European Journal of Contemporary Education

ELECTRONIC JOURNAL

Management Information System and Quality Assurance

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Abstract
Supported by Martin's and Parikh's (2017) systemic view of quality management (as a synonym of quality assurance), this study examined the availability of key data in a management information system (MIS) of a higher education provider and how these data are used for decision-making. This study also examined the use of the results of several quality assurance processes, mainly from surveys by students and employers and faculty. A questionnaire was designed to survey top and middle leaders of Vietnamese universities and faculty and support staff from 13 HEPs on MIS for QA through stratified sampling techniques. It was found that higher education providers (HEPs) collected key data on teaching and learning in their MIS but made limited use of the information generated for decision-making and quality assurance. Similar results were found in how they used data collected from students, employers, and faculty to assure quality. Yet, there are significant differences in collecting three kinds of data in MIS between public and private universities. Private HEPs are better at using the surveyed results by students and employers for discussion by faculty at the departmental level, rewarding faculty and support staff, and continuing or ceasing contracts with visiting faculty; and using surveys by faculty and staff for reviewing academic programs and continuing or ceasing contracts with visiting faculty. Furthermore, the findings indicated that large-size HEPs had more comprehensive MIS, with more data and higher use of these data than small-size HEPs in the Vietnamese context. To promote a culture of evidence whereby decision-making is data-driven, it is necessary to orient internal stakeholders, such as academic and administrative staff, to use the information generated through MIS for

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quality improvement and open up dialogues between top management and these stakeholders for the deployment of the information collected.

Keywords: management information system, quality assurance, governance and management, quality improvement.

1. Introduction

Quality assurance (QA) is a mechanism of demonstrating accountability for higher education providers (HEPs) because it is stated by HEPs about what they could do to achieve stakeholders' confidence that they fulfill expectations to threshold minimum requirements (Lemaitre, Karakhanyan, 2017). HEP governance and management can lead to innovation in quality assurance, while quality assurance is the foundation for innovation, a tool to evaluate innovation, creativity, and effectiveness of governance and management. To improve administrative decision processes whereby activities such as decision making, policy analysis, planning, monitoring and management at different levels can be facilitated, it is important to have an effective MIS (Bright, Asare, 2019). The success of a QA system relies on HEP governance and management, which can be facilitated by an effective management information system (MIS); therefore, an MIS should be developed to integrate the QA system with the management process and assessable information about it for quality enhancement (Kahveci et al., 2012). Information on HEP's performance and quality assurance need to be transparent, public, and accountable to meet the needs of stakeholders. Therefore, an information management system (MIS) for decision-making should be fully developed to improve governance and serve as a basis for quality improvement. Only when this is done will it be possible to build the trust of the various stakeholders in the HEP. These are the conditions for HEPs to develop their strategic profile and position against their partners, competitors, sponsors, and students in an increasingly complex and rapidly changing environment. This paper examines how an MIS can support a QA system, which is a mediator for enhancing HEP performance and quality improvement. This study also examines if there is any difference between public and private universities in using MIS for a QA system.

2. Results and discussion
Institutional research and management information system

Institutional research focuses on the analysis of data to produce desired information in a HEP to assist decision-making for management, planning, and institutional policy (Villalobos et al., 2018). Because there have been different issues with data quality and a need for an institutional policy on data quality management, HEPs need high-quality information systems to deal with information requirements (Tahvildarzadeh et al., 2017). In other words, information systems' main task is to generate information for strategic decision-making. Furthermore, it is a mechanism for HEPs to reflect critically on educational processes and quality management to determine areas that need improvement (Raffaghelli et al., 2021). In addition, HEPs' information systems aim to enhance their activities' productivity and management efficiency (Sagitova, 2012). Therefore, HEPs' management information system can be viewed as "an organizational and technical system where information technologies are realized, and hardware and software are used for collection, processing, acquisition, storage, search, and dissemination of information" (Sagitova, 2012: 56). Then, these systems facilitate the sustainment and consolidation of quality management within an internal quality assurance mechanism and system (with QA tools and processes for planning and monitoring, for example) and a QA culture that foster continuous quality enhancement at all level of the HEP (González Bravo et al., 2022).

Management information system in quality assurance
MIS for continuous quality enhancement

MIS provides information for a corrective action plan and facilitates HEP's continuous improvement. A clear internal quality assurance model framework for institutional effectiveness that integrates quality assurance and performance evaluation processes is viewed as helping the institution achieve its mission and strategic priorities (Reneau, Howse, 2019). The method of assessing the effectiveness of a HEP based on a review of whether operational results align with the vision, mission, and strategic objectives, as well as the operational quality assurance process, requires an information management system. Therefore, HEPs must ensure the collection, analysis, and use of relevant information for effective management of institutional outcomes as

regards study programs and other activities (ENQA, 2015). Thus, information about the achievement of institutional outcomes should be considered for assessment. If a QA system is not augmented with the management system, it is impossible for HEPs to assess whether they achieve the required outcomes for quality enhancement (Kahveci et al., 2012). In other words, to meet information demands for organizational concerns and objectives, HEPs need to develop integrated data-based information systems (Randhahn, 2017). A well-established information system can be a mechanism for formulating and assessing institutional objectives and therefore serves as a mediator for decision-making processes for sustainable strategic planning in higher education (Küpper, Friedl, Hofmann, Hofmann and Pedell 2013, as cited in Randhahn, 2017). For example, to support a HEP's operations and management, Tsolakidis et al. (2015) recommended a multi-layer structure of the Quality Assurance Information System, which typically includes a database system, data mining, and decision support system, executive information system, and KPI monitoring. Among these different layers of controlling information, the executive information system is a Management Information System that informs and supports senior executives in decision making. It helps monitor all the performance indicators against the HEP's strategic goals and assist the administration to improve the quality and set strategic objectives.

