

Waste In Higher Education Institution: A Systematic Literature Review

Lusia Permata Sari Hartanti, Ig. Jaka Mulyana, Theresia Intan Putri Hartiana

Abstract: Over the last few years, the Lean Higher Education (LHE) has been discussed. LHE can be implemented by identifying and eliminating waste. Literature contribution to waste in Higher Education Institutions (HEIs) are fragmented and limited. The purpose of this study is to identify the waste concept of waste in HEIs by integrating various waste concepts in relevant literatures into a coherent framework. A Systematic Literature Review (SLR) was carried out by authors. In this systematic review, two databases, including Emerald Online and Taylor & Francis Online, were searched using keywords. The authors addressed the waste categories in HEIs. They are overproduction, over-processing, waiting, motion, transportation, inventory, defect, people, and information. These waste categories may guide the implementation of Lean in HEIs.

Index Terms: Lean, Lean Higher Education, Higher Education, Waste, Overproduction, Over-Processing, Waiting, Motion, Transportation, Inventory, Defect, People, Information

1. INTRODUCTION

Quality plays an important role in the industry. Various studies show that quality has a strong effect on customer satisfaction, reducing costs, increasing work performance, and increasing profits. The foundation of quality was built by Deming, Crosby, and Juran. Service quality has more difficult characteristics compared to products, some of the main differences are the relationship between service providers and end-users, time, nature of services, and intangibility [1]. One of the service sectors is educational institutions at all levels: the primary, secondary and higher levels and each has different characteristics. The education process is a process of ongoing transformation which includes empowerment and enhancement of customers [2]. Higher education is a complex organization, where the process is carried out to meet the diverse expectations of various stakeholders and customers [3]. In addition, they also stated that some factors are regulated by external parties such as the government, so this affects internal processes and adds to the complexity that must be faced by Higher Education Institutions (HEIs) to meet the desires of stakeholders and customers. The purpose of higher education as to direct self-actualization through human values [4]. The issue of higher education quality began to be widely discussed around 1990, although in the previous year there had been little references regarding it. Some community colleges in the United States of America initiated the discussion of quality in education and subsequently developed in the United Kingdom [1]. Several studies have shown that quality is a relative concept. Relative means that groups or stakeholders in HEIs have different priorities and focal views [4].

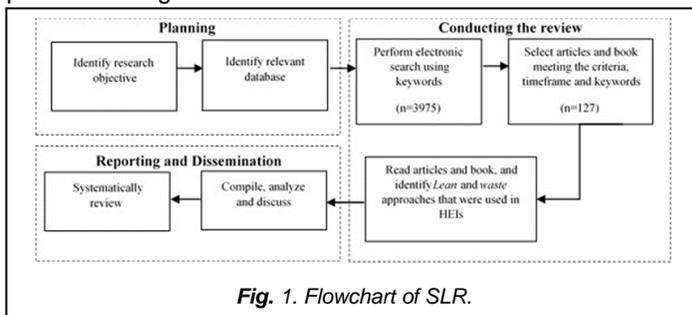
Relative definition of quality showing that it is not an attribute of a product or service, but something that is ascribed to the product or service itself which consists of two aspects, namely specifications and the fulfillment of consumer needs. There are many factors why HEIs emphasizes quality [1]. Factors that drive quality needs in higher education can be Key Performance Indicators (KPI), national and global pressure, preparing students for meaningful lives, high standards, budgetary interests, safe investment interests, measuring systems, customer satisfaction, learning practices for students, process improvement, and innovation [4]. Total Quality Management (TQM) is the concept of management that focuses on quality by involving the participation of everyone in the organization in order to achieve customer satisfaction. Every organization can have the same or different structure in implementing TQM. The structure must be appropriate and facilitate the implementation of TQM within the organization [1, 3]. Organizations that implement TQM must be simple, lean, and built by a strong team. In the late 1990s the term Kaizen emerged which was a development of TQM and it was increasingly developed until finally, the term of Lean appeared [5]. Lean was introduced by Toyota Motor Company as a method used to achieve operational excellence. Lean as a concept can be traced back to the works of Taylor and Deming in the nineteenth and twentieth centuries. The core of Lean Thinking today is based on Toyota which pioneered the spread of Lean principles throughout the world [6]. Lean methodology adopted from the initial quality concept that aims to facilitate the organization's understanding and implementing operational excellence [7]. As its development Lean is not only used in the manufacturing industry but also services. The Lean philosophy in the service industry is known as Lean Services. Although the philosophy of Lean is the same, there are differences in its application in the service sector compared to the manufacturing sector [7]. Several studies on the application of Lean services include in the health sector [8], the public sector [9], and the education sector [6, 10, 11]. Lean services are vary greatly, ranging from exploring the meaning of concepts, HEIs application (case studies), and theoretical concepts (models) to produce new definitions [12]. Lean and Higher Education sector are close to each other, researchers at the Massachusetts Institute of Technology (MIT) emphasized Lean approaches to improving performance (doing more) using a minimum amount of resources [4]. Lean in higher education is known as Lean Higher Education (LHE). Many HEIs have adopted Lean initiatives to improve the

