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Article

Development of a data governance framework of MOOC providers in Indonesia

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Abstract: Massive open online courses (MOOCs) are intentionally designed to be easily accessible to many learners, regardless of their academic level or age. MOOCs leverage internet-based technology, allowing anybody with an internet connection to have unrestricted access, regardless of their location or time limitations. MOOCs provide a versatile and easy opportunity for acquiring top-notch education, enabling anyone to learn at their preferred speed, free from limitations of time, cost, or geographical location. Given the advantages they offer, MOOCs are a valuable method for improving the quality and availability of education in Indonesia. Following the outbreak of the COVID-19 pandemic, colleges and institutions have implemented the establishment of digital campuses. One important characteristic of these digital campuses is that they prioritize processes but overlook data and lack standardized standards. The problems and fundamental causes include challenges related to the comprehensive information architecture. The main factor contributing to this challenge is the absence of uniform and well-defined information standards. The existing connectivity and data exchange mechanisms in several schools are poor, leading to substantial data discrepancy among various departments due to the limited content of the fundamental data utilized. Moreover, the absence of clear information about the reliable source of data exacerbates the problem. The main objectives of data governance are to improve data quality, eliminate data inconsistencies, promote extensive data sharing, utilize data aggregation for competitive benefits, supervise data modifications based on data usage patterns, and comply with internal and external regulations and agreed-upon data usage standards. The aim of this project is to create a data governance framework that is customized to the specific conditions in Indonesia, with a specific emphasis on MOOC providers. The researcher chose design science research (DSR) as the research paradigm as it can successfully tackle relevant issues linked to the topic by creating innovative artefacts about the data governance framework for MOOC providers in Indonesia. This research highlights the necessity and significance of implementing a data governance framework for MOOC providers in Indonesia, hence increasing their awareness of this requirement. The researchers incorporated components from the data management body of knowledge (DMBOK) into their data governance framework. This framework includes ten components related to data governance, which are further divided into sub-components within the MOOC providers' framework.

Keywords: data governance; framework; development; MOOC providers; Indonesia

1. Introduction

The massive open online course (MOOC) is an innovative learning platform that offers exceptional accessibility. MOOC, like traditional e-learning, offers a course that

is taught and learned without in-person meetings. The distinction between MOOC and traditional e-learning resides in the ability to accommodate many learners. MOOCs are designed to be accessible to a vast number of learners (massive) without any specific prerequisites such as academic level or age (open). MOOCs utilize web-based technologies, enabling universal access to anybody with an internet connection, regardless of geographical location or time constraints. The fundamental attributes of MOOCs contribute to their high level of accessibility (Sari et al., 2020).

The architects of MOOC platforms have the conviction that MOOCs can serve as a remedy for the issue of educational justice in developing nations (Schuwer et al., 2015). MOOCs are thought to have the potential to achieve equal and high-quality education. They have the potential for universal access to education, which is a fundamental entitlement for all individuals. They also allow unlimited participation without any restrictions on the number of participants. Prior enrollment at a certain institution is not a prerequisite for individuals to participate in MOOC. Therefore, MOOCs offer a flexible and convenient option for obtaining high-quality education, allowing individuals to learn at their own pace without being constrained by time, expense, or location. Considering its benefits, they are a worthwhile approach to enhance the quality and accessibility of education in Indonesia. Malaysia, being the nearest adjacent nation, integrated MOOC into its strategic blueprint for educational advancement inside the country (Lubis et al., 2020).

MOOCs were first introduced to two universities in Indonesia in 2013, marking the beginning of their presence in the country. During that period, the two schools exclusively offered MOOCs to students as a supplementary learning tool to enhance their knowledge acquisition through online courses. Furthermore, this aligns with the directive of the Ministry of Education and Culture in Indonesia, who promoted the utilization of MOOC services to enhance current educational knowledge with a particular focus on students and eventually making it accessible to everyone (Ginting et al., 2022; Kurniasari et al., 2018).

The emergence and adoption of MOOCs in Indonesia can be attributed to their ability to facilitate widespread learning, irrespective of institutional affiliations. MOOCs offer individuals the opportunity to learn based on their specific course requirements, thereby promoting educational advancement for all. Consequently, it will enhance the quality of education in Indonesia. The rapid development of internet technology in Indonesia has greatly facilitated education, enabling individuals to simply and publicly obtain the necessary courses (Ifada et al., 2022). Furthermore, this MOOC platform offers a contemporary learning environment that is revolutionizing the field of education, particularly in Indonesia. It enables learners to broaden their perspectives and enhance their skills by engaging in open and accessible learning, thereby acquiring new knowledge and competencies that can be applied in the workplace. Utilizing this MOOC platform offers a more cost-effective alternative to traditional institutional learning, enabling individuals to acquire knowledge more efficiently through the available course materials and direct interaction with subject matter experts. This platform revolutionizes the conventional learning approach by enhancing three key aspects: economics, technology, and organization, particularly in the field of education in Indonesia (Lubis et al., 2020).

In recent decades, digital campuses in colleges and universities have been

established particularly following the occurrence of the COVID-19 pandemic. However, a notable aspect of these digital campuses is the emphasis on processes while neglecting data and lacking standardized practices (Xie et al., 2021). During the occurrence of the COVID-19 pandemic in Indonesia, there was a significant interruption in various corporate activities, including the education sector. Both students and college students were prohibited from attending school or campus for the purpose of studying. This measure was implemented for health purposes to prevent the transmission of the virus within Indonesia. The outbreak evolved into a life-threatening disaster in Indonesia. Prior to the onset of the epidemic, internet technology in Indonesia had undergone significant advancements and was effectively utilized by the Indonesian population. In Indonesia, education is facilitated by the use of technology and the internet, which enhances the learning experience by providing convenience (Hadayani and Valeria, 2020).

The MOOC platform is widely adopted by schools in Indonesia as a component of blended learning, facilitating both synchronous and asynchronous learning. In this scenario, certain learning activities are exclusively available to registered learners, while other courses became accessible to the general public from the start (Alwi et al., 2021). Consequently, the COVID-19 epidemic in Indonesia has led to an increase in the utilization of the MOOC platform in the country. The rapid development of the MOOC platform, particularly in Indonesia, is evident. Learners, as well as educators, including instructors, lecturers, and practitioners, actively engaged in the MOOC platform to enhance education in Indonesia (Sari and Dahnial, 2022).

The issues and underlying factors are as follows. Firstly, there exist challenges pertaining to comprehensive information architecture. The primary cause of this difficulty is the lack of consistent and established information standards. Due to the independent development of business systems in each department, there is a lack of standardized norms and consensus that can be universally referenced and implemented by all departments. As a result, the codes and coding methods employed in system building vary among different business departments. For instance, it is common to see profession codes, department codes, and instructor numbers that lack consistency. Even crucial information like employment numbers and student numbers may exhibit inconsistencies. Secondly, the current connectivity and data exchange and sharing systems in many schools are insufficient, resulting in a significant amount of data inconsistency among different departments due to the inadequate content of the basic data used. For instance, the fixed asset registers and the finance department, the personnel register of the academic department, and the personnel department may face discrepancies, potentially resulting in inconsistencies in the data during statistical analysis and the inability to locate reliable data sources. Thirdly, the lack of clarity regarding the authoritative source of data contributes to the issue. Occasionally, when there is a data issue, it may be difficult to determine which department should assume responsibility. Several other data are in a similar predicament. All the issues pertain to challenges in the broader data framework and require careful consideration and resolution primarily within the information centre. This is a key motivating factor for many educational institutions to initiate data governance practices.

Data quality issues arise from insufficient design or poor quality of functional modules of different business system software. This research specifically focuses on

the manifestations of software quality connected to data quality. These manifestations primarily occur during the data entry phase of the software, where there is a lack of appropriate limitations and checks (Xie et al., 2021). When applied to the challenges of education in Indonesia, MOOCs have the capacity to expedite the enhancement of education quality and accessibility. MOOCs possess noteworthy attributes that merit inclusion in the nation's strategic plan for educational advancement.

The COVID-19 pandemic and the implementation of digital contact tracing have resulted in alterations to data governance policies and have raised important considerations on the consequences of these changes in the post-pandemic era (Li et al., 2022). Currently, MOOC platforms are being utilized in all educational institutions in Indonesia. Multiple institutions collaborate to contribute their learning content to the MOOC platform, while others separately develop MOOC platforms to ensure accessibility for all learners seeking the course. In Indonesia, both the government and private companies have utilized the MOOC platform for instructional purposes. Government civil officials and commercial employees are required to engage in independent learning to acquire skills that are not provided by their respective firm institutions (Strategy and Literacy, 2021).

When a company seeks to enhance the abilities of its employees, it may either utilize specific pre-existing MOOC platforms or develop its own MOOC platforms (UNICEF, 2021). The primary objective of utilizing the MOOC platform, either autonomously or in collaboration with other institutions, is to obtain a precise assessment of the learner's proficiency in the course material (Sarilita et al., 2024).

Data governance is a framework that regulates the allocation of decision-making authority and responsibility in processes related to information. Data governance is enforced based on a predetermined model that specifies the individuals who are authorized to carry out specific actions, using specific information, at specific times, under specific conditions, and using specific techniques inside a process. There are various methods available for resolving data issues, one of which is the data governance framework provided by the Data Governance Institute.

Data governance provides a means to effectively manage and guarantee the availability, accessibility, quality, consistency, auditability, and security of data within an organization. This improves the value of data as an organizational asset and enables its use in decision-making processes while ensuring compliance with established data standards. Additionally, it possesses the capability to detect data modifications within the business and effectively notify the relevant individuals (Bosua et al., 2022). Notable frameworks for implementing governance in an enterprise, recognized by the worldwide community, include COBIT (Control Objectives for Information and Related Technology), ITIL (IT Infrastructure Library), and ISO (International Standard Organization) (Maciá Pérez et al., 2021).

The primary goals of data governance are to enhance data quality, eradicate data discrepancies, facilitate widespread data sharing, leverage data aggregation for competitive advantage, oversee data modifications in accordance with data usage patterns, and adhere to internal and external regulations and agreed-upon data usage standards. Data governance is the act of supervising the utilization and accessibility of data as a valuable resource within an organization. Multiple data governance frameworks are available in numerous publications; nevertheless, there is currently no

universally recognized standard or optimal approach for data governance (Chinoperekweyi and Ekundayo, 2023).

A crucial element for establishing data governance is the development of a framework that oversees the responsibilities and functions involved in carrying out data governance operations. Similar to information technology governance, organizational structure is a crucial element, along with process and leadership, in data governance. Insufficiently defined roles and responsibilities pose a challenge in ensuring consistent and effective implementation of governance processes. The Data Governance Institute's architecture mandates the establishment of a data governance council of members who represent pertinent stakeholders (Ekundayo, 2022).