Thus, the primary task of quality management is to produce and use the information to assist internal discussion and decision-making for quality improvement (Martin, Parikh, 2017). Information can be collected through inductive methods (e.g., the analyses of organizational documents and data or a survey based on interviews or questionnaires) to identify information supply and subjective information needs, and deductive methods within a systematic way to examine objective information needs (Randhahn, 2017). For example, a study by Martin and Parikh (2017) used a survey to collect information on the availability of key indicators derived from MISs, which investigated "the use of generated information to provide feedback to stakeholders or to inform quality-related processes such as review of study programs and academic staff assessment" (p. 65).

Use of information for decision-making

Different stakeholders, such as students, graduates, teachers, officers and administrators, and academic audit and QA teams, require different information (Musti, 2020). As users of an information system, students must know about educational processes such as course registration, fee structures, checking their academic progression, and other activities. Graduates as users need something different such as their student transcripts and the ease of the online payment process. Faculty need many data transactions such as verification of courses, details, assessment components, prerequisites, registered students, and marks submission. Another group of special stakeholders includes several layers and numbers of officers and administrators that need to incorporate HEP's information into their decision-making through dashboards and/or data visualization. Furthermore, a group of stakeholders involved in the quality assessment includes internal and external audit and QA teams requiring different data specifications accessible for verifying QA tools and processes. For example, Martin and Parikh (2017) examined the availability and use of information on the following:

Availability and use of information on teaching and learning. QM relies on the availability of data and information derived from an MIS, which commonly has data on students, staff, infrastructure, and financial resources. Then generated information can help formulate key indicators such as student characteristics, progression and graduation rates, and student/teacher ratios at the departmental level. Martin and Parikh (2017) found that key information was relatively available in the participating HEPs, but it was less likely systematically used for QM. For instance:

The institutions were asked whether certain key information generated typically by MIS was available (without being used) or whether it was used (given availability) for QM [quality management] purposes. Around 87 % of the institutions had information on student progression available, but only 40 % of these institutions used this information for QM. This is followed by teacher/student ratio – available in 81 % of institutions, although only 36 % of institutions used it for QM. Information on learning inventory was available in 80 % of the institutions, but only 28 % used it in QM. Information on student characteristics was the least available information; even so, it was available in 70 % of the responding institutions but only 38 % of institutions used it in their QM (Martin, Parikh, 2017: 65-66).

Frequency of use of survey results for feedback. Besides statistical data from MIS, QM usually depends on the results of surveys from stakeholders such as students, staff, graduates, and employers. It was found that although much information was produced, it was often not used to provide feedback to students and faculty. For instance:

... a majority (74 %) of the responding institutions use the results of surveys either often or always in discussion with academic staff at the departmental level. Only half or slightly less of the responding institutions (48 %) often or always informed students who participated in surveys about the results (Martin, Parikh, 2017: 67).

Frequency of the use of survey results to support decision-making. As discussed earlier, QM is used to inform and assist decision-making at various levels of a HEP to close the gap between the production and use of data. The generated information can be used for various actions, such as improving the quality of academic programs in the processes of program development or review and career advancement of faculty through student satisfaction surveys or graduate surveys. For instance:

Interestingly, most responding institutions said that they use results from these surveys either always or often to support decision-making in the design and review of academic programmes (75 %), and in the assessment and promotion of teaching staff (64 %) (Martin, Parikh, 2017: 69).

Methods and participants

A survey method was used in this study. A questionnaire was designed to survey top and middle leaders of Vietnamese universities and faculty and support staff on MIS for QA. Out of 44 higher education providers (HEPs), 13 ones (accounting for 30 % of total HEPs in a Vietnamese city) were selected to join this study using stratified sampling techniques. They represent both different public and private HEPs in this city. The HEPs were accredited and recognized.

Data was collected through a questionnaire to seek information on the management information system and information use in decision-making (see Appendix A). This included examining a set of information focusing on teaching and learning such as student characteristics (e.g. socioeconomic background, gender, ethnicity;faculty–student ratios at the departmental level; student progression, success and/or graduation rates; and Inventory of learning resources (e.g., labs, computers)). It also included examining the use of generated information from surveys of students, alumni, employers, academic and support staff to provide feedback to stakeholders or to support decision-making as regards QA processes. Specifically, it investigated the extent to which the results of surveys were used: in a discussion by faculty at the departmental level; for students who have responded are informed about the results; in the design of academic programs; in the review of academic programs; in the evaluation of academics' teaching; in the appraisal of academic and support staff; in continuing or ceasing contract with visiting faculty; in upgrading facilities for teaching and research.

