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The Components of Data Governance Framework for MOOC Providers in Indonesia

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Abstract: The COVID-19 pandemic had a universal and synchronous impact on all countries globally, leading to the implementation of the social distancing policy that mandated all activities take place within one's own house. One of the implementations is distance education. Since the pandemic, e-learning, which is the dominant use of information technology in the education sector, has gained widespread recognition and acceptance as a mainstream concept in contemporary society. An illustration of this is the growth of the Massive Open Online Course (MOOC), which has attracted the attention of both public and private universities, prompting them to adopt its implementation. The rise of MOOCs can be ascribed to the internet's ability to provide a more dynamic and flexible learning environment in comparison to traditional methods. The pandemic coincided with the establishment of digital campuses in schools and universities in recent decades. However, one important characteristic of these digital campuses is that they prioritize processes but overlook data and lack standards. Therefore, this study aims to identify important data governance components for MOOC providers in Indonesia from various past publications to construct a data governance framework. By examining the initial topic, the fundamental elements of data governance were ascertained. This study employed the Systematic Literature Review (SLR) methodology to address the research issue. The results derived from the SLR led to the initial derivation of six main components and 128 sub-components. Subsequently, interviews were carried out with 10 specialists representing 8 MOOC providers. The interview data were subsequently used to calculate the outcomes of the components using the fuzzy Delphi method. Based on statistical computation, six components, and 112 sub-components were deemed genuine and accepted by the eight MOOC providers in Indonesia. The subsequent phase of this study aims to construct a data governance system specifically tailored for MOOC providers in Indonesia.

Keywords: Components, Data, Governance, Systematic Literature Review, MOOC

Introduction

The COVID-19 pandemic had a simultaneous impact worldwide and has resulted in significant socio-economic costs for numerous countries and their inhabitants. Considering the magnitude of the issue, governments worldwide adopted diverse strategies to tackle the health epidemic, proactively anticipate challenges, and improve conditions even in the face of uncertainties (Halimatussadiah *et al.*, 2020).

Amidst the COVID-19 pandemic, leaders in higher education were presented with a significant opportunity to reconsider the future of their institutions. They were able to undertake a substantial overhaul in higher education to enhance the effectiveness of operational procedures and reorganize the entire system for optimal performance.

E-learning is the most prevalent application of information technology in the field of education, which is widely recognized and accepted as mainstream today. In fact, it is now possible to identify educational establishments that employ e-learning alongside conventional teaching methods. The swift advancement of website and internet technologies enabled the execution of remote and/or distance education, which offered numerous advantages to the learning process such as achieving educational fairness by overcoming the constraints of geographical distance and time limitations (Stecuła and Wolniak, 2022). One example is the Massive Open Online Course (MOOC), which has garnered the interest of both public and private universities, leading them to adopt its implementation. The emergence of MOOCs is attributed to the internet's capacity to offer a more dynamic and adaptable learning environment compared to conventional approaches (Akbari and Pratomo, 2022).

MOOCs are innovative learning platforms that offer exceptional accessibility. Similar to traditional e-learning, MOOCs offer courses that are taught and learned without in-person meetings. The distinction between MOOCs and traditional e-learning resides in their 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). They utilize web-based technologies, enabling universal access to anybody with an internet connection, regardless of geographical location or time constraints. These fundamental attributes of MOOCs contribute to their high level of accessibility (Sari, Bonk and Zhu, 2020).

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 have the potential to achieve equal and high-quality education and provide universal access to education, which is a fundamental entitlement for all individuals. They also allow for unlimited participation without any restrictions on the number of participants. Enrollment at a certain institution is not a prerequisite for individuals to participate in MOOCs, which makes it 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, MOOCs are a worthwhile investment to enhance the quality and accessibility of education in Indonesia. Malaysia, being the nearest adjacent nation, has also integrated MOOCs into its strategic blueprint for the country's educational advancement (Lubis *et al*., 2020).

In recent decades, the creation of digital campuses in colleges and universities has been accompanied by the occurrence of the 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). The issues and underlying factors are as follows. Firstly, there are challenges regarding the necessary information architecture due to a lack of consistent and established information standards. The independent development of business systems in each department leads to 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 professional 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 inconsistencies among different departments due to inadequate content of the basic data used. For instance, the fixed asset register, the finance department, the personnel register of the academic department, and the personnel department may have discrepancies, potentially resulting in inconsistencies in data during statistical analyses which may lead to the inability to locate reliable data sources. Thirdly, there may be a lack of clarity regarding the authoritative source of data, which contributes to the issue. When there is a data issue, this may lead to difficulties in determining the department that should assume responsibility. Several other data face a similar predicament. All these issues pertain to challenges in the broader data framework and require careful consideration and resolution primarily within the information center. This is a key motivating factor for many educational institutions to initiate data governance practices.

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 a nation's strategic plan for educational advancement. To remain in the strategic plan for educational development, it is important to establish a robust data governance framework that ensures the reliability of data. Hence, this study aims to determine the essential components required for constructing a data governance system specifically tailored for MOOC providers in Indonesia.

The observation of MOOC providers in Indonesia reveals a unique approach to the course learning process. Rather than merely offering courses online for learners to learn from, the MOOC providers also present onsite discussions that enable learners to meet directly with the instructor at certain times. MOOC providers also allocate a specific period for learning, such as a

semester or every quarter. This is unique among MOOC managers in Indonesia.

The objective of this study is to identify data governance components for MOOC administrators in Indonesia from diverse existing publications to be utilized for assembling a data governance framework. By addressing the initial research question, we can identify the key components of data governance. Furthermore, by obtaining the constituents of the data governance framework, MOOC providers can identify the crucial elements they must attain or possess in data governance.

Literature Review and Methodology

Massive Open Online Courses

MOOCs are a form of distance education. In Indonesia, the term e-learning is used to refer to distant learning. However, in contrast to traditional e-learning, MOOCs strongly emphasize the qualities of being massive and open. These characteristics eliminate the requirement of prior registration with an institution and allow an unlimited number of participants to join the MOOC (Gomez *et al.*, 2022).

The initial idea of MOOC was proposed by Dave Cormier and Bryan Alexander in 2008 (Shen *et al.*, 2016). The New York Times declared 2012 as the year of MOOCs. Like traditional classes, MOOCs involve a process of learning that is facilitated by an online Learning Management System (LMS) that is accessible to both the teacher and the learners. The learning process in MOOCs is asynchronous, meaning that it occurs at various times without a fixed schedule. Therefore, MOOCs are not constrained by either location or time. MOOCs have the advantage of not being restricted by the number of people who can enroll in them. Anyone with internet access can participate in a MOOC (Englund *et al*., 2023). MOOCs also possess attributes that enable the achievement of fair and equal education, as well as the capacity to serve as a substitute for individuals who encounter challenges in accessing high-quality conventional education. In addition, MOOCs can serve as a viable alternative for meeting the ongoing learning requirements of professionals in the industry.

Systematic Literature Review

A systematic literature review is a rigorous and structured approach to gathering, evaluating, and synthesizing prior research that is relevant to a specific research problem or topic. It is a transparent methodical process of discovering, assessing, and summarizing all available material on a specific issue to get a comprehensive understanding of the current state of knowledge, which is highly regarded in academia and research.

There are certain steps that need to be followed to conduct the review (Kitchenham *et al*., 2009). The first is to formulate a research inquiry, where it is crucial to clearly state the research topic or aim of the review. This facilitates the determination of the scope and priority of the assessment. The *sec*ond step is to formulate a systematic plan for doing a search. In this step, a systematic search methodology is developed to determine all relevant studies, which often involves performing searches on multiple databases such as PubMed, Scopus, Web of Science, and others. Search phrases and parameters are predetermined to ensure consistency and inclusiveness.