A framework, specifically a data governance framework, is necessary to guarantee that data is systematically arranged, supervised, and utilized in a manner that is productive, resourceful, and protected, while adhering to relevant legislation and standards (Ladley, 2019). This framework would facilitate the identification of elements or criteria associated with each attribute of impact in a certain subject, such as data governance (Passey, 2020). Organizations can optimize the utilization of their data for business decisions, product innovation, strategy development, and public services by implementing a robust data governance framework that is responsible for ensuring data quality and integrity by implementing suitable standards, procedures, and technology. This aids in reducing errors, eliminating redundancy, and mitigating data abnormalities. Additionally, it guarantees the confidentiality and protection of data. Organizations can safeguard their data from unlawful access, loss, or destruction. A data governance framework also aids in the effective regulation and prevention of misuse of sensitive and personal data. A data governance framework facilitates organizational compliance with relevant legislation and policies for data utilization. This aids in mitigating legal liabilities and reducing financial damages. By implementing a data governance structure, firms can guarantee that data utilization remains uniform and unified throughout various teams and departments. This contributes to enhanced work productivity and efficacy (Ladley, 2019).

Organizations can optimize the value of their data and mitigate data-related risks by implementing a robust data governance structure. A data governance framework facilitates the attainment of business objectives and enhances the effectiveness of public services. In the context of MOOC providers in Indonesia, it enables them to offer openly available educational services to a large range of individuals that promotes widespread education throughout the country (Ladley, 2019). The absence of data governance in MOOC management might lead to compromised data quality. Therefore, ensuring high data quality is crucial while delivering openly available educational services. Issues pertaining to data, particularly the substandard quality of reports produced by MOOCs, can lead to inaccurate information being obtained by decision makers (Wang and Jiang, 2022). To enhance the quality of data on MOOC providers, it is imperative to implement restrictions, particularly regarding data usage, and establish clear rules and procedures. This will ensure that MOOC services in Indonesia offer more reliable services to users, and that MOOC providers have effective governance over the data, enabling informed decision-making in future operations.

The implementation of the MOOC platform in Indonesia enables learners and the

general public to access and engage in any course available on the platform. There is a wide array of courses, ranging from hundreds to thousands, that are accessible on various platforms in both Indonesia and worldwide. The utilization of the MOOC platform, particularly in Indonesia, has a significant impact on learners and the community by enhancing their digital literacy skills.

Prior to the advent of the MOOC platform, learners are required to either visit the library and engage in self-directed learning or attend an in-person course in order to acquire knowledge. The present MOOC platform enables learners to develop an awareness of learning and enhance their digital literacy, which becomes a valuable asset in their lives (Irianto et al., 2023). Furthermore, the enhancement of careers is driven by the increase in digital literacy. The issuance of an official certificate by the MOOC platform provides learners with tangible evidence of their acquisition of new knowledge and serves as a recognition of their accomplishment in completing the course on the platform (Dhewandrie and Yuniawan, 2023).

Research conducted in Indonesia complements the research conducted in America by focusing on evaluating the effectiveness of learning materials, providing recommendations for further learning, examining the features and components that support learning in MOOCs, and exploring how learning materials can enhance career skills for learners (Yulianto et al., 2021). A data governance structure is necessary to examine the evaluation data from each lesson and provide reports that can inform decision-making by the MOOC providers. Hence, the research inquiry investigates the way the current components might be linked together to construct a data governance framework for MOOC providers in Indonesia.

The objective of this study is to develop a data governance system that is specifically tailored to the circumstances in Indonesia, with a particular focus on MOOC providers. The Data Governance Institute is one of the most relevant data governance frameworks for MOOC management. According to research that has been conducted (Ruipérez-Valiente et al., 2022), MOOC providers have resource requirements for developing and disseminating MOOCs. One such requirement is the proper management of data received and generated, including stakeholder data and analysis data conducted by each MOOC provider. The next research question pertains to the utilization of the data governance framework testing by MOOC providers in Indonesia.

This study employs the design science research (DSR) methodology to elucidate the definition, constraints, guidelines, and execution of the design and implementation of research. The aim is to comprehend and communicate a more reliable research process, particularly in the realm of information systems. The objective is to generate artifacts and test data governance frameworks that align with the requirements of MOOC providers, which was investigated in this study.

The researcher opted for DSR as the research paradigm as it effectively addresses pertinent concerns related to the topic by generating inventive artifacts (vom Brocke et al., 2020). DSR can facilitate the generation of novel insights in this scenario. Design artifacts are highly valuable for gaining a deep grasp of the problem at its core. DSR primarily focuses on the creation of artifacts through two basic actions, with the goal of enhancing and comprehending the behavioral characteristics of information systems. These activities are:

1) The generation of novel information through the inventive development of new artifacts, whether they be physical objects or procedures.
2) Examine the utilization and/or effectiveness of artifacts through the process of reflection and abstraction.

Providers of MOOCs possess the capacity to expedite the enhancement of both the quality and accessibility of education, particularly in Indonesia. MOOC providers facilitate the widespread adoption of MOOCs, ensuring high-quality learning experiences and maintaining secure and user-friendly data flows. Given the information provided, this study necessitates the implementation of a data governance framework for the management of MOOCs in Indonesia.

In this research, there are two (2) research questions that were examined:

a) How do the interconnected components form a data governance framework for MOOC providers in Indonesia?
b) How can the resulting data governance framework be used by MOOC providers in Indonesia?

The objectives to be achieved are:

a) To create a data governance framework specifically tailored for MOOC providers in Indonesia. To address the second research question, a data governance framework is developed by combining the components identified in the answer to the first research question. This framework offers a visual representation that is specifically designed for MOOC providers in Indonesia.
b) To verify that the data governance framework testing that has been created is capable of being executed and utilized by MOOC management in Indonesia. Once the first research objectives have been addressed, the framework testing phase can be conducted to verify the extent to which this framework can enhance data governance and serve as a decision-making tool for MOOC providers in Indonesia.

2. Materials and methods

2.1. Massive open online courses

MOOCs are a form of remote education. In Indonesia, the word “e-learning” is synonymous with remote education. Unlike traditional e-learning, MOOCs prioritise the characteristics of being vast and accessible. These features remove the need for pre-registration with an institution and enable an unlimited number of participants to enroll in the MOOC (Gomez et al., 2022).

The initial idea of MOOCs was proposed by Dave Cormier and Bryan Alexander in 2008 (Zhang, 2020). The New York Times proclaimed 2012 as the year of MOOCs. MOOCs, like traditional classes, also encompass a learning process. An online Learning Management System (LMS) is utilized to facilitate the learning process, providing accessibility to both the teacher and the learners. In MOOCs, the learning process is asynchronous, which means that it takes place at different times without a set schedule. Thus, they are not limited by either geographical or temporal constraints and also offer the benefit of unlimited enrolment capacity. People who have internet connectivity have the opportunity to engage in a MOOC (Englund et al., 2021). MOOCs have characteristics that facilitate the attainment of equitable and unbiased

education. They have the potential to act as a replacement for people who have difficulties in accessing high-quality traditional education. They can also be a practical substitute for fulfilling the continuous learning needs of professionals in the industry.

Currently, Indonesia possesses sufficient internet technology to access the MOOC platform. Indonesia lags other Southeast Asian countries in terms of speed, particularly in the context of internet connectivity. While the majority of Indonesia currently relies on 4G technology, it is adequate for accessing MOOC platforms for educational purposes. Despite the COVID-19 pandemic, the Indonesian government offered financial support for internet fees to students and college students. This initiative aimed to enable online learning and facilitate access to the MOOC platform. Once the COVID-19 pandemic subsides in Indonesia, government support for internet expenses will cease for students and college students. However, the community, particularly students and college students, now have affordable and convenient internet access (Hidayah, 2022; Sulistiowati et al., 2021).

2.2. Data governance

Data governance, as per the definition provided by the Data Governance Institute, is a structured system that regulates the authority and obligations associated with decision-making in activities linked to information. The implementation is based on established models that govern access and management of information. These models identify the individuals who are authorised to execute specific actions, the conditions under which these actions can be carried out, and the techniques that can be used (Al-Ruithe et al., 2019). Data governance is commonly established through a data governance council at the executive level or a comparable platform. The primary responsibility of this council is to establish and enforce rules and procedures pertaining to the utilization and technical administration of data throughout the entire organization. This information is based on the research conducted by Jimenez et al. (2019). The primary objectives of data governance are to improve data quality, address data inconsistencies, encourage data sharing, utilize data aggregation for competitive advantage, manage data modifications based on usage patterns, and comply with internal and external regulations and agreed-upon data usage standards. Data governance refers to the implementation of a system within an organization that oversees the management and importance of data as a valuable resource for the organization (Jimenez et al., 2019).

Various data governance frameworks can be found in numerous publications, however currently, there is not a globally acknowledged standard or ideal method for data governance. Data governance is commonly employed as a solution to address an organization's data quality problems (Hikmawati et al., 2021). There are ten key elements that can diminish the quality of data. The factors encompass a range of elements such as varied data sources, subjectivity in data generation, restricted computing resources, security compromises due to access needs, variations in data coding across different domains, intricate data representations, substantial data volumes, excessively rigid or absent data entry regulations, evolving data demands, and the utilization of distributed and diverse systems. The existence of these factors presents data quality hazards to the organization.

An essential aspect of implementing data governance is the creation of a framework that supervises the duties and activities associated with data governance operations. The organizational structure is an essential component of data governance, just as information technology governance. It works in conjunction with technique and leadership. Without clearly defined roles and responsibilities, it will be difficult to implement governance practices consistently and effectively. The Data Governance Institute's data governance architecture requires the creation of a data governance council that consists of members who represent the relevant stakeholders (Al-Ruithe et al., 2019).

Research conducted by Yebenes and Zorrilla (2019) emphasized on the significance of software architecture, particularly data as a service, in the era of Industry 4.0. The study highlights the importance of employing both horizontal and vertical strategies to digitize industrial processes. The problem with this research is the lack of a complete framework for the development of policies, directives, and standards that regulate effective governance. Moreover, this study is primarily centered on the application of cloud computing to improve both performance and security. The objective of this research is to present a framework that is in line with the concepts of Industry 4.0. The framework will facilitate the realization of the industry's vision and commercial goals during the era of Industry 4.0. This will facilitate the establishment, conceptualization, creation, and implementation of appropriate services.

2.3. Methodology

To answer the three research questions, the framework development stages was followed. Each stage was carried out systematically and each output generated from one stage was used for the next stage. The framework used for this research was the DSR (vom Brocke et al., 2020). This was to provide a clear explanation of the definition of this research, limitations, guidelines and delivery of the design and implementation of research that can understand and communicate a more credible research process, especially in the field of information systems so as to produce artifacts and test the data governance framework according to the needs of the MOOC providers for this study. The DSR framework is shown in **Figure 1**.

