). As mentioned by Adhikari and Shrestha (2023), the promotion of knowledge and its management are significant challenges for organizations, and even more so for HEIs, as they are the main source of knowledge promotion in a country.

But to that end, more than just validating the scale, its applicability is important. So, the present paper contributes to the literature by demonstrating the application of a validated scale such as that of Klein et al. (2023). In this way, it is applied in a real context and an analysis of causes and factors generating knowledge waste is outlined.

Carrying out this work and its results generate relevant contributions and insights in theoretical and practical terms. For theory on the subject, this article provides a clear, applicable framework for identifying knowledge waste and then mitigating the causes of why it happens (Klein et al., 2023). In addition, this study can contribute to understanding situational restrictions in these institutions that lead employees to hide knowledge (Anand et al., 2020). Facilitating channels and routes to spread knowledge can increase the speed of application by knowledge workers (Chen et al., 2018). Additionally, society's investment is made in the case of HEIs to deal with and promote knowledge daily (Al-Kurdi et al., 2018). Wasting it is, therefore, a sign of double failure of HEIs: failure to properly manage the society's investments; and failure to manage what is part of the final activities of an HEI, the knowledge.

From a practical point of view, applying the scale used allowed for demonstrating a general parameter of the perception of knowledge waste in the researched sample and verifying which groups a particular waste is more evident. Such an analysis allows managers to direct more specific measures and actions so that the waste of this essential organizational asset, knowledge, is reduced and better used in HEIs. As described by Gamble (2020), specific actions make institutions more capable of optimizing the knowledge of their employees, such as incorporating narrative skills, providing moments and group activities, and adapting their structure so that employees can play their roles. For the manager, it is essential to know the most significant waste to manage among the existing ones to propose guidelines that can reduce waste and promote concomitant effects on other waste. Applications of scales like the one performed in this work are viable for this purpose.

The results of this work must be interpreted under some research limitations. One of the main ones is that, despite a considerable number of respondents, the survey results cannot be generalized to all HEIs in Rio Grande do Sul, where data collection was carried out because a sampling plan was not carried out and followed. The second limitation concerns the way of data collection, carried out through online questionnaires, which directs the sample's composition to those willing to participate in the research. Although more expensive, data collection in person increases the possibility of obtaining respondents forming this bias.

In this sense, future studies can be carried out to reduce the limitations mentioned above based on the application of the scale used in this article in specific HEIs, and unique cases. Studies can also direct specific measures and actions to be taken in the face of the different types of knowledge waste identified.

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Leander Luiz Klein
ORCID: https://orcid.org/0000-0001-6075-6107
Ph.D. in Business Administration and Professor from the Department of Administration at the Federal University of Santa Maria (UFSM).
E-mail: leander.klein@ufsm.br

Desirée Prati Ribeiro
ORCID: https://orcid.org/0009-0007-7646-3238
Master's student from the Postgraduate Program in Public Administration at the Federal University of Santa Maria (UFSM).
E-mail: desiree.ribeiro@ufsm.br

Kelmara Mendes Vieira
ORCID: https://orcid.org/0000-0002-8847-0941
Ph.D. in Business Administration and Professor from the Department of Administration at the Federal University of Santa Maria (UFSM).
E-mail: kelmara.vieira@ufsm.br

Taiane Keila Matheis
ORCID: https://orcid.org/0000-0003-2427-878X
Doctorate student in the Postgraduate Program in Administration at the Federal University of Santa Maria (UFSM). E-mail: taianetrim@gmail.com

AUTHORS' CONTRIBUTION

Leander Luiz Klein: Conceptualization (Lead); Methodology (Lead); Project administration (Lead); Supervision (Lead); Writing - original draft (Equal); Writing - review & editing (Equal); Validation (Lead).

Desirée Prati Ribeiro: Investigation (Supporting); Data curation (Equal); Formal Analysis (Equal); Writing - original draft (Equal); Writing - review & editing (Supporting); Visualization (Supporting).

Kelmara Mendes Vieira: Supervision (Supporting); Methodology (Supporting); Writing - review & editing (Lead); Validation (Supporting); Resources (Lead); Funding acquisition (Lead).

Taiane Keila Matheis: Data curation (Equal); Formal Analysis (Equal); Visualization (Lead); Writing- original draft (Equal); Writing- review & editing (Supporting); Investigation (Lead).

DATA AVAILABILITY

The dataset supporting the results of this study is not publicly available.

ACKNOWLEDGMENTS

The authors are grateful for the financial support received by FAPERGS (Fundação de Amparo à Pesquisa do Estado do Rio Grande do Sul) – research project n. 21/2551-0002185-3; and CNPq (Conselho Nacional de Desenvolvimento Científico e Tecnológico) – research project n. 406168/2021-0.

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