Sample

Table 1 illustrates the number of participants from each group of stakeholders who responded to the questionnaire with a total of 769 responses. As regards the positions of respondents, it is noted that they represented a typical structure of a university. They were grouped into five positions: (1) top leaders of the university, (2) QA staff, (3) leaders of disciplinary departments, (4) faculty, and (5) support staff.

Table 1. Participants – Position in a higher education provider (HEP)

Positions	HEP A[1]	HEP B	HEP C	HEP D	HEP E	HEP F	HEP G	HEP H	HEP I	HEP J	HEP K	HEP L	HEP M	Total	Missing
President of HEP Council	2	2												4	
Vice-President of HEP Council					2									2	
Rectors (or equivalent)				1										1	
Vice-Rectors (or equivalent)	1													1	1
QA leader	2		2	7		2			1	1			2	17	8
QA staff	1	1	2	15	3	1		1	4	3	1		1	33	5

[1] HEP A.M are the pseudonyms of higher education providers participating in this study

Positions	HEP A[1]	HEP B	HEP C	HEP D	HEP E	HEP F	HEP G	HEP H	HEP I	HEP J	HEP K	HEP L	HEP M	Total	Missing
Leader of functional units	2		1	11		1					1	1		17	3
Leader of disciplinary depart.	3		7	5	2	6	4		3	4	5	2	3	44	4
Leader of sub-divisions	10		3	14	6	1	2	3	1	7	11	1	2	61	13
Lecturers	52	23	58	22	35	30	45	12	21	34	3	10	8	353	39
Researchers	1	1		1										3	2
Support staff	12	11	30	28	5	9	4	3	2	17		1	6	128	6
Others	6		1				2		3	2				14	
Total	92	38	104	104	53	50	57	19	35	68	21	15	22	**678**	81
Missing	1														10
Top leaders	3	2		1	2									8	1
QA staff	3	1	4	22	3	3		1	5	4	1		3	50	13
Middle leaders	15		11	30	8	8	6	3	4	11	17	4	5	122	20
Faculty	53	24	58	23	35	30	45	12	21	34	3	10	8	356	41
Support staff	18	11	31	28	5	9	6	3	5	19		1	6	142	6
Total	92	38	104	104	53	50	57	19	35	68	21	15	22	**678**	81
Missing	1														10

Table 2 displays each HEP's ownership (public or private), characteristics, and orientation (research or application).

Table 2. HEPs: Kinds and autonomy

		HEP A	HEP B	HEP C	HEP D	HEP E	HEP F	HEP G	HEP H	HEP I	HEP J	HEP K	HEP L	HEP M
Ownership	Public	1	1	2		1	1			2	2	2	3	2
	Private				3			3	2					
Characteristics	Public, state funding	1	1	1			1			2	2		3	
	Public, autonomous financing	1				1						2		2
	Private, not for profit				2									
	Private, for profit				2			3	2					
Orientation	Research-oriented	1			2						2	2	3	2
	Teaching-oriented	1	1		2	2	1	3	2					
	Research + teaching			3	1				1	2				
	Others					1								

Table 3 displays information on the categories of the participating HEPs.

Table 3. Categories of HEPs

Ownership-Finance	HEPs	Size	HEPs
Public-state funding	HEP A	>20,000 students	HEP B
	HEP B		HEP C
	HEP C		HEP D
	HEP F		HEP E
	HEP I		HEP K
	HEP J		HEP M
	HEP L		
Public autonomy in finance	HEP E	<20,000 students	HEP A
	HEP K		HEP F
	HEP M		HEP G
			HEP H

Ownership-Finance	HEPs	Size	HEPs
	HEP D		HEP I
Private	HEP G		HEP J
	HEP M		HEP L

Data analysis

Cronbach's alpha was run to test the reliability of the questionnaire and items modified in the Vietnamese context. The results of Cronbach's alpha reliability coefficients are as follows:

Table 4. Cronbach's alpha Coefficients

Constructs/Items	Cronbach's alpha	No. of items
Management information system on teaching and learning	.705	4
Using survey results by students and employers to assure quality	.904	8
Using the survey results by faculty	.929	7

They are all accepted (α > 0.7).

To test any differences between public and private universities, independent sample t-tests were run.

As regards the display of nominal information (yes, no, do not know), the results are reported using two principles. Principle 1 means that the data will be reported with the percentage of participants choosing each option offered in the answer. The data were then converted to a scale of 4: if >80 % chose yes/selecting an option → 4; 80 %..>60 % → 3; 60 %..>40 % → 2; 40 %..>20 % → 1; 20 %..0 % → 0.

Management information system and use of information in decision-making

Information on teaching and learning

This section reports on the results of (a) data in the system and (b) the use of the information to assure quality.

Data inventory

The survey asked participants about the availability of four types of data on personal information of individual students, student progression, success and/or graduation rates, inventory of learning resources, and faculty-student ratios. The results are reported in two types. First, Table 5 shows the percentage of participants responding "yes" to the question. Table 6 displays the results on a scale of 4, as explained in the method section.

The results show that the percentage of participants responding yes to these data was not high. Their responses show moderate confirmation of the availability of these types of information. There was also a discrepancy in the information available between these HEPs. HEP I, L, and M have means from 3.0 to 3.3. In contrast, the HEPs with low means (0.5 and 1.0) were HEPs J, E, F, and H.