The third step is screening and selection. After conducting the search, identified studies are assessed to decide whether they match the predefined criteria for inclusion or exclusion. This process often involves two stages: An initial screening based on the title and abstract, followed by a more comprehensive screening of the full text. Only research that meets the predetermined criteria is included in the review. Data extraction refers to the process of retrieving relevant information from selected research using a defined format. Usually, this includes information such as the study's design, the participants, the interventions or exposures, the outcomes, and the key findings. The fourth step entails quality assessment, where an evaluation of the quality of the studies is performed to ascertain the accuracy and reliability of their conclusions. Various approaches and criteria can be employed to assess the quality of a study, depending on the specific designs included in the evaluation. For example, data synthesis and analysis can entail the amalgamation and scrutiny of the extracted data to identify patterns, trends, and connections that exist among various research studies. Statistical meta-analysis can also be performed if the research included in the analysis has comparable methodologies and results. The final step is the interpretation and conclusion, where the findings of the review are analyzed in relation to the topic and the existing body of literature. Conclusions are drawn based on the overall state of evidence, areas of knowledge gaps, practical or policy consequences, and suggestions for future research.

Fuzzy Delphi Methods

The fuzzy Delphi method is an enhanced iteration of the traditional Delphi method, which is a systematic communication approach used to gather perspectives from a panel of experts. The fuzzy Delphi method incorporates the concept of fuzziness into the Delphi process to handle uncertainty and ambiguity more effectively (de Hierro *et al.*, 2021).

The method is conducted according to the following design. First, a panel of specialists or experts is carefully selected based on their exceptional expertise and proficiency in the subject matter or issue at hand by employing a methodology akin to the traditional Delphi method. These specialists may be researchers, practitioners, or professionals who possess extensive

expertise in the relevant field. Next is the design and development of a questionnaire with the specific purpose of collecting the perspectives and assessments of the group of experts. The questions are often designed to allow the experts to provide a comprehensive response and may be either open-ended or semi-structured in nature. Experts can make remarks that can be either qualitative or quantitative. Following this is the use of fuzzy ratings, where, unlike the traditional Delphi method that mandates experts to provide exact and clear responses, the fuzzy Delphi method allows experts to provide responses that encompass different levels of uncertainty or ambiguity. Fuzzy logic is utilized to articulate responses using language variables (e.g., highly likely, somewhat likely, unsure, slightly unlikely, very unlikely) or numerical values on a fuzzy scale. Next is the iteration and feedback, where feedback received from the experts is collected and analyzed to identify areas of consensus and divergence. Experts can provide subsequent rounds of feedback, allowing them to adjust their views based on the viewpoints of others. This iterative cycle continues until a consensus or stability is reached. The process of aggregation and consensus building entails the integration of outcomes from multiple iterations utilizing fuzzy logic techniques, such as fuzzy arithmetic or fuzzy set operations. This is conducted to ascertain the consensus among the specialists. This may involve allocating varying degrees of importance to experts' opinions based on their reliability or expertise.

The analysis of the results obtained from the fuzzy Delphi method is conducted within the context of the study problem or topic. This involves analyzing important insights, trends, or patterns that emerge from the experts' perspectives and developing recommendations based on the consensus reached (Mei *et al*., 2020; Roldán López de Hierro *et al.*, 2021.

Methods

The research topic in this study was addressed using the methods outlined in Fig. (1), starting with the process of identifying the problem. This research identified the necessity to uncover components for developing a data governance system.

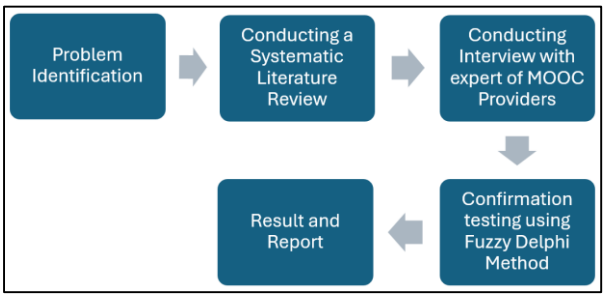

Fig. 1: A research framework

Following the identification of the problem, the researchers proceeded to perform a methodical examination of existing literature by searching for articles that had been published and were considered trustworthy, such as those indexed in Scopus.

Following the acquisition of components from the systematic literature review, the researchers sought out specialists among MOOC providers and conducted interviews with them to ascertain the veracity of whether these components were utilized in the operations of MOOCs. Subsequently, the researchers sent questionnaires to MOOC providers as confirmation checks. Using the fuzzy Delphi approach, the hierarchical ordering of the most significant components requested by expert MOOC providers could be conducted, as well as identifying those that are statistically rejected. Upon obtaining the results, the researchers analyzed and documented them in the form of a written research report.

Results and Discussion

Conducting a Systematic Literature Review

The systematic literature review was conducted to answer the first research question of this study, namely, to identify the components of a data governance framework for MOOC providers. In applying this method, the researchers collected data in the form of components that had been concluded in various previous studies as the components of data governance.

The first step was to search for various studies that had concluded the components that makeup data governance. This search was carried out by collecting publications from various sources including ACM, Emerald, IEEE Explore Digital Library, Science Direct, Taylor and Francis, SAGE, Springer, and several others.

After identifying the publications that matched the indicators above, the researchers re-selected the search results based on the year of publication, ensuring they were not published before 2016. The selection process then continued to the second stage, which divided the literature selection into three processes.

The first process noted the research found, which included research that appeared from search results on the various publication sites mentioned. The second process included a selection based on the title and abstract of the publications to ensure that they meet the problem of this research and can become candidate publications that could be used. The last process was to group publications that had been confirmed to meet the research criteria, which were included in the selected publication group.

From the search results using the keywords mentioned earlier, this study found a total of 145 publications with criteria that matched the needs of the study. Of the 145 publications, the title and abstract of 85 publications

matched the topic. The last process was to read the results that can be used for this research, which produced a total of 53 research publications. Table (1) details the research publication selection process.

From the entire literature, 53 research publications were relevant to this study to obtain data governance components. Table (2) below lists the literature selected for the research.

The 53 studies selected as the source of this research from 2016 to 2023 were divided into two types of publications: conferences and journals. Of the two types of publications mentioned, 28 (53%) were conference proceedings and 25 (47%) were journals. All elected studies were international publications. After collecting the components mentioned in the 53 publications, the ones in Table (3) provide existing components along with the categories. These categories formed the main components, where from each main component, there were several sub-components that referred to the main component.

Table 1: Research publication selection process

Source	Found	Candidate	Selected
ACM	13	8	2
Emerald	19	5	2
IEEEXplore Digital Library	36	32	24
Others	9	3	3
SAGE	12	5	3
Science Direct	27	18	12
Springer	14	8	4
Taylor and Francis	15	6	3
TOTAL	145	85	53