- Identify problems and motivate

In the first step, the problems were identified from MOOC service providers in Indonesia. The first identification of the problem obtained was the existence of data overload, especially during the pandemic and afterwards. During the pandemic, learning was done online and there was a very high need for MOOCs to be able to do independent learning. This required a large amount of data processing so that it can be organized and managed properly by the MOOC providers. Thus, the motivation that is expected and raised is the existence of data governance that suits the needs of MOOC providers, especially in Indonesia.

- Define objective

In the second step, defining the objective of the need for data governance in MOOC providers was to initially identify the components of the data governance framework in MOOC providers. By knowing the components, this guides the

development of the data governance framework that comes from each component.

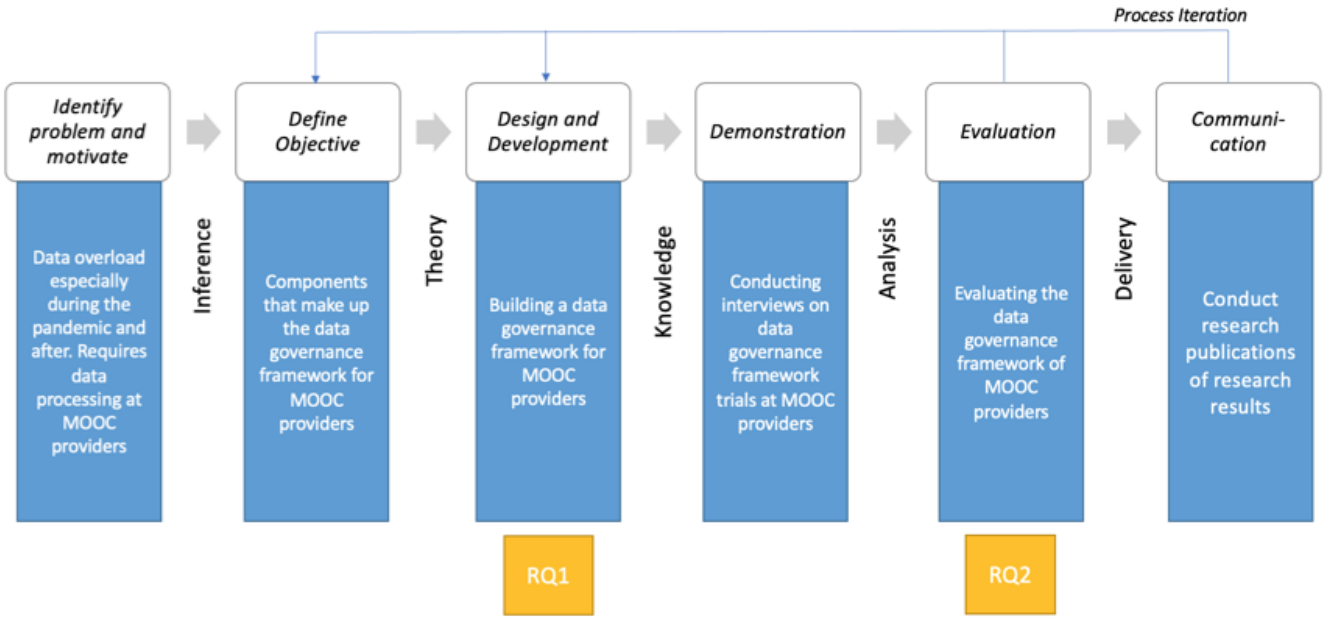

Figure 1. Research framework using DSR.

- Design and development

The next stage was to develop a data governance framework on the provider/MOOC providers to get an overview of the appropriate framework from the findings of the components in the previous stage.

- Demonstration

In the next stage, after a draft of the appropriate framework description was made, a demonstration was carried out by conducting a focus group discussion on the data governance framework trial for MOOC providers. If the results of the focus group discussion led to findings that call for changes, adjustments were made so that it can become a suitable framework for MOOC providers.

- Evaluation

At this stage, an analysis of the results from the focus group discussion was carried out. Then, the governance data was evaluated by testing the resulting framework with adjustments to the case studies that most often exist among MOOC providers in Indonesia.

- Communication

If the framework can be implemented among MOOC providers, communication of the framework to the community would be done through publications regarding the data governance framework for MOOC providers in Indonesia. This would allow for improvements in the future for the next design and development, which can then be followed by demonstration and evaluation for the next communication update after the implementation of the data governance framework.

With the use of DSR, iterations would occur when arriving at the evaluation stage. If it is felt that it is still not in accordance with the conditions in the MOOC providers when testing, then the process can return to defining the objectives, which means that there are deficiencies or errors that occurred when previously defining the objectives

of this data governance framework. If the goal definition stage is appropriate, then the iteration will be carried out towards the design and development. This means that in this phase, there is a possibility of inaccuracy in conducting the data governance framework; therefore, revisions could be made until it is adjusted to the conditions that exist in the MOOC providers. At the communication stage, the results of the discussion of the MOOC provider's data governance framework are communicated to ensure that it is acceptable to every MOOC provider in Indonesia.

3. Results and discussion

3.1. Earlier study

Research was conducted using the systematic literature review method which aims to identify the components of the data governance framework in MOOC providers. In applying this method, the author collected data in the form of components that have been concluded in various previous studies and recorded them to provide components of data governance.

After collecting the components from the 53 publications, the researchers conducted interviews with the MOOC providers, which was requested by them as they did not prefer to participate in focus group discussions. Thus, there were ten sources that can be interviewed by the researchers from eight MOOC providers in Indonesia.

Prior to the COVID-19 epidemic, there had already been established MOOC providers. However, numerous others MOOC providers emerged in Indonesia following the outbreak. This is a result of the proliferation of educational institutions and corporations constructing MOOC platforms for educational purposes. Nevertheless, following the conclusion of the COVID-19 pandemic, numerous platforms also ceased their educational activities. Currently, there are four distinct groups of MOOC providers in Indonesia, categorized based on the origin of the MOOC platform: 1) government-affiliated, 2) university or higher education institution-affiliated, 3) private company-affiliated, and 4) community-driven by education enthusiasts. The researchers reached out to a maximum of 20 MOOC providers in Indonesia that have a minimum of 1000 active learners and have been offering MOOCs for over a year. Among the 20 MOOC providers, eight were open to being approached by the researcher. These providers can be categorized as follows:

a) One MOOC provider was government-funded.
b) Two MOOC providers were affiliated with universities or higher education institutions.
c) Four MOOC providers were privately owned companies.
d) One MOOC provider was supported by the educational enthusiast community.

After conducting interviews with the MOOC providers above, the researchers obtained answers with regards to the sub-components that were needed by MOOC providers to be used in the data governance framework. From the results obtained from the MOOC providers, the researchers conducted testing using the fuzzy Delphi method based on the Likert scale of 1–5. The results were obtained to be the components and sub-components as follows in **Table 1**:

Table 1. Results of components and sub-components.

#	Components	Count sub-components
1	People and organization	31
2	Technology	24
3	Policies/standards/procedures	25
4	Process	21
5	Requirement	9
6	Other governance	2
	Total	**112**

3.2. Discussion of research question 1 (RQ1)

3.2.1. Actors and roles involved in MOOC providers

When conducting interviews with MOOC providers, the researchers asked about the parties that were involved in the management of MOOCs and the role of the process flow in the MOOC process activities. From the results of interviews with the 10 MOOC providers, **Figure 2** depicts the process flow and entities involved among MOOC providers.

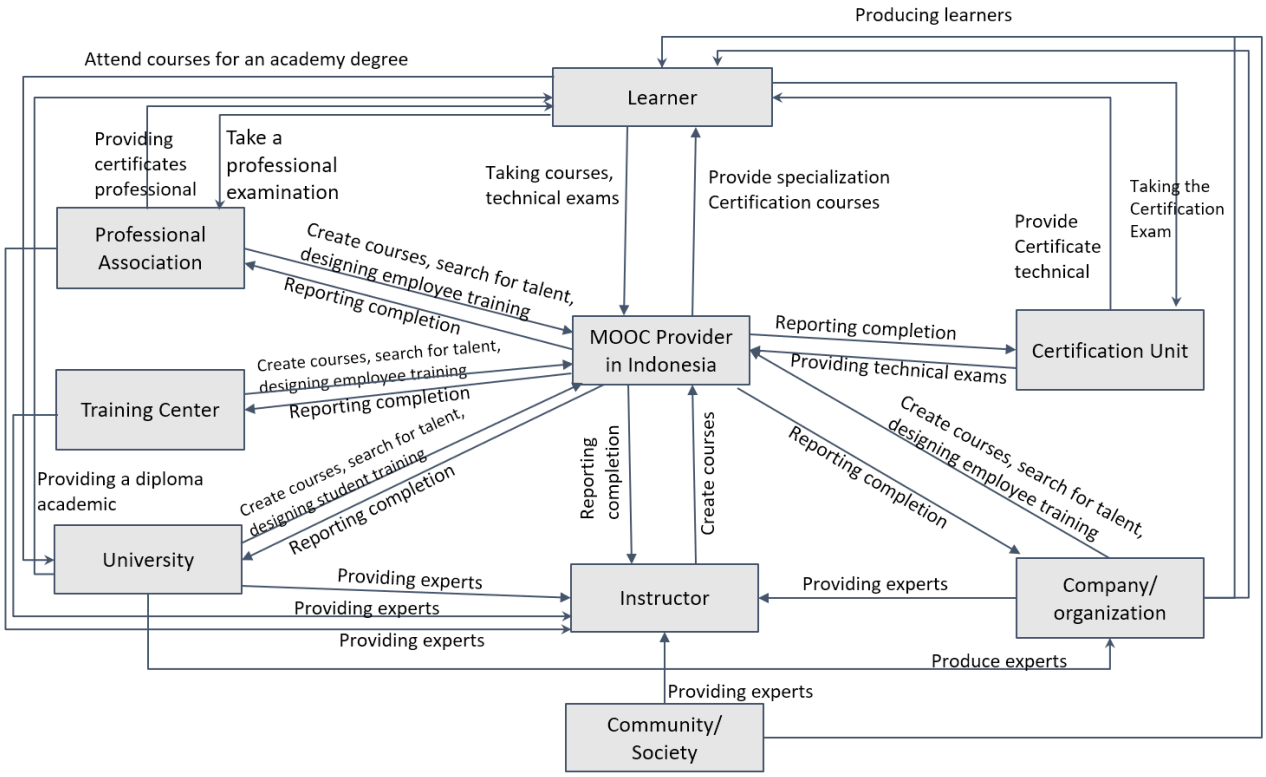

Figure 2. Entity process flow in the preparation of a data governance framework.

In **Figure 2**, in the middle is the MOOC providers in Indonesia. Based on the interview results, MOOC providers in general are getting data sources from other entities. So, it is very rare for providers to create their own learning content, but MOOC providers have become a medium for learners using learning materials from other entities. The related entities are universities, companies/organizations, certification units, training centers, and professional associations. In addition to these

entities, there are instructors, learners and society who are part of the MOOC providers in the provision of learning in the MOOC itself.