Table 5. Management information system on teaching and learning 1

Data	HEP A	HEP B	HEP C	HEP D	HEP E	HEP F	HEP G	HEP H	HEP I	HEP J	HEP K	HEP L	HEP M	Means
Student characteristics (e.g., socioeconomic background, gender, ethnicity)	44	87	34	70	34	26	59	37	72	21	52	67	68	48
Faculty-student ratios at the departmental level	31	79	42	70	28	32	62	21	61	24	67	80	59	48

Data	HEP A	HEP B	HEP C	HEP D	HEP E	HEP F	HEP G	HEP H	HEP I	HEP J	HEP K	HEP L	HEP M	Means
Student progression, success and/or graduation rates	43	13	47	68	34	28	48	21	78	19	62	67	73	45
Inventory of learning resources (e.g., labs, computers)	34	71	45	52	25	26	51	21	61	18	76	87	95	45
N	93	38	104	104	53	53	61	19	36	68	21	15	22	687

Table 6. Management information system on teaching and learning 2

	HEP A	HEP B	HEP C	HEP D	HEP E	HEP F	HEP G	HEP H	HEP I	HEP J	HEP K	HEP L	HEP M	Means
Student characteristics (e.g., socioeconomic background, gender, ethnicity)	2	4	1	3	1	1	2	1	3	1	2	3	3	2.1
Faculty-student ratios at the departmental level	1	3	2	3	1	1	3	1	3	1	3	3	2	2.1
Student progression, success and/or graduation rates	2	0	2	3	1	1	2	1	3	0	3	3	3	1.8
Inventory of learning resources (e.g., labs, computers)	1	3	2	2	1	1	2	1	3	0	3	4	4	2.1
Total	1.5	2.5	1.8	2.8	1.0	1.0	2.3	1.0	3.0	0.5	2.8	3.3	3.0	2.0

Tables 7 and 8 illustrate the results of the independent t-test for public and private universities.

Table 7. Descriptive statistics of data in MIS between public and private universities

	Types of university	N	Mean	Std. Deviation	Std. Error Mean
Student characteristics (e.g., socioeconomic background, gender, ethnicity)	Public	529	1.50	.500	.022
	Private	195	1.36	.481	.034
Faculty-student ratios at the departmental level	Public	529	1.51	.500	.022
	Private	195	1.37	.484	.035
Student progression, success and/or graduation rates	Public	528	1.51	.500	.022
	Private	195	1.41	.493	.035
Inventory of learning resources (e.g., labs, computers)	Public	529	1.49	.512	.022
	Private	195	1.49	.501	.036

The result shows that there are significant differences in collecting three kinds of data (student characteristics, faculty/student ratio, and student success) in MIS between public and private universities ($p < 0.005$). Yet, surprisingly, public and private universities are similar in the inventory of learning resources.

Table 8. The differences between public and private universities of data in MIS

		Levene's Test for Equality of Variances		t-test for Equality of Means					95 % Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Student characteristics (e.g., socioeconomic background, gender, ethnicity)	Equal variances assumed	45.342	.000	3.513	722	.000	.146	.041	.064	.227
	Equal variances not assumed			3.578	358.774	.000	.146	.041	.066	.226
Faculty-student ratios at the departmental level	Equal variances assumed	37.100	.000	3.443	722	.001	.143	.042	.061	.225
	Equal variances not assumed			3.497	356.714	.001	.143	.041	.063	.224
Student progression, success and/or graduation rates	Equal variances assumed	16.242	.000	2.421	721	.016	.101	.042	.019	.183
	Equal variances not assumed			2.437	350.880	.015	.101	.041	.020	.183
Inventory of learning resources (e.g., labs, computers)	Equal variances assumed	.306	.581	-.108	722	.914	-.005	.043	-.088	.079
	Equal variances not assumed			-.109	352.485	.913	-.005	.042	-.088	.078

Use of information to assure quality

The survey further asked participants whether these data were used for quality assurance with three options (Yes, No, Do not know). The results are presented in Table 9. It was found that:

- The percentage of participants who ticked "yes" was extreme between these HEPs (26 %..95 %).

- The HEPs were diverse in confirming the use of information for quality assurance purposes. It is noticeable that HEPs M, B, and L demonstrated more use of the information for QA, contrary to the limited use of these data by HEPs F and H.

Table 9. Use of the information in teaching and learning

		HEP A	HEP B	HEP C	HEP D	HEP E	HEP F	HEP G	HEP H	HEP I	HEP J	HEP K	HEP L	HEP M	Means
Use of information	Yes	51	87	66	85	49	38	46	26	69	56	81	87	95	63
	No	2		5		2	6	3		3	6	5			3
	Don't know	47	13	29	15	49	57	51	74	28	38	14	13	5	35
N		93	38	104	104	53	53	61	19	36	68	21	15	22	687
Total		2	**4**	3	4	2	**1**	2	**1**	3	2	4	**4**	**4**	2.8

Tables 10 and 11 show the results of the independent t-test for how public and private universities used data in MIS for teaching and learning.