Table 2: List of research publications

No.	Source	Year	Type	Title
1	ACM	2019	Proceedings	Data Governance (Romero, Gonzales and Raymundo, 2019)
2	ACM	2023	Proceedings	From data (Duzha *et al.*, 2023)
3	Emerald	2023	Journal	AI governance (Birkstedt *et al.*, 2023)
4	Emerald	2023	Journal	Strengthening health (Holly *et al.*, 2023)
5	IEEE	2017	Proceedings	A conceptual (Al-Ruithe and Benkhelifa, 2017a)
6	IEEE	2017	Proceedings	Governance Framework (Yamada and Peran, 2017)
7	IEEE	2017	Proceedings	Data Governance (Kim and Cho, 2017)
8	IEEE	2018	Proceedings	Proposed (Thammaboosadee and Dumthanasarn, 2018)
9	IEEE	2018	Proceedings	Data Governance (Saed *et al.*, 2018)
10	IEEE	2019	Proceedings	Quality driven (He *et al*., 2019)
11	IEEE	2019	Journal	A framework (Li *et al.*, 2019)
12	IEEE	2019	Proceedings	Data governance (Kurniawan *et al*., 2019)
13	IEEE	2020	Proceedings	A data traceability (Zhang, 2020)
14	IEEE	2020	Proceedings	Big data analytics (Thamjaroenporn and Achalakul, 2020)
15	IEEE	2021	Proceedings	Collective data (Mukhametov, 2021)
16	IEEE	2021	Proceedings	Data quality (Miguel *et al*., 2021)
17	IEEE	2021	Journal	An ontological-based (Castro *et al*., 2021)
18	IEEE	2022	Proceedings	A data governance (Bao, Geng and Yu, 2022)
19	IEEE	2022	Proceedings	AI tools for (He and Peng, 2022)
20	IEEE	2022	Proceedings	How Data Governance (Bento, Neto and Corte-Real, 2022)
21	IEEE	2022	Proceedings	Health data (Oktaviana, Handayani and Hidayanto, 2022)
22	IEEE	2022	Proceedings	General data (Ranathunga and Wickramarachchi, 2022)
23	IEEE	2022	Proceedings	Designing open (Habibie, Suhardi and Muhamad, 2022)
24	IEEE	2022	Proceedings	Data governance (Mirza Harwanto and Nizar Hidayanto, 2022)
25	IEEE	2022	Proceedings	Analysis of design (Hendrawan, Kusumasari and Fauzi, 2022)
26	IEEE	2022	Proceedings	Data governance framework (Kaewkamol, 2022)
27	IEEE	2023	Proceedings	Structure design (Jing, Xianchun and Luyao, 2023)
28	IEEE	2023	Proceedings	Research of (Jiang, Ye and Tan, 2023)
29	Other	2022	Journal	Research of Jiang *et al*. (2023)
30	Other	2023	Journal	Informing the (Marcucci *et al.*, 2023)
31	Other	2018	Journal	Data Governance (Kim and Cho, 2018)
32	SAGE	2020	Journal	Emerging models (Micheli *et al.*, 2020)
33	Sage	2021	Journal	Critical success (Jones, 2021)
34	SAGE	2023	Journal	Digitization and (Bayat and Kawalek, 2023)
35	Science Direct	2023	Journal	Data sustainability (Jarvenpaa and Essén, 2023)
36	Science-Direct	2016	Proceedings	A conceptual (Al-Ruithe, Benkhelifa and Hameed, 2016a)
37	Science-Direct	2017	Proceedings	Analysis and Classification (Al-Ruithe and Benkhelifa, 2020a)

Table 2: Continue

38	Science-Direct	2018	Proceedings	Exploring Big Al-Badi *et al.* (2018)
39	Science-Direct	2019	Proceedings	Towards data Yebenes and Zorrilla (2019)
40	Science-Direct	2019	Journal	Data Governance Abraham *et al.* (2019)
41	Science-Direct	2020	Journal	Determining the Al-Ruithe and Benkhelifa (2020)
42	Science-Direct	2021	Journal	Designing and Ruijer (2021)
43	Science-Direct	2022	Journal	Effects of Liu *et al*. (2022)
44	Science-Direct	2022	Journal	Data matters Zhang *et al*. (2022)
45	Science-Direct	2023	Journal	Data governance Paparova *et al*. (2023)
46	Science-Direct	2023	Journal	Orchestrating distributed Gegenhuber *et al*. (2023)
47	Springer	2018	Journal	A data governance Lee *et al*. (2018)
48	Springer	2021	Journal	Development of Jang and Kim (2021)
49	Springer	2023	Journal	A prototype Ndemo and Thegeya (2023)
50	Springer	2023	Journal	A taxonomy Abraham *et al*. (2023)
51	Taylor and Francis	2016	Journal	Data governance Alhassan *et al*. (2016)
52	Taylor and Francis	2019	Journal	Critical success Alhassan *et al*. (2019)
53	Taylor and Francis	2022	Journal	Grounding data Walsh *et al*.(2022)

Table 3: Components and sub-components

No.	Sub-component	#	Reference	Component
1	Data quality	14	Jing *et al*. (2023); Yeong Kim and Cho (2018); Marcucci *et al.* (2023); Shinta *et al*. (2022); Indhumini Ranathunga and Wickramarachchi (2022); *Habibie et al.* (2022); Kurniawan *et al.* (2019); Mirza Harwanto and Nizar Hidayanto (2022); Castro *et al*. (2021); Jones (2021); Walsh *et al*. (2022); Yeong kim and Cho (2018); Thamjaroenporn and Achalakul (2020); Abraham *et al*. (2019)	Policies/Standards /Procedures
2	Metadata	11	Jing *et al*. (2023); Romero *et al.* (2019); He and Peng (2022); Jarvenpaa and Essén (2023); Habibie *et al*. (2022); Kurniawan *et al*. (2019); Mirza Harwanto and Nizar Hidayanto (2022); Osu and Navarra (2022); Walsh *et al*. (2022); Alhassan *et al*. (2016); Abraham *et al*. (2023)	Technology
3	Data security	11	Jing *et al*. (2023); Shinta *et al*. (2022); Indhumini Ranathunga and Wickramarachchi (2022); Habibie *et al.* (2022); Castro *et al.* (2021); Holly *et al.* (2023); Jones (2021); Abraham *et al*. (2019-2023); Yeong Kim and Cho (2018); Thamjaroenporn and Achalakul (2020)	Technology
4	Monitoring	9	Al-Badi *et al*. (2018); Romero *et al*. (2019); Bao *et al*. (2022); Saed *et al*. (2018); Al-Ruithe and Benkhelifa (2020); Lee *et al*. (2018); Yeong Kim and Cho (2018); Abraham *et al*. (2019); Jang and Kim (2021)	*Process*
5	Data life cycle	7	Jarvenpaa and Essén (2023); Jones (2021); Walsh *et al*. (2022); Alhassan *et al*. (2016); Abraham *et al*. (2023), Thamjaroenporn and Achalakul (2020); Abraham *et al.* (2019)	*Process*
6	Roles	7	Romero *et al*. (2019); Bento *et al*. (2022); Al-Ruithe and Benkhelifa (2020); Kaewkamol (2022); Yeong kim and Cho (2018); Abraham *et al*. (2019); Jang and Kim (2021)	People and Organization
7	Stakeholders	7	Al-Badi *et al*. (2018); Thammaboosadee and Dumthanasarn (2018); Bento *et al*. (2022); Al-Ruithe and Benkhelifa (2020); Ndemo and Thegeya (2023); Osu and Navarra (2022); Birkstedt *et al*. (2023)	People and Organization
8	Data access	6	Jiang *et al*. (2023); Jarvenpaa and Essén (2023); Indhumini Ranathunga and Wickramarachchi (2022); Walsh *et al*. (2022); Alhassan *et al*. (2016); Yeong kim and Cho (2018)	Technology
9	Data Storage	6	Al-Badi *et al*. (2018); Jiang *et al.* (2023); Yeong Kim and Cho (2018); Jones (2021); Abraham *et al*. (2019)	Technology
10	Law and regulations	6	Bao *et al*. (2022); Li *et al.* (2019); Thamjaroenporn and Achalakul (2020); Marcucci *et al*. (2023); Ndemo and Thegeya (2023); Birkstedt *et al.* (2023)	Policies/Standards /Procedures