- University

Universities provide experts who can become instructors in learning videos in MOOCs. In addition to providing experts, namely instructors, the university can also play a role in creating courses on the MOOC platform.

In general, after the MOOC providers runs the course originating from the university, the MOOC providers will provide a completion report that has been done by the learner within a certain period of time.

In terms of the university itself, university learners, namely students, attend lectures to get an academic degree. However, some universities also offer compulsory or additional courses that students can follow by learning on the MOOC platform.

If the student has completed the course placed on the MOOC platform, the proof of the certificate issued by the MOOC providers can be used as evidence of having participated in learning through the MOOC. In addition, universities also provide courses to high school students or their equivalent as learners such as by learning in lectures at universities through the MOOC platform. If the learner is successful, then some universities provide semester credit units to the learner as one of the ways to get talents/new students to continue the level to college. This provides an opportunity for learners to enter university.

- Company/organization

In a company/organization entity, the company has an interest in improving the ability of its employees by conducting training. If the company/organization has not been able to conduct training internally, then the company/organization will ask employees to conduct training online using the MOOC platform. If there is a need for costs in learning in the MOOC, then the company will make payments for its employees. Therefore, the company/organization will send its employees as learners in the MOOC providers.

Some companies/organizations can also create course materials that can be useful for others and cooperate with MOOC platform providers to create materials and participate in designing employee training to MOOC providers. In addition, companies or organizations also can get potential new employees (new talent) after participating in the learning video on the MOOC platform by filling out a form given directly in the individual assignment to the participant.

Some companies/organizations are also willing to become for the MOOC platform. Employees who double as instructors can share experiences and knowledge about what is done in the company and if they have a specialty, they can explain a particular field in the MOOC platform.

Some companies or organizations not only provide learning, but also increase value to learners with additional a technical worker certification. In this case, there is a role for certification bodies to participate as a body that provides certification to company employees.

After the learners learn on the MOOC platform, the MOOC providers will provide a completion report within a certain period of time. This is so that the company/organization can see how many learners participated in the course and passed the course.

- Certification unit

The certification body provides technical exams if there is a need from companies/organizations, universities, training centers, and workers' associations. This certification body cooperates with the MOOC providers as part of the value of the MOOC to provide an official certification for using the MOOC platform. There are some technical exams that can be done on the MOOC platform, but there are some technical exams that need to be done outside the platform. Regardless, the score input and graduation statement will still be done on the platform. Thus, if the learner passes the certification exam, the MOOC will provide a completion report from the learner, then, the certification body will provide the technical certification outside of the MOOC platform by hardcopy to the learner.

- Training center

There are several training centers that provide courses on the MOOC platform so that anyone can access them. Therefore, the training center also makes the MOOC platform as a place to find new prospective learners to be able to conduct additional training onsite/online directly through the training center. For example, the training center can provide free courses on the MOOC platform. After completing a course, on the MOOC platform, learners who want to progress to more advanced levels can contact the training center to learn with a higher level of proficiency. Learning can be done in person at the training center, or online via video conference. This way, the training center attracts talents who want to learn directly at the training center.

Some training centers send teaching staff or experts to become instructors on the MOOC platform to conduct courses created through the training center. Thus, the training center also provides instructors who must comply with the guidelines set by the MOOC providers.

- Workers' association

Workers' associations function like organizations and can provide professional certificates like the certification bodies described above. These associations can also supply instructors for the procurement or creation of courses to allow learners to take professional certificate exams in the MOOC platform. If there is a need to take the exam outside the platform, the statement of passing and giving grades would still be the MOOC platform. The association can also look for new members or talent by conducting learning to prospective members through this MOOC platform. If the prospective member has learned through the MOOC platform, a professional association certificate can be given directly to the learner.

MOOC providers also provide a completion report within a certain period to the labor association who would be informed about the learners who follow the learning through the MOOC platform.

- Instructor

An instructor is anyone from a university, company/organization, training center, or workers' association who can provide course materials for learners. The instructor can also come from the community who is considered to have competence and is proficient in their field in the community. MOOC providers can also make someone from the community an instructor. They need to follow the rules and policies set by the MOOC providers, especially for data governance so that they follow the rules and policies correctly and clearly.

- Learners

The learner is anyone who can participate in learning courses provided by universities, companies/organizations, training centers, and workers' associations. Learners need to abide by the rules and policies set by the MOOC providers when becoming a participant of the MOOC platform. When the learner enrolls and starts learning, they need to follow the process that has been set from the MOOC providers to comply with the applicable procedures and conditions. After the learner completes a lesson on the MOOC platform, the learner will get the rights in accordance with the existing provisions. If the provision is a certificate of completion, the learner will get the certificate after completing the learning activities on the MOOC platform.

- Community/Society

The community or society refers to all those mentioned above who are part of the community. The community plays a role in the MOOC management, particularly when its members can become an expert who is proficient in a certain field. This person can then become an instructor on the MOOC platform. In addition, the community can become a learner on the MOOC platform for open or closed learning (unpaid or paid) on the MOOC platform. The participants from the community can become learners, and after completing the course on the MOOC platform, they can then contribute back to the community with a change in behavior or better knowledge.

Based on the interview and the entity process flow in preparing the data governance framework, the researchers at this stage carried out the design and development of the data governance framework.

3.2.2. Design framework using the theoretical framework

The construction of the data governance framework utilizes the theoretical framework below in **Figure 3**:

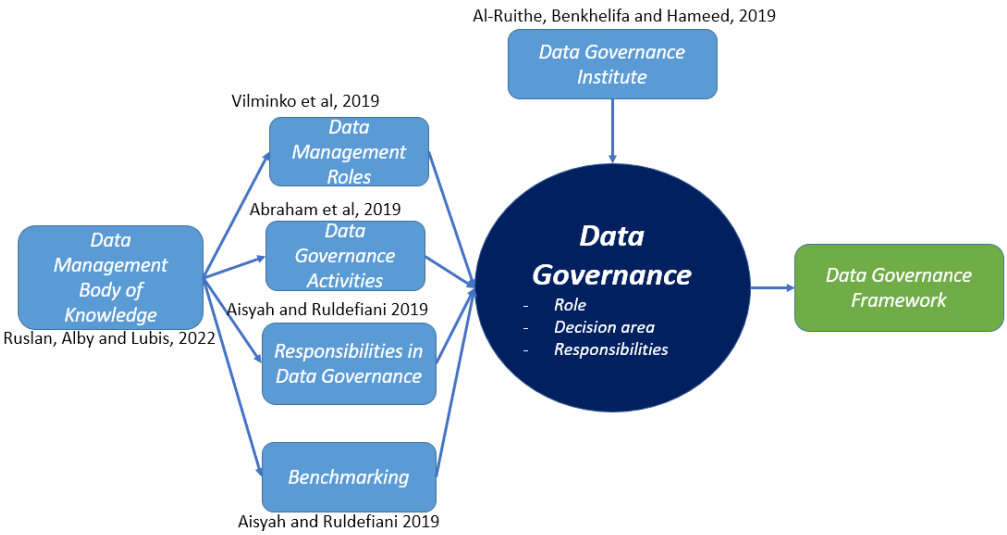

Figure 3. Theoretical framework.

Based on **Figure 3**, the flow begins from the Data Management Body of Knowledge (Ruslan et al., 2022). Through this source, there are 10 components in data governance, namely:

1) Data architecture

2) Data modeling & design
3) Data storage & operations
4) Data security
5) Data integration & interoperability
6) Document & content management
7) Reference & master data
8) Data warehousing & business intelligence
9) Metadata
10) Data quality

The 10 components above are aligned with the sub-components that have been found and validated in answering the earlier study and are included in the data governance framework in answering the research questions.

The next framework comprises four divisions of the DMBOK, namely:

a) Data management roles

By studying the data management roles (Vilminko-Heikkinen and Pekkola, 2019), it is necessary to consider the roles of MOOC providers when building the framework. In this case, based on **Figure 2**, there are various roles related to the MOOC providers, namely the learner, instructor, university, company/organization, certification unit, professional association, training center. These data management roles highlight the activities that exist among MOOC providers.

b) Data governance activities

By studying the data governance activities (Abraham et al., 2019), each role has activities that can be described in the data governance framework that highlight the inputs, processes, and outputs of activities, especially for MOOC providers. This helps the analysis of each activity in data governance. Therefore, it is necessary to describe the activities in the process of the data governance framework.

c) Responsibilities in data governance

Each role has responsibilities that need to be carried out. This is in line with research (Aisyah and Ruldeviyani, 2019) where in the data management body of knowledge, responsibilities need to be carried out so that it becomes one unit with the existing roles of the MOOC providers. Thus, the data governance framework will also need to emphasize the responsibilities of the MOOC management organization. Responsibility is included in the sub-components that have been found in people and organizations from the systematic literature review above.

d) Benchmarking

In conducting the literature review, especially on governance frameworks, no literature was found that specifically discussed the data governance framework for MOOC providers. Therefore, it is very appropriate to do benchmarking to several data governance frameworks to further enrich the data governance framework, especially for MOOC providers. Benchmarking is one of the activities to review other literature in building a data governance framework.

In addition to the data management body of knowledge, in developing the framework for data governance, corporate governance and IT governance support the development of the data governance framework. This is in line with the findings through the previous literature study where other types of governance were found as one component. Other sub-components of corporate governance and IT governance

are complementary components in building a data governance framework.

The framework also uses practical matters, which come from the Data Governance Institute (Al-Ruithe et al., 2019) as a form of benchmarking in building a data governance framework. Through this Data Governance Institute, researchers can easily provide an overview of data governance apart from the DMBOK.

From the framework compiled, the researcher attempted to design the data governance framework. The entity process flow in developing a data governance framework is coupled with the framework discussed above, starting from the use of the DMBOK to the Data Governance Institute. This makes it easy for researchers to build a data governance framework according to the roles, responsibilities, and decision areas carried out by the MOOC providers. From this, a more structured framework can be drawn visually to provide the necessary guidelines and framework directions such as how the role of the learner will be different from the role of the instructor. In addition, the responsibilities of the stakeholders involved in the MOOC providers are a concern by researchers to provide a good relationship for the data governance framework.

Through the sources collected by researchers, a framework was created in **Figure 4**.

In **Figure 4**, there are various colors and shapes that have meaning in the data governance framework. The orange color is part of society. This means that MOOC providers and entities involved in MOOC management are part of society.

There are five white boxes, which are entities related to MOOC providers who are part of the community, namely universities, companies/organizations, worker associations, certification bodies, and training centers. These five entities are between orange and blue which are the main components in data governance. The one that is closest to these five entities is the requirements component. This is also attached to other components, namely policies/standards/procedures, people and organization, process, and technology.