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efficiency of scientific processes by eliminating waste and activities that do not add value. Waste in the higher education sector has a different understanding from other service sectors, this is caused by internal and external factors in the education sector. The benefits of Lean implementation in higher education are helping higher education maintain competitiveness, focus on market needs, improve academic and administrative operational processes, and obtain superior performance by meeting stakeholder needs [4, 5, 6, 13]. The greater implementation of Lean in the manufacturing sector compared to the service sector results in the development of the Lean theory in the manufacturing sector more quickly, including the concept of waste. Various conceptual waste in the manufacturing sector needs to be adjusted to be applied to the service sector, especially in higher education. Although various studies on Lean in higher education have been conducted to reduce waste, there is still limited research that explores the definition of waste. This paper illustrates the concept of waste in higher education and integrate various waste concepts in relevant various literatures into a coherent framework. Without a clear understanding of waste, Lean implementation and finding solutions to a problem will run into obstacles. In line with this perspective, the Research Question (RQ) in this study is "What is the coherent concept of waste in higher education that can be drawn from integrating various concepts in relevant literature? The purpose of this paper is to identify the concept of waste in higher education by integrating various waste concepts in relevant literatures into a coherent framework.

2 METHODOLOGY

The method used in this study is Systematic Literature Review (SLR) which consists of the planning, conducting the review, and preparation of reports [12, 14, 15, 16]. The SLR steps are provided in Fig 1.



At the planning stage, identification of research objectives and identification of relevant databases is carried out. In the implementation phase, an electronic article search is performed on the databases based on predefined keywords. Manual searches were conducted as supplemental approaches to find book in hardcopy to identify additional primary studies for SLR. Book in hardcopy were also included to gain more insight on LHE. All articles that have been obtained are selected and checked for compatibility with the focus of the study by considering the title, abstract, and

keywords of each article. If all the parts of the articles are not clear enough then we continue reading the full paper. The book was selected by considering the author, year of publication and title. Next, we read selected articles and identify Lean and waste approaches to higher education. The report writing and dissemination stage was conducted by compiling, analyzing, and discussing selected articles that explain Lean and waste in HEIs. The criteria and description used for each SLR step can be seen in Table 1. Based on the SLR steps that have been carried out, 16 relevant articles obtained and to complete it then we added one hardcopy book (Table 2). The book written by W. K. Balzer [17] was used to enrich studies.