No.	Sub-component	#	Reference	Component
11	Master data	6	Jing *et al*. (2023); Habibie *et al*. (2022); Kurniawan *et al*. (2019); Mirza Harwanto and Nizar Hidayanto (2022); Osu and Navarra (2022); Abraham *et al*. (2019)	Technology
12	Responsibility	6	Yebenes and Zorrilla (2019); Yeong Kim and Cho (2018); Romero *et al*. (2019); Shinta *et al*. (2022); Kaewkamol (2022); Jang and Kim (2021)	People and organization
13	Privacy	5	Marcucci *et al*. (2023); Li *et al*. (2019); Duzha *et al*. (2023) Osu and Navarra (2022); Thamjaroenporn and Achalakul (2020)	Policies/standards/ procedures
14	Protection	5	Jiang *et al*. (2023); Marcucci *et al*. (2023); Li *et al*. (2019); Duzha *et al*. (2023); Osu and Navarra (2022)	Policies/standards/ procedures
15	Assessment	4	Romero *et al*. (2019); Birkstedt *et al*. (2023); Bento *et al*. (2022); Al-Ruithe and Benkhelifa (2020)	*Process*
16	Data Architecture	4	Osu and Navarra (2022); Castro *et al*. (2021); Jones (2021); Abraham *et al*. (2023)	*Process*
17	Data interoperability	4	Habibie *et al*. (2022); Osu and Navarra (2022); Castro *et al*. (2021); Holly *et al*. (2023)	Technology
18	Data principles	4	Yebenes and Zorrilla (2019); Jarvenpaa and Essén (2023); Walsh *et al*. (2022); Alhassan *et al*. (2016)	Policies/standards/ procedures
19	Stewardship	4	Kurniawan *et al*. (2019); Mirza Harwanto and Nizar Hidayanto (2022); Osu and Navarra (2022); Thamjaroenporn and Achalakul (2020)	People and organization
20	Measurement	4	Yeong Kim and Cho (2018); Lee *et al*. (2018); Thamjaroenporn and Achalakul (2020); Abraham *et al*. (2019)	*Process*
21	Regulatory compliance	4	Duzha *et al*. (2023); Lee *et al*. (2018); Thamjaroenporn and Achalakul (2020); Jang and Kim (2021)	Policies/standards/ procedures
22	Strategic planning	4	Al-Ruithe and Benkhelifa (2017b); Yeong Kim and Cho (2018); Bao *et al*. (2022); Li *et al*. 2019)	People and organization
23	Training and Education	4	Diaz Iturry *et al*. (2021); Al-Ruithe and Benkhelifa (2020); Yeong Kim and Cho (2018); Abraham *et al*. (2019)	*Process*
24	Accountability	3	Marcucci *et al*. (2023); Gegenhuber *et al*. (2023); Thammaboosadee and Dumthanasarn (2018)	Policies/standards/ procedures
25	Communication	3	Bento *et al*. (2022); Al-Ruithe and Benkhelifa (2020); Abraham *et al*. (2019)	*Process*
26	Data management	3	Al-Badi *et al*. (2018); Habibie *et al*. (2022); Jang and Kim (2021)	People and organization
27	Data Sharing	3	Liu *et al*. (2022); Micheli *et al*. (2020); Holly *et al*. (2023)	technology
28	Focused and tangible data strategies	3	Bento *et al*. (2022); Kaewkamol (2022); Abraham *et al*. (2019)	People and organization
29	Internal and external auditing	3	Romero *et al*. (2019); Bao *et al*. (2022); Birkstedt *et al*. (2023)	*Process*
30	Trusted data source	3	He *et al*. (2019); Bao *et al*. (2022); Li *et al*. (2019)	*Requirement*
31	Tools	3	Yeong Kim and Cho (2018); Bento *et al*. (2022); Al-Ruithe and Benkhelifa (2020)	Technology
32	Access control	2	Duzha *et al*. (2023); Jiang *et al*. (2023)	Technology
33	Authority	2	Yebenes and Zorrilla (2019); Abraham *et al*. (2019)	Policies/standards/ procedures
34	Awareness	2	Kurniawan *et al*. (2019); Mirza Harwanto and Nizar Hidayanto (2022)	*Process*
35	Business intelligence	2	Osu and Navarra (2022); Castro *et al*. (2021)	Technology
36	Data assets	2	Jing *et al*. (2023); Bao *et al*. (2022)	Technology
37	Data availability	2	Indhumini Ranathunga and Wickramarachchi (2022); Yeong Kim and Cho (2018)	Technology
38	Data exchange	2	Jing *et al*. (2023); Thamjaroenporn and Achalakul (2020)	Technology
39	Data integration	2	Jing *et al*. (2023); Castro *et al*. (2021)	Technology
40	Digital risk	2	Bao *et al*. (2022); Osu and Navarra (2022)	Technology
41	Guidelines	2	Yeong Kim and Cho (2018); Kaewkamol (2022)	Policies/standards/ procedures
42	*Governance* Metrics/success measures	2	Thammaboosadee and Dumthanasarn (2018); Al-Ruithe and Benkhelifa (2020)	People and organization
43	Reference	2	Habibie *et al*. (2022); Osu and Navarra (2022)	Technology

No.	Sub-component	#	Reference	Component
44	Classification	2	Saed *et al.* (2018); Al-Ruithe and Benkhelifa (2020)	*Process*
45	Controls	2	Thammaboosadee and Dumthanasarn (2018); Saed *et al.* (2018)	Policies/standards/ procedures
46	Data auditability	2	Indhumini Ranathunga and Wickramarachchi (2022); Yeong Kim and Cho (2018)	Policies/standards/ procedures
47	Change management	2	Al-Ruithe and Benkhelifa (2020); Yeong Kim and Cho (2018)	People and organization
48	Data committee structure	2	Romero *et al*. (2019); Thamjaroenporn and Achalakul (2020)	People and organization
49	Data consistency	2	Indhumini Ranathunga and Wickramarachchi (2022); Yeong Kim and Cho (2018)	Policies/standards/ procedures
50	Data modeling	2	Castro *et al.* (2021); Yeong Kim and Cho (2018)	*Process*
51	Data *governance* level agreement	2	Al-Ruithe *et al*. (2016); Al-Ruithe and Benkhelifa (2020)	Policies/standards/ procedures
52	Data *governance* office	2	Thammaboosadee and Dumthanasarn (2018); Romero *et al*. (2019)	People and organization
53	Decision rights	2	Yebenes and Zorrilla (2019); Thammaboosadee and Dumthanasarn (2018)	*Process*
54	Decision-making bodies	2	Yebenes and Zorrilla (2019); Jarvenpaa and Essén (2023)	People and organization
55	Employee data competencies	2	Bento *et al.* (2022); Alhassan *et al*. (2019)	People and organization
56	Formalization	2	Kurniawan *et al.* (2019); Mirza Harwanto and Nizar Hidayanto (2022)	Policies/standards/ procedures
57	Improved optimization	2	Bao *et al*. (2022); Al-Badi *et al.* (2018)	*Process*
58	Legal	2	Duzha *et al.* (2023); Ndemo and Thegeya (2023)	Policies/standards/ procedures
59	Mission and vision	2	Jing *et al*. (2023); Thammaboosadee and Dumthanasarn (2018)	People and organization
60	Ownership	2	Osu and Navarra (2022); Holly *et al*. (2023); Lee *et al*. (2018)	People and organization
61	Transparency	2	Marcucci *et al.* (2023); Osu and Navarra (2022)	Policies/standards/ procedures
62	Analysis	1	Li *et al*. (2019)	*Process*
63	AI System	1	Birkstedt *et al*. (2023)	Technology
64	Algorithms	1	Birkstedt *et al*. (2023)	Technology
65	Building roadmap	1	Yamada and Peran (2017)	*Process*
66	Business case	1	Al-Ruithe and Benkhelifa (2020)	*Requirement*
67	Contextual alignment	1	Al-Ruithe and Benkhelifa (2017a)	*Requirement*
68	*Corporate governance*	1	Al-Ruithe and Benkhelifa (2020)	Other *governance*
69	Contextual integration	1	Al-Ruithe and Benkhelifa (2017a)	*Requirement*
70	Business domain entities	1	He and Peng (2022)	Technology
71	Data collaboration	1	Zhang *et al*. (2022)	Technology
72	Data cooperatives	1	Micheli *et al.* (2020)	Technology
73	Data scope	1	Abraham *et al*. (2019)	*Requirement*
74	Define the sustaining requirements	1	Al-Ruithe and Benkhelifa (2017a)	*Requirement*
75	Data formats	1	Yeong Kim and Cho (2018)	Technology
76	Confidentiality	1	Marcucci *et al.* (2023)	Policies/standards/ procedures
77	Data pre-processing	1	Jiang *et al*. (2023)	*Process*
78	Business strategy	1	Al-Ruithe and Benkhelifa (2020)	People and Organization
79	Conformance	1	Lee *et al*. (2018)	Policies/standards/ procedures
80	Data traceability	1	Zhang (2020)	*Process*
81	Data marketplaces	1	Mukhametov (2021)	Technology
82	Data protection	1	Jiang *et al*. (2023)	Technology
83	Evaluation	1	Bao *et al*. (2022)	*Process*
84	IT *Governance*	1	Al-Ruithe and Benkhelifa (2020)	Other *governance*