The blue color as explained above concerns the five main components, namely requirements, policies/standards/procedures, people and organization, process, and technology. These are coupled with other governance components, namely corporate governance and IT governance which are colored green as there is an overlap between the two main components. For corporate governance, it intersects between the people and organization component and the process component. Corporate governance is related to people and organizations and how to manage the processes that take place in a company/organization. Meanwhile, IT governance concerns the governance component that intersects between the process component and the technology component. IT governance runs with the use of technology that is in line with the process journey in a company/organization.

The light blue color is the instructor who is part of the community. The blue color of the instructor is also above the orange society. In addition, instructors are above the main component, namely requirements, and under the main components of policies/standards/procedures, people and organization, process, and technology. This is because the instructor must comply with the requirements of the MOOC providers, but also needs to comply with each component in policies/standards/procedures, people and organization, process, and technology as part of data governance.

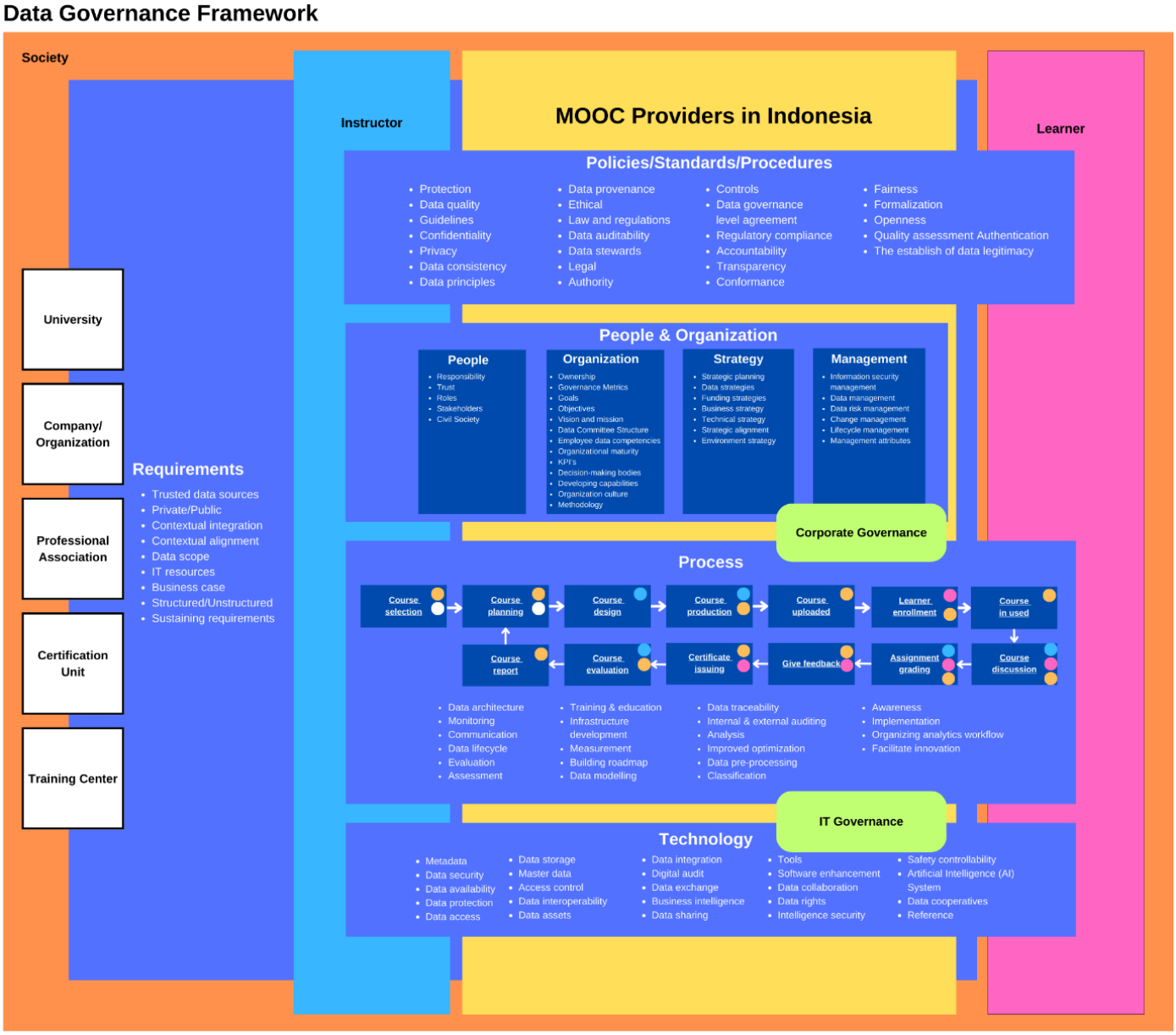

Figure 4. Draft data governance framework.

The yellow color refers to the MOOC providers as the object of this research. MOOC providers obey and fulfill the requirements which are the main components of data governance in relation to the other five entities in the white box. MOOC providers need to obey and submit to four other main components, namely policies/standards/procedures that have been mutually agreed upon, people and organization, process, and technology. In addition, MOOC providers must also run other governance correctly with the green color, namely corporate governance and IT governance. MOOC providers also stand in the community, meaning that they also need to contribute to the community so that the community benefits from the existence of the MOOC.

The pink color is the learner. Learners are part of the community. The learner is involved in data governance when obeying the policies/standards/procedures of the MOOC providers, obeying the applicable process, and including the sub-

components in the process. They are also involved in the use of the MOOC platform as part of the technology that has sub-components accompanying the learner in the learning process.

In the main component of people and organization, there are two colors, namely blue which is above the instructor and the MOOC providers, and dark blue which has four boxes, namely people, organization, strategy, and management. This means that the four boxes are in the main component of people and organization, but also relate with every process running in the main component of the process which is also underneath the dark blue. This means that in undergoing the process in the main component of the process, people, organization, strategy and management are also part of the process. This is also supported by the existence of another main component, namely corporate governance, which is the link between people and organization and process. In the main component of people and organization, it does not reach the learners because this component is more attached to the instructor and MOOC providers.

In the main component of the process, there is a process flow, which is displayed as follows in **Figure 5**:

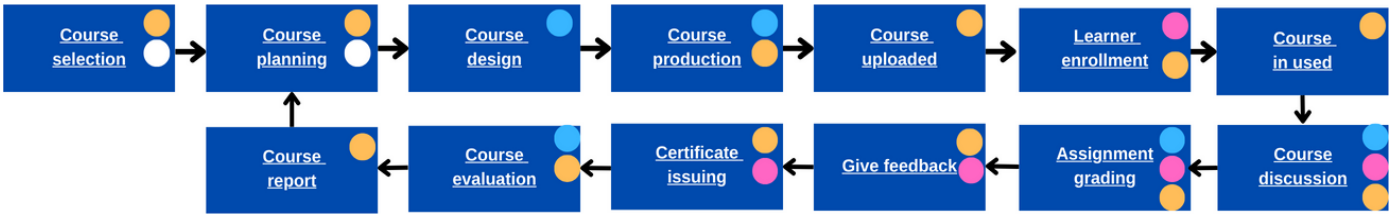

Figure 5. Process flow.

The process starts with course selection. Usually, this first process is a discussion between the MOOC providers (marked with a yellow circle) and one of the five existing entities, namely universities, companies/organizations, work associations, certification bodies, and training centers (marked with a white circle). Course selection is marked with a dark blue box process, which means that there is an attachment to the people and organization component in carrying out this process activity.

After the course selection is completed, the MOOC providers will discuss with five other entities in conducting course planning. Like course selection, course planning is still based on the main components of the people and organization because it is marked with a dark blue process box.

After the planning of the course is completed, the activity continues with course design. At this stage, the course design is done by the instructor. This is also marked by a dark blue process box which means that it is still subject to data governance in the people and organization component.

After the course design is completed by the instructor, the next process is to carry out course production carried out by the MOOC providers and instructor in terms of providing the necessary materials and content on the MOOC platform.

After the course production is completed, the course is uploaded to the MOOC main platform to be published. This is done by the MOOC providers because at this stage, each material in the course is tested according to the planning that has been decided.

After the course is published, the learner will see that there is a new course, and if the learner is interested in the course, the learner can enroll in the course. The parties involved in this process are the learner and the MOOC providers. After the course is enrolled by the learner, the course is in use. Currently, the running course is still monitored by the MOOC providers.

After the learners go through the learning, they can sometimes conduct discussions with their instructors. This is still monitored by the MOOC providers. After the discussion, the next step is the assessment of the learners' test. In this case, it is done by the instructor, learners, and the MOOC providers who monitor the assessment.

After the assessment is completed and the assessment results are notified, the MOOC providers ask the learners to provide feedback so that it becomes a lesson for the MOOC providers as well. After the learner completes all activities on the MOOC platform, the MOOC providers award a certificate to prove that the learner has completed the course on the MOOC platform. However, in this case, there are various provisions if there are additional certificates issued by workers' associations or from certification bodies.

The next step is for the MOOC providers to discuss with the instructor about the evaluation of the course activities that have been carried out. If there is any input from the learners when giving feedback, this is informed to the instructor as an area of improvement for the next learning video. In addition, the MOOC providers can also prepare a report to be given to one of the five entities involved in providing the course, so that the next activity is course planning on the MOOC platform with quality improvement through joint course planning with the MOOC providers and one of the five entities.

With this, the cycle continues so that it can improve the quality in the course on the MOOC platform developed by the MOOC providers. In doing this process, the main components start from data architecture to facilitate continuous innovation. This is also equated with corporate governance that continues to run along the MOOC providers.

The sub-components that have been discussed in section 3.1. answer the first research question. The sub-components are inside each blue box of the main components, and the recording in the data governance framework in **Figure 4** is in order according to the ranking that has been calculated based on fuzzy Delphi calculations.

3.2.3. Demonstration of draft data governance framework to MOOC providers

The demonstration was conducted to MOOC providers in Indonesia. Researchers managed to recontact eight MOOC providers who had previously participated (10 experts) in selecting the data governance components of MOOC providers.

By conducting demonstrations and asking the opinions of the MOOC providers above, the framework was revised based on input from the MOOC providers and the following is the input from the MOOC providers who were willing to participate in the interviews (**Table 2**):

Table 2. Feedback from MOOC providers during the demonstration of the draft framework.