TABLE 1
CRITERIA AND DESCRIPTION

Criteria	Description
Timeframe	2010- May 2020
Database Source	Emerald Online dan Taylor & Francis Online for article search Library for book in hardcopy
Language	English
Keywords	Lean, Lean Service, Higher Education, Total Quality Management, Waste
Filter	Title, abstract, keywords
Action	Conduct manual checking to eliminate irrelevant publications in this study

3 RESULTS AND DISCUSSION

3.1 The Profile of Reviewed Articles

SLR was conducted based on 16 articles and 1 book that meets the criteria. Although LHE has long been introduced a long time ago, the number of articles discussing waste in higher education is still limited. There are many articles on the application of LHE, for example [3, 4, 10, 11, 16, 19]. However, the articles did not discuss waste in the LHE application. The breakdown of articles published in each journal is provided in Fig 2. It can be seen that eight journals accounted for 16 articles. Six of the journals focus on quality, two on management and one on production. Relevant articles are predominantly published in the journals focused on quality. The 16 articles included in this study were published between 2010 and 2020 (Fig 3). The pattern shows clearly an increase in the number of publication.

TABLE 2
LIST OF RELEVANT ARTICLES

No	Author	Year	Focus	Result
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No	Author	Year	Focus	Result
1	Chiarini [18]	2011	Comparing and discussing the evolution of six important management systems: Japanese Total Quality Control (JTQC), Total Quality Management (TQM), Deming's system of profound knowledge, Business Process Reengineering (BPR), Lean Thinking and Six Sigma.	This study discovered and proposed nine factors inside the six system: results and benefits, management style, system deployment, employee management, deployment and participation, voice of customer, tools, techniques and information technology, system optimization, daily check and control of results, and system review.
2	Thirkell and Ashman [10]	2014	Knowing the implementation of Lean in several universities in the UK in its activities, specifically on the role of human resources in the function of facilitating the introduction of Lean.	This study found problems in understanding, communicating, and transferring Lean Thinking in higher education.
3	Suárez-Barraza and Ablanedo-Rosas [12]	2014	Evaluating the impact of basic quality practices on manufacturing and service organizations in Mexico.	This study revealed the implementation of 5S practices produces significant benefits in organizational performance.
4	Douglas et al. [13]	2015	Translating the eight wastes of Lean for HEIs, identify several examples of each waste and to propose Lean solutions that are appropriate for those wastes.	The eight wastes were successfully translated for higher education and a number of examples were identified in academic and support services.
5	Balzer et al. [19]	2015	Providing evidence from experience and literature on organizational change and transformation in implementing and sustaining LHE initiatives designed to benefit the university, employees, and the individuals it serves.	This study addressed the techniques in implementing and sustaining LHE. First, assessing and improving the readiness of the institution; second, enhancing leader awareness, understanding, and support for Lean higher education; third, strategic planning, Lean leadership, and getting help for LHE and fourth, facilitating Lean transitions.
6	Sunder M [4]	2016	Presenting various constructs regarding quality, application, successes and shortcomings in higher education services.	This study found the requirements for building quality, the reasons for the lack of quality practices in the higher education and future research opportunities to apply a quality culture in higher education.
7	Balzer et al. [5]	2016	Synthesizing the accumulation of research on Lean in higher education, draw conclusions as a guide to successful Lean implementation, and propose future research directions to build a strong knowledge base that informs practice and research.	This study showed Lean has significant and measurable value when used to improve academic and administrative operations in higher education. These improvements were effective at the department/unit level or throughout the institution. However, implementing Lean in an institution is a serious step that has the most impact if it involves long-term strategic planning.
8	Thürer et al. [20]	2016	Knowing the concept of waste	This study explained two different types of waste: (i) obvious waste, to refer to waste that can be reduced without creating another form of waste; and, (ii) buffer waste, to refer to waste that cannot be reduced without creating other waste.
9	Narayanamurthy et al. [21]	2017	Developing and demonstrating a framework that can provide structured procedures for implementing Lean Thinking in educational institutions.	This study showed comparison of performance measures during implementation before (batch 1) and after (batch 2) produces an interesting perspective on the effectiveness of Lean Thinking.
10	Psomas dan Antony [22]	2017	Determining the Total Quality Management (TQM) elements adopted and the respective results achieved by higher education institutions in Greece.	This study found the elements of TQM adopted by most higher education in Greece concern the following: student focus, leadership and top management commitment, quality strategic planning, process management and teaching staff and employee involvement