No.	Sub-component	#	Reference	Component
85	Deploy context requirements	1	Al-Ruithe and Benkhelifa (2017a)	Requirement
86	Civil society	1	Ndemo and Thegeya (2023)	People and organization
87	Data provenance	1	Lee *et al*. (2018)	Policies/standards/ procedures
88	Data risk management	1	Thamjaroenporn and Achalakul (2020)	People and organization
89	Data rights	1	Holly *et al*. (2023)	Technology
90	Data source management	1	He *et al.* (2019)	People and organization
91	Data service	1	Bao *et al*. (2022)	Technology
92	Facilitate innovation	1	Holly *et al*. (2023)	*Process*
93	Digital audit	1	Bao *et al*. (2022)	Technology
94	Developing capabilities	1	Zhang *et al*. (2022)	People and organization
95	Implementation	1	Al-Ruithe and Benkhelifa (2017b)	*Process*
96	Environment strategy	1	Al-Ruithe and Benkhelifa (2020)	People and organization
97	Data stewards	1	Thammaboosadee and Dumthanasarn (2018)	Policies/standards/ procedures
98	Funding strategies	1	Thammaboosadee and Dumthanasarn (2018)	People and organization
99	Goals	1	Thammaboosadee and Dumthanasarn (2018)	People and organization
100	Governments	1	Ndemo and Thegeya (2023)	People and organization
101	Infrastructure development	1	Liu *et al*. (2022)	*Process*
102	information security management	1	Yeong Kim and Cho (2018)	People and organization
103	IT resources	1	Shinta *et al.* (2022)	Requirement
104	Empowerment value data	1	Bao *et al*. (2022)	Policies/Standards /procedures
105	Preparation requirements	1	Al-Ruithe and Benkhelifa (2017a)	Requirement
106	Ethical	1	Duzha *et al.* (2023)	Policies/standards/ procedures
107	Fairness	1	Marcucci *et al.* (2023)	Policies/standards/ procedures
108	Informed consent	1	Marcucci *et al.* (2023)	Policies/standards/ procedures
109	Intelligent security	1	Bao *et al*. (2022)	Technology
110	KPI'S	1	Yebenes and Zorrilla (2019)	People and organization
111	Life cycle management	1	He *et al.* (2019)	People and organization
112	Management attributes	1	He and Peng (2022)	People and organization
113	Methodology	1	Romero *et al*. (2019)	People and organization
114	Major technical support	1	He *et al.* (2019)	Technology
115	Openness	1	Gegenhuber *et al*. (2023)	Policies/standards/ procedures
116	Objectives	1	Yebenes and Zorrilla (2019)	People and organization
117	Organization culture	1	Romero *et al*. (2019)	People and organization
118	Organizational maturity	1	Liu *et al*. (2022)	People and organization
119	Strategic alignment	1	Al-Ruithe and Benkhelifa (2017a)	People and organization

No.	Sub-component	#	Reference	Component
120	Private/public	1	Ndemo and Thegeya (2023)	Requirement
121	Software enhancement	1	Diaz Iturry *et al*. (2021)	Technology
122	Technical strategy	1	Al-Ruithe and Benkhelifa (2020)	People and organization
123	Quality assessment authentication	1	Jiang *et al*. (2023)	Policies/standards/ procedures
124	Safety controllability	1	Bao *et al*. (2022)	Technology
125	Organizing analytics workflow	1	Yamada and Peran (2017)	Process
126	The establishment of data legitimacy	1	Zhang *et al*. (2022)	Policies/standards/ procedures
127	Trust	1	Osu and Navarra (2022)	People and organization
128	Structured/unstructured	1	Ndemo and Thegeya (2023)	Requirement

Table 4: Summary of components and sub-components from the systematic literature review

No.	Components	Count sub-components
1	People and organization	35
2	Technology	31
3	Policies/standards/procedures	27
4	Process	22
5	Requirement	11
6	Other governance	2
	Total	128

From the table above, based on the predetermined components, six components, and 128 sub-components were summarized from the systematic literature review. Table (4) provides the number of components and sub-components that were found.

Conducting Interviews with MOOC Providers in Indonesia

After obtaining the components through the literature review, the researchers contacted more than twenty MOOC providers operating in Indonesia; however, only 10 experts from eight MOOC providers accepted the invitation and indicated their willingness to participate in the study. Interviews were conducted because all MOOC providers asked for interviews and not a focus group discussion. Thus, 10 experts were interviewed from the eight MOOC providers in Indonesia.

Confirmation of Sub-Component Testing Using Fuzzy Delphi Methods

After conducting interviews, the researchers obtained answers regarding the sub-components that were needed for MOOC providers to be used in the data governance framework. From the results obtained, testing was conducted using the fuzzy Delphi method through a 5-point Likert scale. The results were obtained to answer the first research question.

People and Organization

Based on the ranking calculations, the order of the sub-components for "people" is as follows:

1. *Responsibility*
2. *Trust*
3. *Roles*
4. *Stakeholders*
5. *Civil society*

Meanwhile, the rejected sub-component was stewardship. The calculation of fuzzy delphi for people is available in Table (5).

Due to page limitations, the table results from the fuzzy Delphi for organization, strategy, management, technology, policies/standards/procedures, requirements, and other governance are in the following link: https://doi.org/10.5281/zenodo.13188171.

Organization

Based on the ranking calculations, the order of the sub-components for "organization" is as follows:

1. *Ownership*
2. *Governance metrics*
3. *Goals*
4. *Objectives*
5. *Vision and mission*
6. *Data committee structure*
7. *Employee data competencies*
8. *Organizational maturity*
9. *KPI's*
10. *Decision-making bodies*
11. *Developing capabilities*
12. *Organization culture*
13. *Methodology*

Meanwhile, the sub-components that were rejected were:

1. *Data governance office*
2. *Governments*

Strategy

Based on the ranking calculations, the order of the sub-components for "strategy" is as follows:

1. *Strategic planning*

Table 5: Fuzzy Delphi calculation on people

Results	Responsibility	Stakeholders	Stewardship	Roles	Civil society	Trust
Expert1	0	0.04619	0.01732	0.02309	0.18475	0.01155
Expert2	0	0.04619	0.04041	0.02309	0.06928	0.01155
Expert3	0	0.04619	0.01732	0.02309	0.18475	0.01155
Expert4	0	0.06928	0.01732	0.09238	0.04619	0.01155
Expert5	0	0.04619	0.04041	0.02309	0.04619	0.01155
Expert6	0	0.06928	0.01732	0.09238	0.04619	0.01155
Expert7	0	0.18475	0.01732	0.02309	0.04619	0.01155
Expert8	0	0.04619	0.04041	0.02309	0.16166	0.01155
Expert9	0	0.04619	0.01732	0.02309	0.04619	0.10392
Expert10	0	0.04619	0.01732	0.02309	0.04619	0.01155
Statistics	Responsibility	Stakeholders	Stewardship	Roles	Civil society	Trust
Value of the item	0	0.06466	0.02425	0.03695	0.08776	0.02079
Value of the construct						0.03907
Item < 0.2	10	10	10	10	10	10
% of items < 0.2	100%	100%	100%	100%	100%	100%
Average of % consensus						100
Defuzzification	0.8	0.72	0.13	0.76	0.52	0.78
Ranking	1	4	6	3	5	2
Status	Accept	Accept	Reject	Accept	Accept	Accept

2. *Focused and tangible data strategies*
3. *Funding strategies*
4. *Business strategy*
5. *Technical strategy*
6. *Strategic alignment*
7. *Environment strategy*

Management

Based on the ranking calculations, the order of the sub-components for "management" is as follows:

1. *Information security management*
2. *Data management*
3. *Data risk management*
4. *Change management*
5. *Lifecycle management*
6. *Management attributes*

Meanwhile, a sub-component that was rejected was data source management.