Table 10. Descriptive statistics of using data in MIS in teaching and learning between public and private universities

	Types of university	N	Mean	Std. Deviation	Std. Error Mean
Use of the information in teaching and learning	Public	571	1.67	.927	.039
	Private	195	1.63	.923	.066

Table 11. The differences between public and private universities in using data in MIS

		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95 % Confidence Interval of the Difference	
									Lower	Upper
Use of the information in teaching and learning	Equal variances assumed	.318	.573	.520	764	.603	.040	.077	-.111	.191
	Equal variances not assumed			.521	337.023	.602	.040	.077	-.111	.191

It was found that public and private universities are not different in using these data in teaching and learning.

Use of survey results by students and employers to assure quality

Eight questions were surveyed related to the frequency of using the results collected from students and employers for eight activities (curriculum design and review, informing students, faculty evaluation and rewards, faculty termination/teaching invitation, and facility improvement) with six options: never, not frequent, sometimes, regular, always, and do not know. The percentage of participants responding "do not know" was low (~8 %..13%). The result of EFA shows that all eight items converged to one factor (α =.909).

As can be seen in Table 12:

- The difference between the frequency of using the survey results was not too significant, most often for the review of academic programs and evaluation of faculty (3.4) and least frequent use for faculty and staff reward (2.5) and in reporting the results to students (2.7).

- Similarly, the difference among the HEPs was not too significant: the highest means for HEP H (3.6), HEPs K and D (3.5), HEPs C and L (3.4), and the lowest means for HEP E (2.4) and HEP A (2.7).

Table 12. The frequency of using survey results by students and employers to assure quality

Using survey results by students and employers for	HEP A	HEP B	HEP C	HEP D	HEP E	HEP F	HEP G	HEP H	HEP I	HEP J	HEP K	HEP L	HEP M	Menas
discussion by faculty at the departmental level	2.7	3.5	3.3	3.7	3.5	2.3	3.0	2.9	3.6	3.1	3.1	3.6	3.5	3.2
informing students who have responded to the surveys	2.5	3.0	2.8	2.6	3.2	2.2	2.1	2.2	3.6	2.7	2.5	3.2	2.9	**2.7**
the design of academic programs	2.8	3.8	3.5	3.7	3.6	3.0	3.0	2.8	3.8	3.3	3.2	3.6	3.5	**3.3**
the review of academic programs	3.2	3.7	3.4	3.7	3.9	3.0	3.2	3.1	3.8	3.3	3.2	3.6	3.6	**3.4**
evaluation of faculty	3.3	3.7	3.3	3.6	3.7	2.8	3.2	3.1	4.0	3.3	3.3	3.5	3.6	**3.4**
rewarding faculty and	2.2	2.4	2.3	3.0	3.3	1.8	2.2	2.7	2.9	2.0	3.2	3.3	2.8	**2.5**

Using survey results by students and employers for	HEP A	HEP B	HEP C	HEP D	HEP E	HEP F	HEP G	HEP H	HEP I	HEP J	HEP K	HEP L	HEP M	Menas
support staff														
continuing or ceasing contract with visiting faculty	2.6	3.6	2.7	3.2	3.5	2.1	2.8	2.6	3.5	2.8	3.5	3.5	3.8	2.9
upgrading facilities for teaching and research	2.5	3.3	3.0	3.5	3.5	2.1	2.5	2.9	3.8	2.6	3.3	3.4	3.5	3.0
Total	**2.7**	3.0	3.4	**3.5**	**2.4**	2.8	2.8	**3.6**	2.9	3.2	**3.5**	3.4	3.0	3.0
N	85	26	94	95	43	50	61	17	34	58	19	14	17	612

Tables 13 and 14 show the results of the independent t-test for how public and private universities used survey results by students and employers to assure quality.

Table 13. Descriptive statistics of using survey results by students and employers to assure quality between public and private universities

Using survey results by students and employers for	Types of universities	N	Mean	Std. Deviation	Std. Error Mean
discussion by faculty at the departmental level	Public	571	3.77	1.624	.068
	Private	195	4.06	1.406	.101
informing students who have responded to the surveys	Public	571	3.39	1.721	.072
	Private	195	3.25	1.487	.106
the design of academic programs	Public	571	3.83	1.718	.072
	Private	195	3.92	1.523	.109
the review of academic programs	Public	571	3.77	1.809	.076
	Private	195	3.94	1.596	.114
evaluation of faculty	Public	571	3.56	1.951	.082
	Private	195	3.64	1.777	.127
rewarding faculty and support staff	Public	571	3.14	1.714	.072
	Private	195	3.57	1.304	.093
continuing or ceasing contract with visiting faculty	Public	571	3.43	1.821	.076
	Private	195	3.73	1.465	.105
upgrading facilities for teaching and research	Public	571	3.43	1.771	.074
	Private	195	3.64	1.642	.118

Table 14. The differences between public and private universities in using survey results by students and employers

Using survey results by students and employers for		Levene's Test for Equality of Variances		t-test for Equality of Means						95 % Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference		Lower	Upper
discussion by faculty at the departmental level	Equal variances assumed	9.537	.002	-2.246	764	.025	-.293	.130		-.549	-.037
	Equal variances not assumed			-2.410	384.070	.016	-.293	.121		-.532	-.054
informing students who have responded to the surveys	Equal variances assumed	14.326	.000	1.021	764	.307	.141	.138		-.130	.412
	Equal variances not assumed			1.097	384.797	.273	.141	.129		-.112	.394
the design of academic programs	Equal variances assumed	12.062	.001	-.645	764	.519	-.089	.139		-.362	.183