TABLE 2
LIST OF RELEVANT ARTICLES

No	Author	Year	Focus	Result
11	Petrusch et al. [3]	2018	Knowing the level of adoption of Lean Thinking in private higher education administration services in Brazil. The results are compared with studies from the United States (US) and the United Kingdom (UK), highlighting the maturity of personnel empowerment, principles, tools and performance measures related to Lean.	The results of the study were convergent with those presented by other studies in the USA and the UK. There was a gap between knowledge of Lean in the academic sphere of higher education and its application to the academic process.

12	Cudney et al. [16]	2018	Knowing the role of Lean and six sigma in improving the system to improve the quality of higher education.	This study found the challenges for implementing Lean and six sigma: institutional failure to identify and target customers, inability to cope with process changes, lack of interest and commitment from stakeholders, and different difficulties in understanding methodology and adapting it to the educational context. Studies showed that increasing stakeholder commitment and involvement, by engaging internal and external customers, and emphasizing the importance and direct involvement can improve quality and reduce waste in learning, teaching contexts, and administration
13	Sfakianaki dan Kakouris [14]	2019	Developing a structured approach to implementing Lean Thinking at the level of primary and secondary education.	Proposed instruments for Lean implementation in primary and secondary education.
14	Alzafari dan Kratzer [11]	2019	Knowing the challenges in applying quality in higher education institutions in Europe and explore the differences between them.	This study found the challenges of implementation are divided into three categories: (1) organizational challenges that include the quality of the system, the education system and external stakeholders; (2) implementation challenges including execution, competence and funding; (3) leadership and cultural quality challenges.
15	Kazancoglu dan Ozkan-Ozen [6]	2019	Investigating and defining eight wastes in higher education by proposing a multi-stages model	The results showed the most important waste is repetitive tasks, unnecessary bureaucracy, mistakes due to misunderstanding/communication problems, excessive number of academic units and excessive information creation. One more important thing in the result was that all sub-waste from talent is in the causal group, while waste in the form of movement and transportation is in the effects group.
16	Davidson et al. [15]	2020	Presenting a literature review that considers the use of a quality framework in higher education.	This study addressed that the quality framework is lacking, insofar as their focus on compliance is an incentive for continuous improvement. This finding was similar to the challenges in other sectors. The findings further identified the need for academic professional practice to go beyond quality assurance in student transformation.

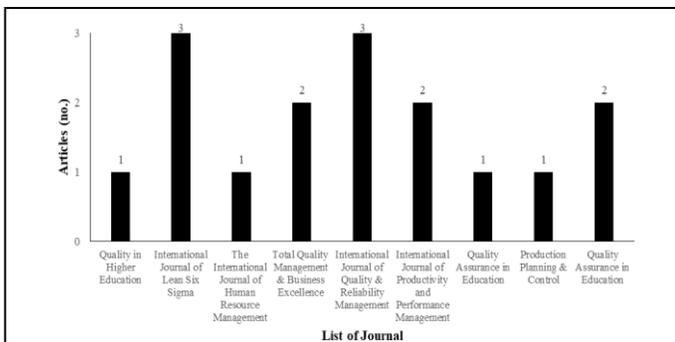


Fig. 2. List of Journal Which Have Published Relevant Articles.

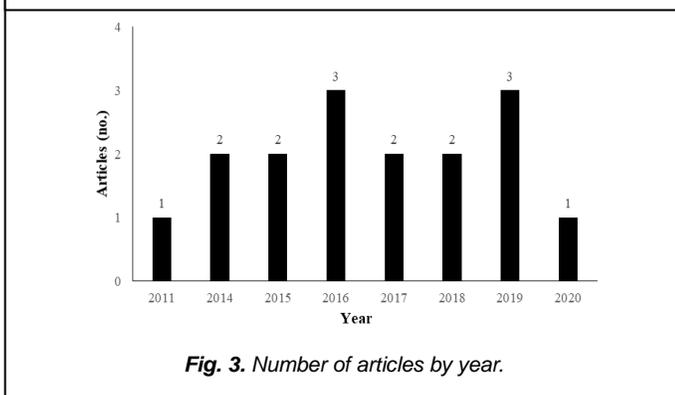


Fig. 3. Number of articles by year.