No.	Feedback from MOOC providers	Researcher response
1	The word "requirement" is still incomprehensible, but the meaning is understandable.	Will rename "requirement" to "required Information"
2	Why don't the 5 entities just merge into the name "MOOC Partners"?	Will be changed by merging all entities and become the name "MOOC partners"
3	The sub-components contained in each component are still too many and can actually be simplified.	Will try to simplify so that there are not too many sub-components that are easier to understand.
4	It seems that corporate governance and IT governance cover all processes, policies/standards/procedures, and also technology, because corporate governance needs these three components and IT governance is more focused on technology and processes.	Get a new understanding to change the structure of corporate governance and IT governance so that it can become a group that can cover all three components.
5	The foundation of MOOC is in technology and there are regulations that must regulate MOOC technology, so the foundation above the technology is policies/standards/procedures.	The foundation will be changed in the visual image so that it gives the meaning that the MOOC providers has a technological foundation and on top of it there is a strong policy.
6	Where are the additional entities if there is a high school?	Will be merged with MOOC partners so that it is not just a university but changed to "education institution"
7	It is also necessary to describe the "learner's journey" so that it can be seen how the learners do the process and how the MOOC providers interacts with the learners.	Gained valuable feedback for the advancement of the framework and redefined the process with a "learner's journey".
8	Usually in the process at the MOOC providers, before doing course selection, there needs to be "market research" to find out.	Will be added to the process section to make the process clearer.
9	Course needs to be promoted on various social media to get the attention of learners.	Will be added to the process section to make the process clearer for learners to understand.
10	In the process, usually after getting the course report, the MOOC providers conducts a course review/evaluation.	The process will be swapped from course evaluation to course report, and reversed to course report and then course review/evaluation.
11	In the process, after doing course production, it is still necessary to validate whether it is in accordance with what is expected.	The process will be added with course approval to make the course that has been produced, eligible to enter the MOOC platform.
12	It is necessary to simplify the sub-components, especially in "People and Organization", it seems that they can be combined, there is no need to separate the four parts.	Good input and will be made simpler to make it easier to understand, especially in the "people and organization" sub-component.
13	Is there still a need for "civil society" in the people sub-component, while society is already in the orange back?	Good feedback and will try to delete this feedback.
14	On the process, how can assignment and grading be one? Maybe it can be separated so we can see who is doing the assignment and who is doing the grading.	Good input and will be separated in the process so that there is an assignment process and a grading process.
15	Before enrolment, learners need to register themselves so that the MOOC providers can know who is registering. So that with the new self-registration can do enrolment.	The process will be added with registration to make the process more clearly understood.

With the input and comments from the eight MOOC providers, the researcher made changes to the data governance framework that was designed (in **Figure 4**). This was to deepen the framework and input from MOOC providers to build a more appropriate data governance framework for MOOC providers.

3.2.4. Data governance framework results answer research question 1 (RQ1)

As shown in **Figure 6**, changes were also made for the position, and the five entities that were previously separated were merged and named "MOOC partners". The location that was previously on the far left was moved to the far right. The position of learners was also moved from the far right to the far left.

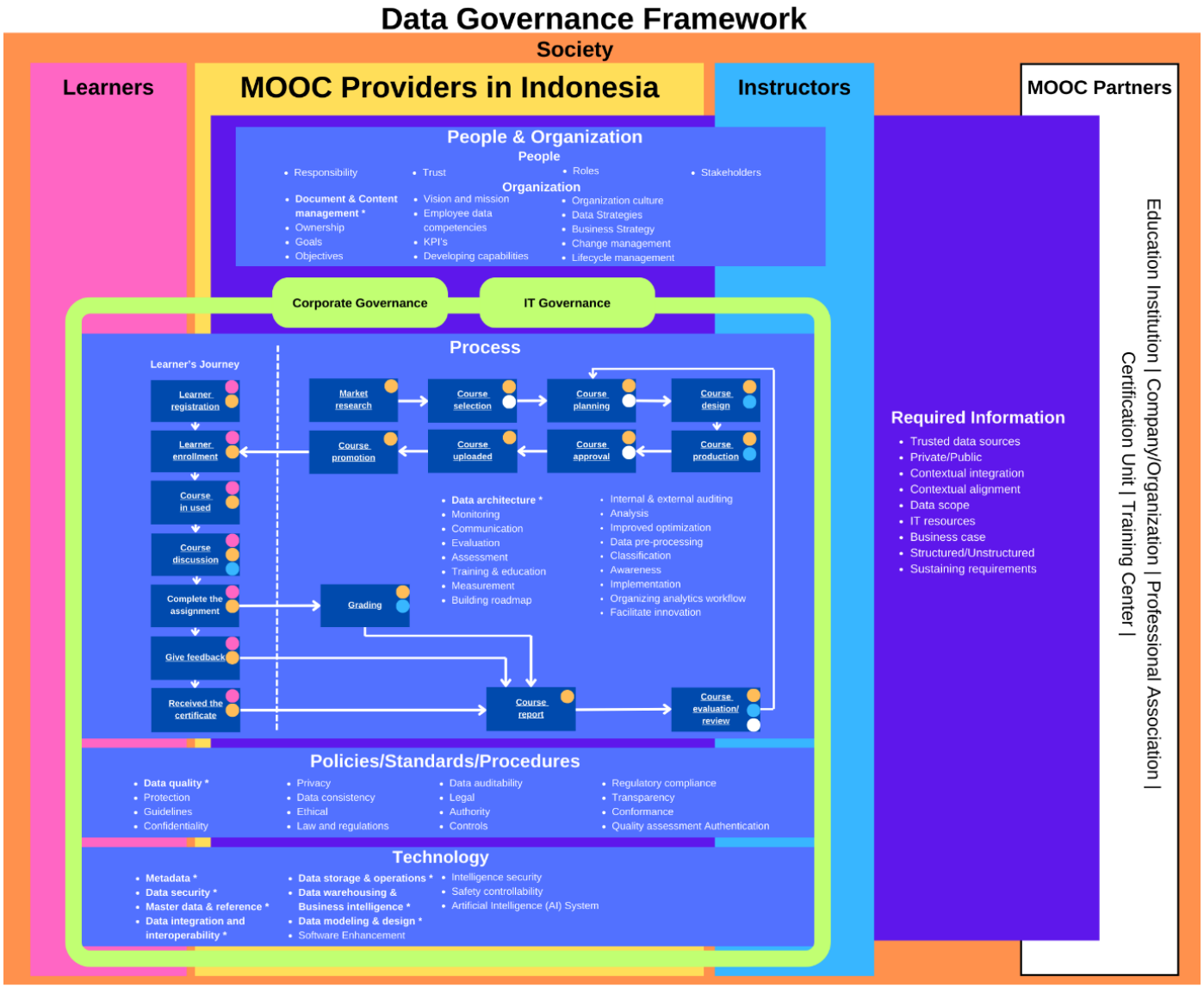

Figure 6. Revised results of the MOOC providers data governance framework demonstration.

The researcher also obtained input from the eight MOOC providers on the process depiction. The latest process in the data governance framework with existing input from the MOOC providers is displayed as follows in **Figure 7**.

The process was completed with the learner's journey. The learner's journey examines the learner's experience in learning using the MOOC. In addition, the position of the process of the learner's journey is above the learner area and the MOOC providers. The change in the process image makes it easier to understand each component in the data governance framework. Thus, the learner's journey starts from the learner registering on the MOOC platform before enrolling in a course. When the learner completes the initial registration, the MOOC providers obtain data, especially the characteristics and demographics of the learner.

After the learners register themselves, they enroll in a course. The learners obtain the course information as the MOOC providers conduct promotional activities on the course which cause them to become interested and register for the course. With the registration, the MOOC providers obtain the data especially on the learners' profile

interest in learning the course.

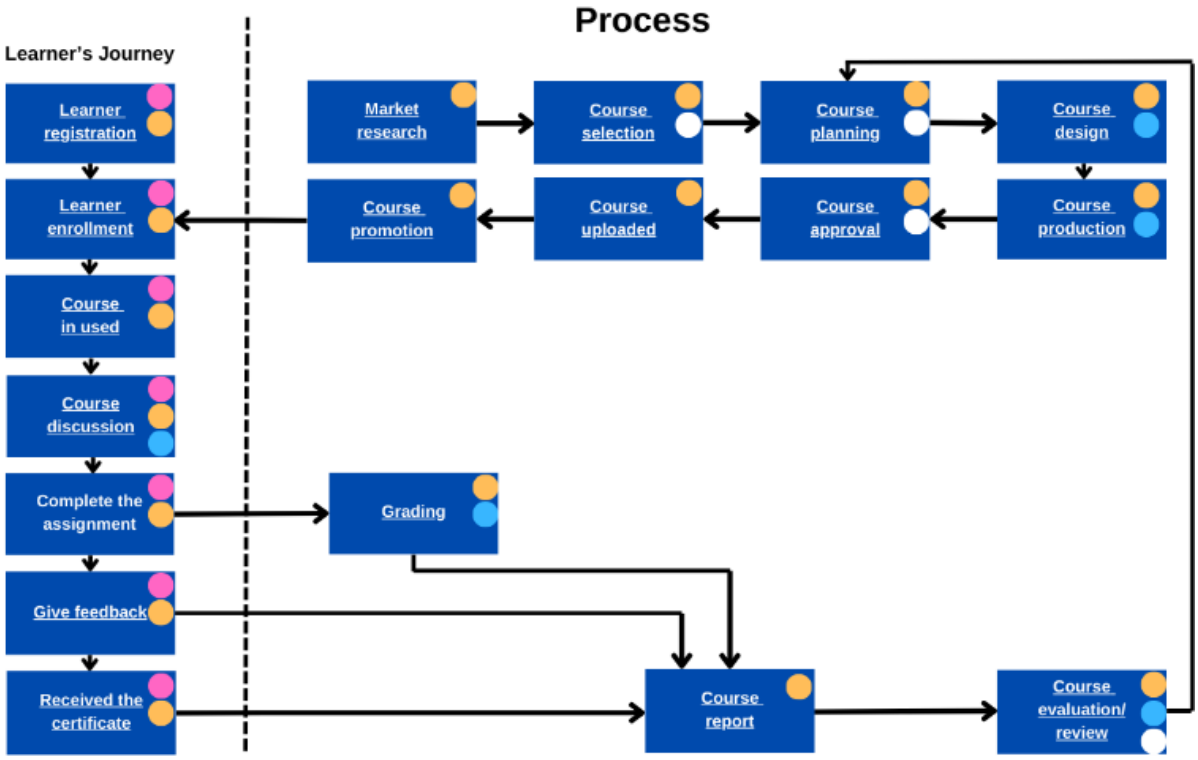

Figure 7. Updated process.

After the learner successfully registers for the course, the learner can start learning in the course (course in use). Then, the learner can also possibly do synchronous and asynchronous learning. The learner can also conduct course discussion on the course. After the course is completed, there will be an assignment that needs to be completed. Once the assignment has been completed or passed, the learner needs to give feedback on the learning in the course. Once completed, the learner can receive a certificate as proof of the completion of the course.

For MOOC providers, before deciding to create a course, they need to conduct market research to ensure that the course will be demanded by learners. After getting the research results, they can enter the course selection stage. In this case, usually the MOOC providers will discuss with the MOOC partner for course selection and planning with topics and speakers. After completing the course planning, the MOOC providers work with the available instructors to build the course design.