		F	Sig.	t	df	Sig. (2-tailed)	Mean Diff.	Std. Error	Lower	Upper
	Equal variances not assumed			-.685	375.279	.494	-.089	.131	-.346	.167
the review of academic programs	Equal variances assumed	15.702	.000	-1.175	764	.240	-.171	.146	-.457	.115
	Equal variances not assumed			-1.249	376.713	.212	-.171	.137	-.441	.098
evaluation of faculty	Equal variances assumed	10.593	.001	-.520	764	.603	-.082	.158	-.393	.228
	Equal variances not assumed			-.545	365.372	.586	-.082	.151	-.380	.215
rewarding faculty and support staff	Equal variances assumed	35.761	.000	-3.194	764	.001	-.429	.134	-.693	-.165
	Equal variances not assumed			-3.645	438.587	.000	-.429	.118	-.661	-.198
continuing or ceasing contract with visiting faculty	Equal variances assumed	27.688	.000	-2.051	764	.041	-.296	.144	-.579	-.013
	Equal variances not assumed			-2.280	413.436	.023	-.296	.130	-.551	-.041
upgrading facilities for teaching and research	Equal variances assumed	5.740	.017	-1.446	764	.149	-.209	.144	-.492	.075
	Equal variances not assumed			-1.501	359.419	.134	-.209	.139	-.482	.065

Table 14 shows no differences in using surveys by students and employers between public and private universities for almost all QA activities except for discussion by faculty at the departmental level, rewarding faculty and support staff, and continuing or ceasing contracts with visiting faculty. Private ones are better at using the surveyed results.

Using the survey results by faculty to assure quality

- Seven questions were surveyed related to the frequency of using the results collected from faculty for seven activities (curriculum design and review, faculty and staff evaluation and rewards, faculty termination/teaching invitation, revising strategies/plans, and facility improvement) with six options: never, not frequent, sometimes, regular, always, and do not know. The percentage of participants responding "do not know" was low (~8 %..13 %). EFA result shows that all seven items converged to one factor (α =.936). The results (Table 15) show that:

- There were subtle differences in the use of the results of faculty surveys for these activities (min = 2.8, max = 3.2)

- However, there was a more significant difference in using the faculty surveys among the HEPs. The HEPs with more frequent use of survey results were HEP M (3.7), HEPs B, E, and K (3.5), and those with low frequency of use included HEP F (2.5) and HEPs H and J (2.8).

Table 15. Using the survey results by faculty

Using survey results by faculty for	HEP A	HEP B	HEP C	HEP D	HEP E	HEP F	HEP G	HEP H	HEP I	HEP J	HEP K	HEP L	HEP M	Means
the design of academic programs	3.1	3.7	3.5	3.5	3.7	2.5	3.0	2.9	3.7	3.2	3.4	3.6	3.7	**3.3**
the review of academic programs	3.1	3.8	3.4	3.6	3.6	2.7	2.8	2.9	3.7	3.3	3.3	3.7	3.8	**3.3**
evaluation of faculty and staff	3.1	3.7	3.2	3.5	3.6	2.9	3.4	2.9	3.6	3.2	3.5	3.4	3.8	**3.3**
rewarding faculty and	2.5	2.8	2.8	3.1	3.4	2.1	2.6	2.5	3.1	2.4	3.3	3.5	3.3	**2.8**

Using survey results by faculty for	HEP A	HEP B	HEP C	HEP D	HEP E	HEP F	HEP G	HEP H	HEP I	HEP J	HEP K	HEP L	HEP M	Means
support staff														
continuing or ceasing contract with visiting faculty	2.7	3.5	3.0	3.1	3.4	2.4	3.0	2.7	3.4	2.5	3.3	3.4	3.9	**3.0**
upgrading facilities for teaching and research	2.9	3.5	3.1	3.5	3.5	2.4	3.0	2.8	3.6	2.6	3.3	3.4	3.8	3.1
Revising strategies/plans	3.0	3.8	3.3	3.5	3.6	2.3	3.0	2.7	3.5	2.7	3.3	3.4	3.8	3.2
Total	2.9	**3.5**	3.2	3.4	**3.5**	2.5	3.0	2.8	3.5	2.8	3.3	**3.5**	**3.7**	3.1
N	85	27	95	95	43	51	61	17	34	60	20	14	18	619

Tables 16 and 17 show the results of the independent t-test for how public and private universities used survey results by students and employers to assure quality.