3.2 TQM and Lean in HEIs

TQM is a philosophy of continuous improvement where educational institutions with a set of tools aim to meet and exceed the needs, desires, and expectations of customers in this time and in the future [1]. TQM is concerned with creating

a quality culture where the goals of each person are directed to consumers and it needs support of the organizations to do this [5]. The implementation of TQM requires a change in mindset culture and practice activities. TQM elements adopted by universities in Greece focused on students, leadership, top management commitment, quality strategic plans, management processes, the involvement of teaching staff and employees [22]. It was further explained that by adopting the TQM element to a high level, HEIs achieved significant results with regard to the internal and external environment. The internal results achieved were very significant, especially related to improving service quality performance, teaching staff and employee satisfaction, and operational performance. The external environment, namely the community, students, and the market also achieved high results. However, this external result was lower than the internal environmental result. Implementing Lean in HEIs may face problems in understanding, communicating, and transferring Lean Thinking, even though the human resource system is a vital aspect of Lean. In addition, they revealed that Lean Thinking is a set of tools and techniques in organizations for implementing processes of improvement and change [10]. Lean Thinking is not only about system change but rather about cultural change. Challenges in applying Lean and six sigma in this higher institution are lack of awareness about Lean and six sigma methodologies, institutional failure to identify and target customers, inability to cope with process change, lack of interest and commitment from stakeholders, and differences in difficulties in understanding methodology and adapting it to the educational context [16]. Their research also showed that increasing stakeholder commitment and involvement, engaging internal and external customers, and directing it directly to emphasize the importance of Lean and six sigma

can improve quality and reduce waste in learning, teaching, and administration. Lean must be implemented in the academic and non-academic sectors because both contain important processes to provide customer satisfaction [13]. The success of significant organizational changes, including HEIs, will depend on whether higher institutions are sufficiently prepared to implement systemic changes widely [19]. It was further explained that the best practice in implementing it is to consider changes outside or within higher education, as well as organizational readiness which includes atmosphere and leadership in the workplace. The key steps of applying Lean principles in the service sector was defining the needs of the relevant service sector and adapting tools that meet these needs [6]. Process improvement in higher education through five general steps; (i) identifying the benefits of the process and what customers value; (ii) applying Lean tools and techniques to analyze the current process, unnecessary steps, inefficient efforts and flow in the process; (iv) redesigning the process using Lean techniques that eliminate waste, increase flow and better meet customer needs; (v) implementing and regularly evaluating updated processes using valuation metrics that reflect customer expectations of the process; and (vi) continue to improve processes with the ultimate goal of achieving perfection in the eyes of all customers [5].

3.3 Waste related to HEIs

Waste reduction is a concept that must be emphasized in Lean Thinking. Lean Thinking is focused on simplification to eliminate all types of waste and accelerate the flow [18] and there are ten factors in implementing Lean, one of which is identifying waste [14]. The concept of waste classified into four: the concept of seven (or eight) wastes, the concept of waste as non-value adding activity, the concept of obvious and less obvious waste, and the concept of waste as buffers [20]. The seven (or eight) waste used in the manufacturing sector can be adjusted because some of the waste mentioned in manufacturing is not directly relevant to the context of higher education institutions. The process at higher education institutions crosses functional and departmental boundaries, this has the consequence that the handover process becomes more numerous, the process becomes longer and the stages become more numerous [13]. They further stated the more stages and handovers, the greater the possibility of mistakes. When it is associated with Lean, then there is a waste. Several articles described the waste that arises in higher education institutions such as [4, 6, 13, 21, 23] (Table 3).