Technology

Based on the ranking calculations, the order of the sub-components for "technology" is as follows:

1. *Metadata*
2. *Data security*
3. *Data availability*
4. *Data protection*
5. *Data access*
6. *Data storage*
7. *Master data*
8. *Access control*
9. *Data interoperability*
10. *Data assets*
11. *Data integration*
12. *Digital audit*
13. *Data exchange*
14. *Business intelligence*
15. *Data Sharing*
16. *Tools*
17. *Software enhancement*
18. *Data collaboration*
19. *Data rights*
20. *Intelligence security*
21. *Safety controllability*
22. *Artificial Intelligence (AI) system*
23. *Data cooperatives*
24. *References*

Meanwhile, the sub-components that were rejected were:

1. *Digital risk*
2. *Algorithms*
3. *Application*
4. *Business domain entities*
5. *Data formats*
6. *Data marketplaces*
7. *Data services*
8. *Major technical support*

Policies/Standards/Procedures

Based on the ranking calculations, the order of the sub-components for "policies/standards/procedures" is as follows:

1. *Protection*

2. *Data quality*
3. *Guidelines*
4. *Confidentiality*
5. *Privacy*
6. *Data consistency*
7. *Data Principles*
8. *Data provenance*
9. *Ethical*
10. *Law and regulations*
11. *Data auditability*
12. *Data stewards*
13. *Legal*
14. *Authority*
15. *Controls*
16. *Data governance level agreement*
17. *Regulatory compliance*
18. *Accountability*
19. *Transparency*
20. *Conformance*
21. *Fairness*
22. *Formalization*
23. *Openness*
24. *Quality assessment authentication*
25. *The establishment of data legitimacy*

Meanwhile, the sub-components that were rejected were:

1. *Empowerment value data*
2. *Informed consent*

Process

Based on the ranking calculations, the order of the sub-components for "process" is as follows:

1. *Data Architecture*
2. *Monitoring*
3. *Communication*
4. *Data lifecycle*
5. *Evaluation*
6. *Assessment*
7. *Training and Education*
8. *Infrastructure development*
9. *Measurement*
10. *Building roadmap*
11. *Data modeling*
12. *Data traceability*
13. *Internal and external auditing*
14. *Analysis*
15. *Improved optimization*
16. *Data pre-processing*
17. *Classification*
18. *Awareness*
19. *Implementation*
20. *Organizing analytics workflow*
21. *Facilitate innovation*

Meanwhile, the sub-component that was rejected was decision rights.

Requirements

Based on the ranking calculations, the order of the sub-components for "requirements" is as follows:

1. *Trusted and clear data source*
2. *Private/public*
3. *Contextual integration*
4. *Contextual alignment*
5. *Data scope*
6. *IT resources*
7. *Business case*
8. *Structured/unstructured*
9. *Sustaining Requirements*

Meanwhile, the sub-components that were rejected were deployed context requirements and preparation requirements.

Other Governance

Based on the ranking calculations, the sub-components for "other governance", specifically corporate governance and IT governance, had the same ranking and acceptance.

After conducting the systematic literature review and interviews to ensure the correctness of adjustments to MOOC management, the six components and 128 sub-components derived were reduced to six components and 112 sub-components after conducting the interviews and using the fuzzy Delphi method calculation. This answered the research question of the study. The following Table (6) summarizes the answers for the components and sub-components of data governance for MOOC providers in Indonesia.

Table 6: 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

Discussion

The issue addressed in this study concerns the growing significance for providers to implement the continuous process for MOOCs from initiation to completion. However, this requires data governance to effectively facilitate business operations in managing data within MOOCs. The quality of data significantly impacts the operations carried out by MOOC providers. Currently, MOOC providers prioritize operational procedures over data quality, which is closely intertwined with data governance as it plays a crucial role in supporting the overall process. This research deviates from the pursuit of identifying the necessary elements for constructing data governance to identify the constituent components of data governance development, particularly for MOOC providers in Indonesia. However, the next research phase will be dedicated to the actual development of data governance.

This research utilized statistical calculations using the fuzzy Delphi methodology. Questionnaires were administered after completing interviews with MOOC providers. As a result, the research identified six components and 112 sub-components that served as the fundamental basis for the researchers to construct a data governance framework that will be beneficial for MOOC providers in Indonesia.

The people and organization component refers to the primary aspect of MOOC providers having an organized structure with individuals dedicated to sustaining the process. For the people sub-component, there are important things to note regarding the human resources of the MOOC provider. It is highly necessary to demonstrate responsibility in carrying out the work that has been assigned, as well as working with roles that have been determined and assigned by the management. While working, interactions with every stakeholder in the MOOC provider and within human resources are essential.

The organizational component entails the vision and mission, which allows the company, particularly the MOOC provider, to have a clear direction to ensure the learning is provided in accordance with the goals and objectives of the MOOC provider. In terms of managing existing employees, it is necessary to have competencies in employee data, the application of KPIs, and the capabilities to measure the performance of employees of the MOOC provider. If the employee still underperforms based on the company's KPI, then the sub-component of developing capabilities such as training can be referred to improve their ability to perform a particular job. MOOC providers also need the organizational culture sub-component to improve the culture of work and employees in accordance with the vision and mission. Employees can easily improve organizational culture with continuous socialization from leaders to employees. MOOC providers also need a strategy, which includes the strategic data and business strategy sub-components. This is a necessity for companies to increase opportunities in the following years, which requires strategy. Because MOOC providers rely heavily on technology to carry out their operations, data strategy becomes an important sub-component for data governance. MOOC providers also need the management sub-component, namely change management and lifecycle management. With these two types of management, the MOOC provider will be ready to face changes following the life cycle based on the vision and mission of the organization.

The process is a crucial element for MOOC providers since it concerns executing many sub-components that establish data governance. The inclusion of the process component is an essential step that must be closely monitored inside the organization. The monitoring sub-component needs to be present at every step so that each process runs smoothly without any obstacles that may hinder the process. The next sub-component is communication, which is also critical for every stage of the process. This includes communicating with every stakeholder, from the MOOC provider itself to the community, learners, instructors, and other parties that are connected to the MOOC provider. Thus, to achieve the goals of the MOOC provider, the communication sub-component is critical.

The next sub-component is evaluation. It is a main component in the evaluation/review stage to determine whether the course should be continued or closed in accordance with the existing process flow. The evaluation of the course should be done at every step of the process periodically. This is to ensure that all processes have been carried out and used by stakeholders as well as those who play a role in each stage of the process.

The next sub-component is the assessment, which is needed at several stages, particularly during course upload. At this stage, it is necessary to conduct an assessment to ensure that all course content can run smoothly and according to the objectives of the course. In addition, assessment is also needed at the grading stage to ensure that the system on the MOOC platform carries out the grading function properly and there are no errors that can result in non-compliance with existing standards.

Training and education are the next sub-component that needs to be considered in maintaining and ensuring that operational employees carry out their tasks according to their functions. If there are competencies that are lacking or need to be trained, then training and education are important to ensure existing employees can keep the process running. In addition, training and education are needed when there is a new technology that is applied by the MOOC provider. The application of new technologies such as business intelligence and artificial intelligence ensures that the employees involved are trained and educated to keep it running optimally in the operational process.

The next sub-component is measurement, which is crucial for MOOC providers. Measurement is done in several stages of the process starting from market research on prospective users' needs to ensure accurate predictions to identifying the technological capabilities required by the MOOC provider. The course design also needs to be measured. When designing a course, measurements are performed based on the target learners who will take the course. Then, during course approval, it is necessary to measure how the course can be used later by the learners and whether it is acceptable. Furthermore, in course promotion, measurement is important to ensure that the promotion carried out does not exceed the cost budget that was set, particularly if there is revenue from the course. Measurement is also needed during grading, as the assessment of learners' performance needs to be measured as feedback for the MOOC manager to determine how successful the course is. Measurement also occurs during course evaluation/review. This is necessary to measure each level of users and learners and determine whether it is acceptable for the learners or whether there are still things that need to be improved.