Table 16. Descriptive statistics of using survey results by faculty and staff to assure quality between public and private universities

Using survey results by faculty for	Types of university	N	Mean	Std. Deviation	Std. Error Mean
the design of academic programs	Public	571	3.83	1.669	.070
	Private	195	3.92	1.616	.116
the review of academic programs	Public	571	3.71	1.792	.075
	Private	195	3.96	1.526	.109
evaluation of faculty and staff	Public	571	3.68	1.789	.075
	Private	195	4.09	1.440	.103
rewarding faculty and support staff	Public	571	3.48	1.600	.067
	Private	195	3.66	1.327	.095
continuing or ceasing contract with visiting faculty	Public	571	3.53	1.737	.073
	Private	195	3.77	1.397	.100
upgrading facilities for teaching and research	Public	571	3.59	1.711	.072
	Private	195	3.91	1.417	.101
Revising strategies/plans	Public	571	3.70	1.706	.071
	Private	195	3.95	1.439	.103

Table 17. The differences between public and private universities in using survey results by faculty and staff

		Levene's Test for Equality of Variances		t-test for Equality of Means					95 % Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
the design of academic programs	Equal variances assumed	18.766	.000	-1.754	764	.080	-.251	.143	-.533	.030
	Equal variances not assumed			-1.897	390.301	.059	-.251	.133	-.512	.009
the review of academic programs	Equal variances assumed	26.415	.000	-2.927	764	.004	-.415	.142	-.693	-.137

	Equal variances not assumed			-3.253	413.347	.001	-.415	.127	-.665	-.164
evaluation of faculty and staff	Equal variances assumed	21.895	.000	-1.413	764	.158	-.180	.127	-.430	.070
	Equal variances not assumed			-1.548	400.710	.122	-.180	.116	-.408	.049
rewarding faculty and support staff	Equal variances assumed	27.254	.000	-1.723	764	.085	-.237	.137	-.507	.033
	Equal variances not assumed			-1.915	413.724	.056	-.237	.124	-.480	.006
continuing or ceasing contract with visiting faculty	Equal variances assumed	25.786	.000	-2.370	764	.018	-.323	.136	-.590	-.055
	Equal variances not assumed			-2.598	401.353	.010	-.323	.124	-.567	-.078
upgrading facilities for teaching and research	Equal variances assumed	22.031	.000	-1.796	764	.073	-.245	.136	-.512	.023
	Equal variances not assumed			-1.952	394.154	.052	-.245	.125	-.491	.002

The result shows no differences in using surveys by faculty and staff between public and private universities for almost all QA activities except for reviewing academic programs and continuing or ceasing contracts with visiting faculty. Private ones are also better at using the surveyed results.

In short, the synthesis of the quantitative analysis of MIS is presented in Table 18. As seen from the table, large-size HEPs (M and K) had sound information management systems, with more data and more frequent use of the data to assure quality compared with small-size HEPs.

Table 18. MIS and decision-making

	HEP A	HEP B	HEP C	HEP D	HEP E	HEP F	HEP G	HEP H	HEP I	HEP J	HEP K	HEP L	HEP M	Means
Data in MIS	1.5	2.5	1.8	2.8	1.0	1.0	2.3	1.0	3.0	0.5	2.8	3.3	3.0	2.0
Use of data in MIS for QA	2	4	3	4	2	1	2	1	3	2	4	4	4	2.8
Use of survey results by students and employers	2.7	3.0	3.4	3.5	2.4	2.8	2.8	3.6	2.9	3.2	3.5	3.4	3.0	3.0
Use of survey results by faculty	2.9	3.5	3.2	3.4	3.5	2.5	3.0	2.8	3.5	2.8	3.3	3.5	3.7	3.1
Ownership	PL	PL	PL	PV	PL	PL	PV	PV	PL	PL	PL	PL	PL	2.7
Size**	n	L	L	L	L	n	n	n	n	n	L	n	L	

Notes:
* PL: Public, PV: Private
**: L: large HEP > 20.000 students, n: small HEP < 20.000 students

The study results show that there existed a discrepancy in the availability of four key information fields (including information on teaching/learning such as student characteristics (e.g., socioeconomic background, gender, ethnicity); faculty-student ratios at the departmental level; student progression, success and/or graduation rates; inventory of learning resources (e.g., labs, computers)) produced typically by MIS. There was also a greater difference between the HEPs in their use of these data for quality management purposes. The difference between the frequency of using the survey results to assure quality was not too significant, most often for reviewing academic programs and evaluating faculty. The least used is to reward faculty and support staff and report the results to students. Similarly, there was a subtle difference in the frequency of using student and employer surveys and faculty surveys for these activities. The use of information at a moderate level was for discussion by faculty at the departmental level, upgrading

facilities for teaching and research, and continuing or ceasing contracts with visiting faculty. However, there was a more significant difference in using the results of faculty surveys among the HEPs. It was found that there are significant differences in collecting three kinds of data (student characteristics, faculty/student ratio, and student success) in MIS between public and private universities. Private HEPs are better at using the surveyed results by students and employers for discussion by faculty at the departmental level, rewarding faculty and support staff, and continuing or ceasing contracts with visiting faculty; and using surveys by faculty and staff for reviewing academic programs and continuing or ceasing contracts with visiting faculty. The synthesis of the quantitative analysis on MIS shows that large-size HEPs had good information management systems, with more data and use of these data than small-size HEPs.