TABLE 3
WASTE IDENTIFICATION IN SOME ARTICLE

No	Article	Waste Category ^a											
		a	b	c	d	e	f	g	h	i	j	k	l
1	[17]		√							√	√	√	
2	[13]	√	√	√	√	√	√	√		√			
3	[4]		√							√	√	√	
4	[21]	√	√	√	√			√					√
5	[6]	√	√	√	√	√	√	√	√				

^aa: Overproduction; b: Over-Processing; c: Waiting; d: Motion; e: Transportation; f: Inventory; g: Defect; h: Talent; i: Underutilized People; j: Information; k: Asset; l: Rework

In higher education, although the definition of waste has been determined there are disagreements on the definition [6]. There are four types of waste in higher education: people waste, process waste, information waste, and asset waste [23]. People waste is defined as waste that occurs when higher education institutions fail to make full use of the skills and knowledge abilities of employers and workgroups. Process waste refers to the group of waste that occurs due to deficiencies in the design or implementation of higher education institution processes. Information waste is a category of waste that occurs when there is insufficient information available to support the higher education process. Asset waste refers to the waste that occurs when an institution of higher education does not use its resources (human and material) effectively [4]. Study of academic staff on six HEIs to identify the types of waste and provide results in eight categories of waste. These categories are excess motion, excess transportation, underutilized people, inventory, defects, overproduction, waiting, over-processing. This categorization refers to the concept of eight times [13]. The action research conducted by Narayanamurthy et al. [21] produced a modification of seven wastes in the manufacturing sector and produced six categories of waste in educational institutions: rework, motion, waiting, over-processing, over-production, and defect. A new type of waste introduced in this study is rework that is different from defects. Rework means that defects that can be repaired while those that are not fixed can be categorized as defects. An example of rework is the correction of grade in the assessment process. Waste category in higher education divided referring to the concept of eight wastes that exist in the manufacturing sector: overproduction, over-processing, waiting, motion, transportation, inventory, defects, and talent [6]. The eight wastes are then divided into 22 sub-waste. Waste identification was obtained from the participation of faculty personnel from various different departments. Although in the article, they did not make a specific category regarding information, there is a sub-waste in the form of information as conveyed in [23] and [4]. Wastes that is included in the category of waste information are excessive amounts of information, missing information, and communication problems [6]. The waste concept in the LHE was adopted from seven wastes (Muda) developed by Taiichi Ohno at Toyota as part of the Toyota Production System (TPS). The seven wastes include transportation, inventory, motion, waiting, overproduction, over processing, and defects. In the 1990s, the seven wastes experienced development into eight wastes with the emergence of a new category of waste namely unused talent. These seven (eight) wastes then experience adjustments when linked to the higher education sector. For the first time, Jens Jørn Dahlgard in 2000 defined eight wastes in the context of higher education [4]. J. A. Douglas et al. [13] used the concept of eight wastes in his research. Similar to J. A. Douglas et al., Y. Kazancoglu and Y. D. Ozkan-Ozen used the principle of eight wastes, although they use another term to refer to the category of underutilized people as talents [6]. Conceptually, talent has the same definition as underutilized people, namely not utilizing one's expertise or abilities. In contrast, G. Narayanamurthy et al. [21] divided waste into six categories. They took five categories from seven wastes: motion, waiting, overproduction, over processing, and defect, and brought up a new category, namely rework. They argued that there is waste that can still be repaired so that it cannot be included in the defect category

but rework. G. Narayanamurthy et al. [21] emphasized the categorization of waste based on the concept of seven wastes. Waste identification is carried out in six processes that are carried out in scheduling, procurement and distribution, teaching, feedback, examination, and assessment at educational institutions. In his book, W. K. Balzer [23] described four categories of waste: people waste, process waste, information waste, and asset waste. This was later conveyed again by V. Sunder [4]. Although they are divided into four categories, when viewed further in the sub-category, especially regarding assets, it can be seen that there is a discussion of excess production and inventory, unnecessary transportation, loading of people, equipment, and facilitation, which also included in the category based on seven (eight) wastes. Many studies showed communication has an important