Once designed, the instructor follows the course production stages starting from making videos, materials, and others to complete the course. After the production is completed, the instructor submits to the MOOC providers and MOOC partners to determine its feasibility and gain approval to enter the MOOC platform. Once approved, the course is uploaded and then the course is ready for use. In order for learners to get information that there is a course, the MOOC providers will need to promote the course.

When the learner has completed the assignment, the MOOC providers and the instructor can conduct the grading. If it is worthy of passing, then the participant is declared to have graduated from the course. From the results of the assessment, learner

feedback, and having received a certificate, a report on the course is generated. Then, an evaluation or review of the course is carried out which then drives the decision to plan for any changes in the course or to let it remain or be removed from the MOOC platform.

In addition to the process, the number of components after interviewing each MOOC provider and confirming it became less than the previous data governance framework. The new data governance framework focuses more on the role of data governance in dealing with data in MOOC organizations. Based on the framework of this research, the DMBOK became one of the researchers' guides to ensure that the components in this data governance framework also have components from DMBOK.

After discussions with eight willing MOOC providers, the initial 112 sub-components in the earlier study were reduced to 72 sub-components.

Here is the list of sub-components:

People and organization (17):

People (4):

1) Responsibility
2) Trust
3) Roles
4) Stakeholders

Organization (13):

1) Document & content management*
2) Ownership
3) Goals
4) Objectives
5) Vision and Mission
6) Employee data competencies
7) KPI's
8) Developing capabilities
9) Organization culture
10) Data strategies
11) Business strategy
12) Change management
13) Lifecycle management

Process (17):

1) Data architecture*
2) Monitoring
3) Communication
4) Evaluation
5) Assessment
6) Training & education
7) Measurement
8) Building roadmap
9) Internal & external auditing
10) Analysis
11) Improved optimization
12) Data pre-processing

13) Classification
14) Awareness
15) Implementation
16) Organizing analytics workflow
17) Facilitate innovation

Policies/standards/procedures (16):

1) Data quality*
2) Protection
3) Guidelines
4) Confidentiality
5) Privacy
6) Data consistency
7) Ethical
8) Law and regulations
9) Data auditability
10) Legal
11) Authority
12) Controls
13) Regulatory compliance
14) Transparency
15) Conformance
16) Quality assessment authentication

Technology (11):

1) Metadata*
2) Data security*
3) Master data & reference*
4) Data integration & interoperability*
5) Data storage & operations*
6) Data warehousing & business intelligence*
7) Data modeling & design*
8) Software enhancement
9) Intelligence security
10) Safety controllability
11) Artificial intelligence (AI) system

Required information (9):

1) Trusted data sources
2) Private/public
3) Contextual integration
4) Contextual alignment
5) Data scope
6) IT resources
7) Business case
8) Structured/unstructured
9) Sustaining requirements

Other governance (2):

1) Corporate governance

2) IT Governance

In the list of sub-components above, some are marked with an asterisk (*) which refer to components derived from the DMBOK. Thus, the adoption of these DMBOK components became one of the foundations of the sub-components of this framework. Thus, this framework can have the power to carry out data governance with the standards set in the DMBOK.

3.3. Discussion of research question 2 (RQ2)

Conduct final demonstration and thematic analysis of the framework

The visual image of the updated data governance framework in **Figure 6** was demonstrated again to MOOC providers who were willing to conduct interviews, which was the same 10 individuals before. They took part in the interviews and demonstrations of the latest data governance framework.

After the demonstration, the MOOC providers gave their opinions based on the explanation that the researcher had conveyed regarding the updated data governance framework. The opinions of these MOOC providers were then subjected to thematic analysis to obtain confirmation regarding whether they agreed and accepted this data governance framework which can later be applied by the MOOC providers.

There are six stages of thematic analysis, as follows (Braun and Clarke, 2019):

1) Understand data and familiarize with existing data

In this first stage, the researcher needed to understand and be familiar with the qualitative data that has been obtained and that already exists through data collection.

2) Generate initial code

The next step is to do the initial codification (coding) of each data so that it becomes systematic and unique from the entire data set. Relevant data with each code is then compiled.

3) Looking for a theme

The codes are organized into potential themes by collecting all the data relevant to each potential theme.

4) Reviewing the theme

The data is examined within the themes for how they function in relation to the original codes in the previous stage and the entire data set, resulting in a thematic "map" of the analysis.

5) Define and name the theme

An ongoing analysis is conducted to refine each of the established themes to produce clear definitions and names for each theme.

6) Produce a report

After getting the data that has been analyzed in the theme, the researcher produced a report that clearly and convincingly presented the findings according to the literature.

Table 3 presents the results of the thematic analysis summary report conducted by the group. This analysis is based on the themes and codes that have been compiled from researchers using the NVivo application. It also includes explanations from the researcher regarding the opinions of MOOC providers who participated in the interviews.

Table 3. Thematic analysis results on MOOC providers interviews.

Theme group	Code	Description
Process	The process becomes clearer	The process described in the data governance framework is in accordance with the MOOC providers. Some MOOC providers stated that the process is an important part that is always considered in data governance. So that the material can be in accordance with the needs of the learners, the process must still be considered for the convenience of the learners.
	The process really needs architectural data	
	Learning continuity must be measurable	
	Quality control needs to be in the process	
	There are some courses that need to select participants first, even if the participants have enrolled, they can be eliminated.	
	Nowadays most MOOCs can do hybrid	
	Marketing is important in course promotion	
	True, course planning needs a roadmap building component	
	Course selection is made by the providers until it is live	
	Materials need to be reviewed and updated	
	Some classes need to update materials, update trainers	
	Course discussion is more widely used in asynchronous mode	
	Course evaluation needs monitoring results	
	Grading needs to be automatic from learner answers	
	Evaluations can be on the materials, instructors, and technology used	
	market research is very important	
	market research generates learner insights	
	Materials need to be updated every few years	
	This is correct, course evaluation needs to be monitored for assessment, feedback, and certificates	
MOOC partners	There are some partner classes with other institutions	MOOC partners that have been described in the data governance framework are appropriate. From the opinion of the MOOC providers, it is said that partners need to follow the rules and procedures of the MOOC providers.
	Company representatives can be mentors in the course	
	MOOC partner also reviews the material	
	Course production usually also uses a third party	
	In the placement of materials, the on-site procedures must be followed	
	Partners need to comply with our rules	
	Sometimes there are courses that are done together between us and our partners.	
	If pre-employment there is an assessor to decide whether the course can be used or not	
	Certificate validation can be with a partner (third party)	
Sub-components	The role is already clearer	There are several sub-components mentioned by MOOC providers, meaning that the existing sub-components of the data governance framework can be used by MOOC providers.
	Components are much more acceptable than they were at the beginning	
	This component is very much in line with our expectations	
	The law and regulation component are very important to us	
	important awareness during market research	
	Business strategy is important to display the MOOC business model process	
	Funneling marketing needs data preprocessing in knowing the learner profile	
	There needs to be legal guarantees for partners and instructors	

Table 3. (*Continued*).

Theme group	Code	Description
Instructor	Instructors need to have a cooperation agreement Most instructors are practitioners the quality of the instructor must be reliable, trustworthy and responsible. Every mentor/instructor needs to have self-worth In group discussions, the participating mentor may be different from the main mentor in the video	The MOOC providers also emphasized on the instructor that there needs to be more legal agreements as the data required, so that it is more reliable and accountable. The MOOC providers accepted this data governance framework.
Learners	Learner can complain about the material To know the characteristics of the learner means when the learner registers Gen Y Millennials and Gen Z already have different learner characteristics, the stronger ones to undergo this MOOC are those who are still millennials (Y). Our platform is used to improve learner training needs We MOOC providers help to improve learner capabilities	MOOC providers can understand the needs of learners today. MOOC providers emphasize how the facilities provided are easier for MOOC learners.
Required Information	Contextual is very inspiring for us Need clear definition in required information is trusted data sources The class needs to decide at the beginning whether it is synchronous or asynchronous/hybrid Synchronous and asynchronous are also part of the requirement	The link between MOOC providers and MOOC partners is the required information component. In this case, the MOOC providers realizes the importance of required information as a data requirement for the MOOC providers.
Technology	It is necessary to limit the data time if the participant (learner) finishes running the course, because if it is stored continuously, the server will be more expensive.	MOOC providers pay attention to how data is stored on the server, there needs to be clear regulations regarding data storage so that the server used can still be effective and efficient by MOOC providers.
Framework opinion	The Framework is already quite comprehensive with our working everyday With this framework, document uploads are cleaner This framework is very good and can be applied in our company This framework needs to be used to make it easier for us This framework is ideal but needs more socialization in the team This is something we've already done, but this framework is more helpful This framework is a good value for us Even though this framework has been simplified, the process has become more detailed and excellent. We get good insights from this framework This framework is already very sufficient for our MOOC platform The framework is ideal for us to run this	The MOOC providers can accept this data governance framework well and it can be used to the MOOC providers.
Further proposals	This framework can be an audit material for MOOC providers so as to ensure the condition of the MOOC is always standardized with this framework, very good It would be better if there was an application that shows if in a process then what important components must be present and should not be missed	Some MOOC providers have suggested that this framework can be used as audit material for MOOC providers in Indonesia and is more complete with an application that can control the data governance framework.

The results of thematic analysis on MOOC providers in Indonesia shows that the data governance framework that has been built can be effectively used by MOOC providers. MOOC providers have requested that this framework serve as a basis for work audits, such as self-assessments, to determine whether their processes are

appropriate and provide effective results for the development of MOOC-based learning in Indonesia.

With the input and comments gathered through this thematic analysis, MOOC providers can reflect on the current processes for managing learning, instructors, learners, partners, and so on. They also recognize that this data governance framework includes many sub-components that can be further developed to enhance their resources and the interaction between partners. This helps build the necessary trust needed between MOOC providers, their partners, instructors, and learners.

3.4. Final results of data governance framework testing

After conducting interviews with MOOC providers and performing a thematic analysis to gauge the interest in the data governance framework, the researcher simplified the existing data governance framework shown in **Figure 8**. **Figure 6** depicts the data governance framework involving various actors in managing MOOCs, namely learners, MOOC providers, instructors, MOOC partners, and the general public. **Figure 8** provides the core image of the data governance framework, which focuses on people and organization, required information, other governance (corporate governance and IT governance), process, policies/standards/procedures, and technology.

These six components are the main and essential elements in the data governance framework. In this framework, there is a slight difference in that the required information is included under people and organization. This shows that people and organizations, as part of the MOOC providers, can interact with MOOC partners, making the required information always associated with people and organization.