The findings concur with earlier research on using information generated from quality assurance for decision-making in that some key information is available but not necessarily used for decision-making (Martin, Parikh, 2017). In their selective review of the utilization of decision-making support systems for making decisions in HEPs, Mora et al. (2017) found that these systems have been present. Still, their utilization for quality improvement is insufficient and partially deployed. This suggests that there exists a relevant knowledge gap in the generation and utilization of information for quality management and decision-making, and there are open opportunities to implement an effective MIS and further research on MIS for quality enhancement. In other words, HEPs leaders may need to engage stakeholders, mainly faculty and other staff, in extracting actionable information for the data in their MIS so that they gain insights into the relationships between the inputs and outputs of educational activities across their institution, which help to inform their decision making for improved outcomes they collectively target and to achieve their mission successfully (Soares et al., 2016). Although there are no diference in using surveyed results between public and private universities for almost all QA activities, private HEPs are better at using the surveyed results from stakeholders such as students, faculty, and staff for rewarding faculty and support staff, continuing or ceasing contracts with faculty, and reviewing academic programs, as Nguyen (2012) found in her study through case analysis of private universities. Collecting feedback from stakeholders may be part of private HEPs' scheme to stay competitive with public ones. The information collected may be used to improve educational quality in order to keep present students satisfied and attract propsective learners. Meanwhile, it is difficult to cease contracts with faculty in public HEPs, for example, because they are considered as public servants. The findings that large HEPs tend to have more sophisticated MIS and utilize generated information for decision-making suggest that HEPs are on their way to data-driven management. It is a must for HEPs to implement critical reflection on information generated from the use of data through administrative activities, quality assessment, and teaching because "the lack of adequate shared reflection (also and above all at the institutional level) on technology and its purpose creates a situation of fragmentation in data practices" (Raffaghelli et al., 2021). Thus, opening up to the data and engaging frontline academic and support professionals in conversation on MIS can encourage the development of a culture of evidence (Soares et al., 2016). To do this, the management of HEPs needs to provide adequate support so that information is generated by MIS and utilized to achieve targeted outcomes in quality management. Further research may examine moderating factors that affect the decision-makers' intention to use the information generated by HEPs' MIS.

The study has a few limitations. It used convenience sampling method, so the findings are true for this particular group of participating HEPs but cannot be generalised for the larger populations. Another limitation is that the data collected based on the participants' perception (opinions) or self-report, rather than objective data. For example, stakeholders at the same university may have different ideas about their MIS because their perception depends on their role, ability to access and use data, and their awareness of the use of MIS, for example. The study is limited in that students' voice was not included. The final limitation is that it lacks interviews with stakeholders.

4. Conclusion
The findings of this study can be useful for assisting HEP decision-makers in improving their MIS as regards the generation and utilization of information to improve their quality management and educational quality. The results concur with previous studies in that HEPs may have established their key information but partially utilized it for decision-making. This study figured out such issues in using MIS for quality management that would shed light on HEP top

management's framing of relevant strategies for implementing and managing MIS in their institutions. To promote a culture of evidence whereby decision-making is data-driven, it is necessary to orient internal stakeholders, such as academic and administrative staff, to use the information generated through MIS for quality improvement and open up dialogues between top management and these stakeholders for the deployment of the information collected. Thus, sufficient support and guidance should be systematically provided so that these stakeholders can use the information for quality enhancement. Further studies may examine contextual factors influencing decision-makers use of information for quality management in HEPs. Then, a mixed method may need to be used, inclusive of student participants.

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Appendix A

Questionnaires on management information system and information use in decision-making

1. What information on teaching/learning is available from your management information system?
    a. Student characteristics (e.g. socioeconomic background, gender, ethnicity)
    b. Teacher–student ratios at the departmental level
    c. Student progression, success and/or graduation rates
    d. Inventory of learning resources (e.g., labs, computers)
    e. Other (please specify)

2. Is this information used for QM purposes in your HEP?
    a. Yes   b. No   c. I do not know.

3. How often are the results of surveys (including student satisfaction surveys, graduate surveys, and employer surveys) used for these activities?

No	The results of surveys were used	I do not know	Never	Not often	Someti mes	Often	Always
1	In discussion by faculty at the departmental level	☐	①	②	③	④	⑤
2	Students who have responded are informed about the results	☐	①	②	③	④	⑤
3	In the design of academic programs	☐	①	②	③	④	⑤
4	In the review of academic programs	☐	①	②	③	④	⑤
5	In the evaluation of faculty's teaching	☐	①	②	③	④	⑤
6	In the pay rise/or awarding of teaching staff and support staff	☐	①	②	③	④	⑤
7	In continuing or ceasing teaching contracts with visiting faculty	☐	①	②	③	④	⑤
8	In upgrading facilities for teaching and research	☐	①	②	③	④	⑤
9	Other (please specify)						

4. How often are the results of academic and support staff surveys used for these activities?

No.	The results of surveys were used	I do not know	Never	Not often	Sometimes	Often	Always
1	In the design of academic programs	☐	①	②	③	④	⑤
2	In the review of academic programs	☐	①	②	③	④	⑤
3	In the evaluation of faculty teaching	☐	①	②	③	④	⑤
4	In the pay rise and/or awarding of teaching staff and support staff	☐	①	②	③	④	⑤
5	In continuing or ceasing teaching contracts with visiting faculty	☐	①	②	③	④	⑤
6	In upgrading facilities for teaching and research	☐	①	②	③	④	⑤
7	In the adjustment of institutional quality objectives or institutional development plan	☐	①	②	③	④	⑤
8	Other (please specify)						