role in implementing Lean, but it often happens in the production and distribution of information causing waste. Communication in higher education is the process of sending and receiving information in a complex condition because it includes vertical, horizontal, and even cross-work communication. So that in higher education it is important to build and maintain effective communication systems. Discussion about information waste was delivered in [4, 6, 23]. Based on the discussion that has been delivered in this paper and some relevant articles [4, 6, 13, 21, 23] concerning waste in higher education, the category of wastes in this study is shown in Table 4.

TABLE 4
WASTE CATEGORIES

No	Categories	Description	Subcategory of Waste
1	Overproduction	An activity is not needed or implemented earlier than schedule.	<ul style="list-style-type: none"> Excessive amounts, for example too many handouts are made forward and then saved. The workload of teaching/educational staff is uneven/balanced Scheduling lectures in one semester/day is not evenly distributed within a few days.
2	Over-processing	The category of waste that occurs in the design or implementation of higher education processes.	<ul style="list-style-type: none"> Repeating unnecessary tasks/repair errors. Excessive variability of courses. Ineffective lecture material control. Non-strategic efforts. Unclear/necessary process flow.
3	Waiting	Delay of a process/source.	<ul style="list-style-type: none"> Waiting for an empty classroom from the previous user/multimedia system to begin lecturing. Waiting for repairs/maintenance. Awaiting permission or approval Looking for books, papers, documents, etc. Inefficient scheduling practices such as having long breaks between classes.
4	Motion	Unnecessary movements	<ul style="list-style-type: none"> Movement of lecturer/staff/students from classrooms or from one campus location to another. Transfer of classrooms, which might force educators/students to go too far. Excessive movement using machines and office facilities.
5	Transportation	Excessive movement material/object.	<ul style="list-style-type: none"> Transfer/transfer administrative documents for approval in either the same or different campus locations. Lack of use of technology in terms of lecture material (hard copies of material, books, etc.) so it is necessary to bring it between classes/spaces.
6	Inventory	Availability of supplies or goods needed.	<ul style="list-style-type: none"> Records and documents stored longer than needed. Too much inventory of marketing brochures/stationery and other documents. Too many photocopies of class notes/documents. Storage for all of the above in the office or storage room. Lack of resources (academic journals, research materials, equipment, databases, software, etc.) Number of classes that are not balanced (unemployed or over capacity / not suitable)
7	Defect	Every aspect that is inappropriate according to standards/needs.	<ul style="list-style-type: none"> Incorrect input of values to the system. Data correction and checking. Schedule errors. Rework.
8	People	Underutilized human resources skills/abilities due to inappropriate work allocation.	<ul style="list-style-type: none"> Educators do not teach based on specialist area courses. No time for research or scientific activities. Unnecessary Bureaucracy. Educators/educators don't work by their expertise. Misalignment of goals.
9	Information	Waste that occurs when the available information does not support the university process.	<ul style="list-style-type: none"> Information lost during delivery. Irrelevant information Inaccurate information Incorrect translation of information. Excessive amount of information. Mistakes due to misunderstanding/communication problems

4 CONCLUSION

Every process carried out in HEIs has waste consequences. Some of these wastes are easily identified, but some are hidden so it is difficult to identify. The Lean principle emphasizes eliminating waste that arises so that customer and stakeholder's satisfaction can be achieved. The nine categories presented in this paper can be used as a tool in recognizing waste that occurs in higher education so that it can be eliminated when applying LHE. The waste is overproduction, over-processing, waiting, motion, transportation, inventory, defect, people, and information. The categories and subcategories owned by each higher institution can be different according to process. The main emphasis when HEIs implements Lean is to identify waste and implement solution to eliminate it, not in the true or false category of waste.

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