The building roadmap sub-component is also important in the process component for data governance. It is relevant to course planning and design so that the learning is done through logical stages. This could be done, for example, by starting with a course for beginners, after which it progresses to a course for the intermediate level and advanced level. This roadmap for each course allows learners to see the value in always improving their skills by learning on the MOOC platform.

The next sub-component is internal and external auditing, which is an overall audit of the existing process to ensure all processes run smoothly. Internal and external auditing ensure that the quality of the processes carried out remains on track in accordance with the MOOC provider's data governance framework. This should be established as a routine that needs to be done periodically by the MOOC provider to check and ensure that the right process is carried out as well as to improve optimization, which is a sub-component that also exists in the process component. Improved optimization becomes the output of the audit result which benefits the stakeholders of the MOOC provider. Improved optimization is also needed for course evaluation/review. If the results of the course evaluation/review are good, then there needs to be improvements to make the course better than before in providing quality to the learners.

The analysis sub-component is also important in the process component, which is relevant for all stages of the process. This is because every process requires an analysis of the inputs and outputs that occur in each process. If the input or input is not maximized, it needs to be analyzed in the previous process, or if the output or output is not maximized as well, it is necessary to analyze every process that occurs. All existing process steps should be analyzed to identify those that need to be replaced, changed, or improved.

The data pre-processing sub-component is also a sub-component in the process that is important for the data governance framework. Data pre-processing is highly used in market research to get early market predictions based on analysis from external data such as from interest in social media data or other data. This is one way to find out how interesting the courses offered by the MOOC provider are. In addition, pre-processing is needed for course promotion. This becomes measurement data on the course interest of prospective learners. By conducting research, the results can be processed for further development by the MOOC provider.

Furthermore, the classification sub-component is needed in many stages of the process, especially in course selection up to course production. Classification is needed when conducting course selection so that the courses that are followed by learners can be classified and become more specialized from course selection to course production. With this classification, it is possible for learners to choose based on the personalization expected from learning on the MOOC platform.

The next sub-component is awareness. This is widely used from market research to course design, which is necessary to quickly find out what intentions are expected by the learners in a course offered. With awareness, the MOOC provider is closer to the needs of learners who want to learn a certain course based on the time or trends in the community. Awareness needs to be built from the beginning so that sensitivity to the learners' needs is more easily reached by the MOOC provider.

The implementation sub-component is relevant for each step of the process in the MOOC provider, particularly for course production, upload, report, and evaluation/review. Implementation needs to be done so that it can be used and utilized by learners and interested parties to access data or courses that have been implemented. This influences other sub-components to provide maximum functionality in each stage of the process.

The organizing analytics workflow sub-component is part of the process component, which is similar to the analysis sub-component. However, analytics focuses more on the regular workflow of the processes that are easy for MOOC providers to understand. This is more widely used at the early stages of the learner's journey. MOOC providers can observe and analyze the process carried out by learners to ensure a dynamic and fun journey so that they enjoy the learning process on the MOOC platform.

The facilitating innovation sub-component is mostly used during the course production stage. MOOC providers can implement hybrid learning that encompasses asynchronous and synchronous learning. This means that there are several facilities that need

increased innovation so that learning is not done traditionally but can utilize new and developing technology and innovations in learning to maximize the fun of learning for learners.

In the policies/standards/procedure component, there is a sub-component for data quality which concerns the standard that needs to be set by the MOOC provider regarding the data and information owned. Therefore, data quality is a sub-component of the policies/standards/procedures owned by the MOOC provider.

Apart from data quality, the standards comprise the sub-components of guidelines, data consistency, data auditability, authority, transparency, conformance, and quality assessment authentication. These sub-components are essential for MOOC providers to ensure that data is reliable and that the processes owned by the MOOC provider are in accordance with the provisions of existing standards.

Meanwhile, the sub-components that are part of policies include protection, confidentiality, privacy, ethics, law and regulations, and legal. What is meant by policies here are sub-components that provide policies to all stakeholders in the MOOC provider. This provides a sense of comfort and security for MOOC managers and MOOC platforms to access data.

The sub-components for procedures include controls and regulatory compliance. These sub-components concern procedural matters that need to be addressed by the MOOC provider in carrying out regular operations. The sub-components of controls and regulatory compliance ensure that MOOC providers update their controls periodically to improve operational quality. In addition, the MOOC provider should make regular updates to their legal compliance both internally and externally. Regular updates to regulatory compliance can become a fixed procedure to ensure that MOOC providers always comply with new rules that are suitable for the organization.

In the technology component, metadata management involves planning, implementing, and controlling activities to enable access to high-quality and integrated metadata. This makes it an appropriate sub-component for the technology of the MOOC provider where metadata management is performed as part of technology management.

Data security involves the planning, development, and implementation of security policies and procedures to provide proper authentication, authorization, access, and auditing of data and information assets. Once the MOOC management organization has strong policies/standards/procedures on the components of this data governance framework, data security can function effectively based on the needs of the MOOC provider. In this case, technology becomes essential to the MOOC platform and the ecosystem to ensure data and information security remain a top priority.

Master data and references are included in the technology component of the data governance framework. It involves managing shared data to meet organizational goals, reduce risks associated with data redundancy, ensure higher quality, and reduce data integration costs. In this case, technology becomes instrumental in supporting the objectives of master data and reference management. The MOOC platform uses application technology, which is fundamental and requires main data and references that are consistently used. Therefore, technology for master data and reference management are important technology sub-components for data control.

Data integration and interoperability are also technological sub-components. They involve the movement and consolidation of data within and between applications and organizations. For MOOC providers, employing suitable technology for data integration and interoperability can provide effective data security and regulatory compliance and identify meaningful events to automatically trigger alerts and actions. With this technology, the MOOC provider can handle complex data and information easily in accordance with the objectives and business strategies appropriate for the organization.

Data storage and operations are part of the technology sub-component which involves the design, implementation, and support of stored data to maximize its value. With the appropriate technology in data storage and operations, MOOC providers can ensure that data storage maximizes data value. This allows for the management of data availability throughout the data lifecycle, ensures data asset integrity, and manages data transaction performance. With this technology, the MOOC provider can make data and information valuable assets that are easily stored or recalled.

Data modeling and design are also included in the technology sub-component, which entails the process of finding, analyzing, and covering data needs and then representing and communicating these needs in an appropriate data model. The process is iterative and can include conceptual, logical, and physical models. For MOOC providers, data modeling technology can confirm and document the understanding of different data perspectives, leading to applications that are better aligned with current and future business needs. It creates a foundation for successfully completing wide-scale initiatives such as master data management and programs on data governance for MOOC providers.

The sub-components that are also part of technology are software enhancement, intelligence security, safety controllability, and artificial intelligence (AI) systems. Software enhancement is crucial for adapting to the fast-paced trends of the current era. Therefore, the software must always be maintained and updated. By updating the technology in the application, the MOOC platform will be more in line with users' needs. For example, an

application that can run responsively on mobile devices requires rapid enhancement and adjustment to meet the needs of learners when accessing the MOOC platform.

Improving data and application security is necessary for MOOC providers. The implementation of intelligence-based security can ensure threats are easily controlled through the reinforcement of technology. Another important sub-component is safety controllability. Security controls that are continuously updated make it very unlikely for attacks on the data assets to occur. This security control makes existing stakeholders feel safe and comfortable in using the MOOC platform.

The technology sub-component involving Artificial Intelligence (AI) that has been widely discussed among researchers can also be a sub-component for MOOC providers in the future. This can help MOOC providers meet current trends such as by conducting analyses and fostering new innovations using AI.