Additionally, processes, policies/standards/procedures, and technology remain in their respective places. Technology is positioned at the bottom because it forms the foundation of the MOOC platform. Above technology is the second foundation, which is policies/standards/procedures. In the middle between people and organization and policies/standards/procedures is the process, which has previously been described in **Figure 5**. Thus, if we examine the data governance framework for MOOC providers in Indonesia without the presence of actors, it can be seen in **Figure 8**.

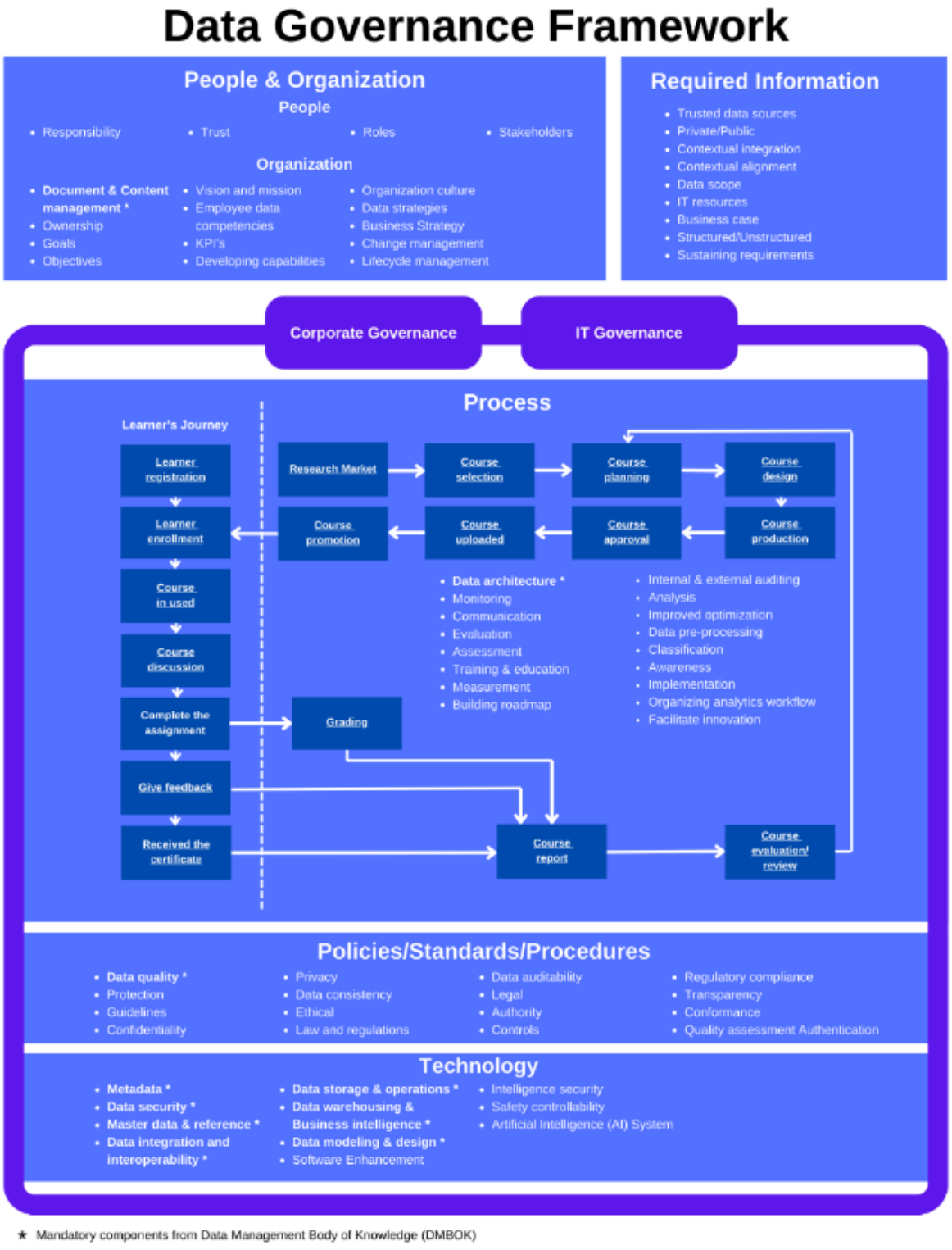

Figure 8. Data governance framework without actors.

3.5. Data governance framework discussion

The data governance framework for MOOC providers in Indonesia that has been built in this research is to answer the problems that occur among MOOC providers. In the background of this research, it was mentioned that institutions that introduce MOOCs have prioritized processes but ignored data and standards. This problem underscores the need for data governance, particularly in MOOCs. With the developed

data governance framework, institutions can ensure their processes run smoothly while also considering data and standards.

From the interviews conducted, many providers neglect standards due to the opportunities from MOOC partners who want to incorporate content in the MOOC platform, leading to a lack of attention to procedures, standards, and data usage. The data governance framework provides clear standard procedures and ensures that data can be maintained as a valuable asset of the MOOC providers.

Prior to the development of this framework, MOOC providers in Indonesia did not have uniform and standardized information standards as each department's business system was built independently. There was a lack of norms and consensus that could be used by all departments for reference and implementation, so the coding used by each business department in system construction was not the same. This is because the overall information architecture had not been improved.

This data governance framework (**Figure 8**) for MOOC providers in Indonesia can achieve data integration and maintain data quality for valid and reliable data. Another problem that occurs is that the interconnection and exchange of data sharing is not consistent where the list in one department with another department can be different. With this data governance framework, MOOC providers can ensure that the data architecture that has been created can apply and be integrated for all departments in the MOOC providers. In addition, this framework ensures that authoritative data sources can be clear to know where the data came from and where it will go. This is due to the existence of data architecture and document and content management that can be applied with this framework.

Other problems that also often arise are various data quality problems caused by inadequate design or low quality of functional modules and various business system software. The software quality problem itself has many issues surrounding data quality, resulting in a lack of necessary constraints and checks. With the data governance framework built in this research, constraints and checks can be carried out immediately on a regular basis, highlighting the need for this framework especially in data governance among MOOC providers in Indonesia.

This data governance framework incorporates components from the DMBOK and is based on systematic literature studies. Thus, this framework benefits from the strengths of the components of the DMBOK. The 10 components of the DMBOK are represented within the sub-components of the data governance framework. The document and content management component are included in organization as this component requires management skills in handling documents and content. This aligns well with the characteristics of MOOC providers.

The data architecture component is part of the process, as every process must consider the architecture that was established by the business process maker and the existing architecture to prevent issues. The data quality component is included in the policies/standards/procedures component. This is because data quality is a goal that needs to be considered by all departments within MOOC providers for their business processes.

The components of metadata, data security, master data & reference, data integration and interoperability, data storage & operations, data warehousing & business intelligence, and data modeling & design are included in the Technology

component. These DMBOK components form the foundational elements that need to be implemented within the Technology component. The technology built by the MOOC providers should incorporate these DMBOK components, along with other components found through the literature study.

Researchers have sought previous research related to data governance frameworks, especially for MOOC providers, but found no relevant literature. Therefore, the researchers conducted "benchmarking" by looking at other existing data governance frameworks, namely for Industry 4.0 and from the Data Governance Institute. From the benchmarking results, it can be concluded that the components and sub-components in the data governance framework for MOOC providers incorporate essential components such as people and organization, process, and technology.

However, given the issues that occur in relation to MOOCs which include the lack of standards and the need for improved data quality, this framework includes Policies/Standards/Procedures components to help MOOC providers manage data processes. It also includes required information to ensure the data is in accordance with the common needs of MOOC providers.

In addition to the developed data governance framework, researchers have added components for corporate governance and IT governance to ensure comprehensive governance that extends beyond data, encompassing corporate governance and IT governance for MOOC providers in Indonesia.

4. Conclusion

This research had two research questions that had been answered in the previous sections, as explained below.

a) Research question 1 explores how existing components can be interconnected to build a data governance framework for MOOC providers in Indonesia. After identifying six components and 112 sub-components, the researchers conducted interviews with MOOC providers to gather insights on the process flow, which formed the basis for developing the data governance framework. In addition, by referring to existing frameworks, the researchers developed a visual data governance framework. Then the researcher conducted a demonstration of the framework to the MOOC providers and obtained input that resulted in changes in the sub-components. 112 sub-components were reduced to 72, reflecting those that were truly essential for MOOC operators. Thus, **Figure 5** depicts the framework that answers this research question.

b) Research question 2 examines how the resulting data governance framework can be used by MOOC providers in Indonesia. To answer this, the researchers again conducted interviews with MOOC providers. During this stage, testing of the data governance framework was carried out which involved simulating daily business processes in MOOC. In addition, thematic analysis was conducted on the opinions obtained. The results showed that the framework was well received and can be used by MOOC providers in Indonesia. Eight MOOC providers stated that the framework can be used by MOOC providers, prompting deeper investigation into how these providers implemented the framework. It was observed that providers focused primarily on existing operational processes without emphasizing data architecture or improving data quality. This research underscores the importance of a data governance

framework for enhancing awareness among MOOC providers in Indonesia.

The components compiled by the researchers in this data governance framework have also been supplemented with components from the DMBOK. In data governance there are 10 components, all of which have been included in the sub-components in the proposed data governance framework for MOOC providers.

This research still has limitations, such as the participation of only eight MOOC providers. Despite this limitation, the willingness of these eight MOOC providers to adopt the data governance framework provides insights into the potential future development of data governance. Observing their performance after implementing this framework will be crucial for assessing its effectiveness.

Another limitation is that testing was not carried out on each component to determine its significance. Currently, the researchers have only gained statements from the MOOC providers regarding the importance of each component to be implemented. However, no statistical calculations have been made on how the sub-components and components can work together to significantly contribute to the providers.

Based on the results of research and testing in this study, there are several development suggestions for MOOC providers and further research.

Suggestions for MOOC providers are:

a) Considering that the implementation of the data governance framework is currently a priority to further improve the data quality in MOOC providers, it is necessary to prepare for the development of corporate governance and IT governance structures to be in line with the data governance framework. Based on observations made by researchers from the interviews conducted, MOOC providers are concerned with processes but neglect governance structures, be it data governance, corporate governance, and IT governance. Therefore, corporate governance and IT governance can be developed at MOOC providers.
b) It is necessary to have a person in charge for governance, specifically for data governance, corporate governance, and IT governance. Having this specialist can improve the performance of the MOOC providers.
c) Synergy between departments within the MOOC providers should be built so that the data in the information system can be adjusted to data governance.

5. Future research

a) Quantitative research should be conducted to explore the significance of the components in data governance. This can help identify the components and sub-components that are significant to improve the performance of MOOC providers with.
b) Future researchers should examine how significantly data governance, corporate governance and IT governance affect each other. By doing this research, we can get new knowledge about this relationship.
c) Performance comparison research can be conducted for MOOC providers who have used the data governance framework with those who have not used the data governance framework. This can help measure the impact that occurs with these changes.

d) Interviews with MOOC providers that have not been reached by researchers in this study can be conducted to help implement data governance frameworks.

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