The requirement component comprises nine sub-components. The first sub-component is trusted data sources, which is a requirement for MOOC providers. By ensuring that data is reliable through trusted data sources, MOOC providers can maintain data quality and ensure that data received is valid and useful to be used as data assets.

The second sub-component is the private/public classification for learning materials on the MOOC platform. MOOC providers need to determine the context of the data assets used, particularly whether they can be consumed by the public or only for private or certain groups. This sub-component thus helps MOOC providers classify each data asset through this private/public classification.

The third sub-component is contextual integration. This sub-component is important for the process component, particularly for the implementation and facilitation of innovation. Through contextual integration, MOOC providers can understand learning needs, including the facilities required and the context of using other tools needed. This also helps them find ways to integrate data into the technology component. Therefore, contextual integration plays an influential role in the implementation of the operational process.

The fourth sub-component is contextual alignment, which is crucial for MOOC providers to comprehend relevant data from every stakeholder. This enables MOOC providers to determine whether the data received is in accordance with the context of learning, which simplifies the operational process and makes monitoring easier based on the pre-existing context.

The fifth sub-component is scope data. This sub-component is similar to contextual alignment but provides more details on the data used in the MOOC platform. Scope data refers to data that is suitable for a certain scope as determined by the course creator. This ensures that data given to learners is more targeted and relevant, rather than wide and numerous. This simplifies data storage and the management of document technology and content for the MOOC provider.

The sixth sub-component is IT resources. This sub-component is almost the same as the technology component, namely metadata and master data and reference. This component concerns the initial stage of communicating the needs for IT resources required for learning needs. This ensures that the technology used is in accordance with the needs required by the MOOC provider in managing learning on the MOOC platform.

The seventh sub-component is a business case. This sub-component is part of the requirement as it helps determine course selection and course planning. By adjusting the learning to the business case, it is easier for the MOOC provider to prepare the case data more quickly and accurately in providing services to learners through the MOOC platform.

The eighth sub-component is structured/unstructured data. This sub-component is crucial especially in course creation from course selection to course design. With this sub-component, course creators can view available data assets and determine how the data can be used as part of learning in the course, whether structured or unstructured. Given the abundance of both structured and unstructured data that can be used, this sub-component is crucial for initial data collection by the MOOC provider.

The ninth sub-component is sustaining requirement, which is important when additional data assets are needed and has reached mutual agreement between the MOOC provider and the parties involved in the learning process. The requirement ensures that data assets are comprehensive and can be utilized immediately if needed when learning on the MOOC platform.

In the other governance component, there are two sub-components, namely corporate governance and IT governance. Corporate governance provides the understanding that in modern organizations such as MOOC providers today, IT and digital data are part of the function elements in business strategy, especially for MOOC providers (DAHLBERG and NOKKALA, 2015). Corporate governance can influence data governance in an organization to make it more valuable to MOOC providers in business processes. The following Fig. (2) details the corporate governance framework (DAHLBERG and NOKKALA, 2015).

In the picture, corporate governance is depicted with several knowledge areas from DMBOK. Based on previous research (DAHLBERG and NOKKALA, 2015), corporate governance is built based on data governance, which makes it suitable for this study in relation to data governance for MOOC providers.

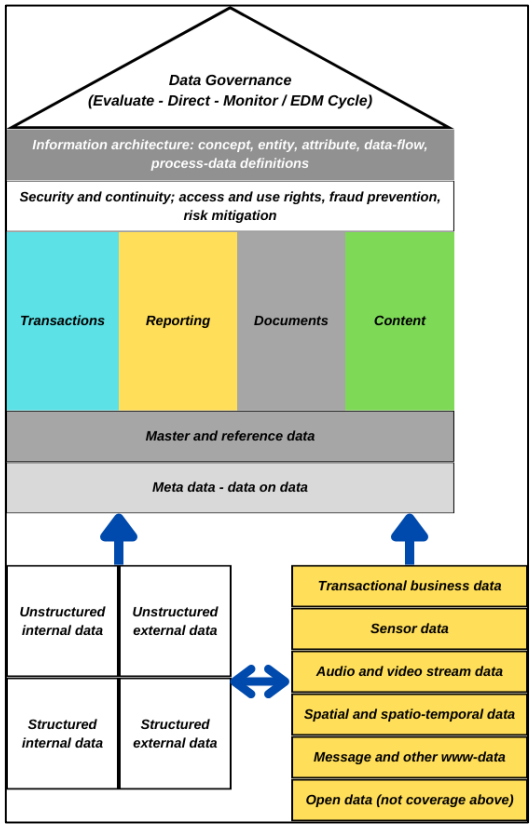

Fig. 2: Corporate governance framework (Dahlberg and Nokkala, 2015)

The figure shows that corporate governance supports data governance through information architecture, security and continuity, transactions, reporting, documents, content, master and reference data, and metadata. This support occurs from data that goes into corporate governance such as unstructured/structured data (According to the requirement component) and data obtained from other stakeholders such as transactional business data, sensor data, audio and video stream data, spatial and spatiotemporal data, messages, other web data, and open data.

The second component is IT governance, which is closely related to corporate governance. IT governance should exist in every corporate organization using tools ranging from operations to strategic areas within the company. Therefore, IT governance is needed to support corporate governance. One of the trends that exist for IT governance today is COBIT 2019, which is a framework for the governance and management of enterprise information and technology aimed at the entire enterprise. Enterprise IT refers to the technology and information processing that a company uses to achieve its goals, regardless of where this happens in the company. In other words, enterprise IT is not limited to the IT department of an organization but includes it. The COBIT framework makes a clear distinction between governance and management. These two disciplines cover different activities, require different organizational structures, and have different objectives.

In most companies, overall governance is the responsibility of the board of directors under the leadership of the chairman. Specific governance responsibilities may be delegated to specialized organizational structures at the appropriate level, especially in larger and more complex companies. This explains the importance of corporate governance and IT governance in other governance components.

Conclusion

This study sought to identify the components needed to build a data governance framework, especially for MOOC providers in Indonesia. To answer this research question, a systematic literature review was conducted which analyzed 53 scientific articles. From these, six main components and 128 sub-components were initially identified. The six components were people and organization, process, policies/standards/procedures, technology, requirements, and other governance. Following this, interviews were conducted with eight MOOC providers in Indonesia. The interview and fuzzy Delphi study led to the finalization of 112 sub-components to answer the research question.

This study was not without limitations. Firstly, the researchers only managed to interview eight MOOC providers. However, these MOOC providers showed a willingness to use the data governance framework. The future development of the data governance framework can be assessed by evaluating the performance after its implementation.

Another limitation was that factor testing was not carried out on each component to determine its significance. The researchers only received statements from the MOOC providers on whether each component is important to be implemented by MOOC providers.

Based on the results of the study, the following development suggestions for MOOC providers and further research can be made:

a. Conduct quantitative research on the significance of the components to further improve the performance of MOOC providers
b. Research how significantly data governance, corporate governance, and IT governance affect each other to obtain new knowledge about the governance relationship
c. Conduct performance comparison research for MOOC providers who have used a data governance framework with those who have not used a data governance framework to measure the impact

d. Conduct interviews with MOOC providers and assist in implementing data governance frameworks that were not addressed in this study

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Author's Contributions

Yakob Utama Chandra: Lead research project, find research problems, review the literature, do experiment, be an interviewer, lead the question for interviewee, data analysis, and writing the manuscript.

Harjanto Prabowo: Advise research project, design the research methodology, data analysis, monitoring, and evaluation for the experiment.

Ford Lumban Gaol: Advise the exploration and analysis of the research model, the analysis and evaluation of the gap analysis finding, monitoring and evaluation for the experiment.

Betty Purwandari: Advise the exploration and analysis of the research model, data analysis, monitoring, and evaluation for the experiment.

Ethics

The authors confirm that this manuscript has not been published elsewhere and that no ethical issues are involved.

Conflict of Interest Declaration

The authors declare that there is no conflict of interest regarding the publication of this manuscript.

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