

Adoption of Big Data in Higher Education for Better Institutional Effectiveness

American Journal of Creative Education

Vol. 2, No. 1, 31-44, 2019

e-ISSN: 2706-6088



 Youngsik Hwang

Higher Education & Student Affairs (HESA), Indiana University, USA.
Email: yh27@indiana.edu Tel: 812-318-4072

ABSTRACT

Big data provides many opportunities to broaden existing insights in different fields and higher education also can use the big data for the better institutional performance. This study examines the conceptual models to adopt big data for institutional effectiveness on higher education system. Based on the three relevant entities including institution, faculty, and student, this research provides the relationship between them and construct the negotiable environment as well as the characteristics of relevant indicators. This research suggests the conceptual model that provide how relevant campus members pursuit the better institutional performance and what the individual targeting is. Conceptual model indicates the three main stakeholders exchange specific values under certain type of negotiable interactions and the trade makes better outcomes for institutional effectiveness in the long run. This relationships between the stakeholders generate potential connections with other players outside and the relation creates another chance to broaden range of institutional growth in the higher education system.

Keywords: *Big data, Higher education, Institutional effectiveness, Campus environment, College student, Faculty, Institution.*

DOI: 10.20448/815.21.31.44

Citation | Youngsik Hwang (2019). Adoption of Big Data in Higher Education for Better Institutional Effectiveness. *American Journal of Creative Education*, 2(1): 31-44.

Copyright: This work is licensed under a [Creative Commons Attribution 3.0 License](https://creativecommons.org/licenses/by/3.0/)

Funding: This study received no specific financial support.

Competing Interests: The author declares that there are no conflicts of interests regarding the publication of this paper.

History: Received: 8 May 2019/ Revised: 11 June 2019/ Accepted: 18 July 2019/ Published: 20 September 2019

Publisher: Online Science Publishing

Highlights of this paper

- This study examines the conceptual models to adopt big data for institutional effectiveness on higher education system.
- Conceptual model indicates the three main stakeholders exchange specific values under certain type of negotiable interactions and the trade makes better outcomes for institutional effectiveness in the long run.

1. INTRODUCTION

1.1. Statement of Problem

Many scholars have focused on the role of big data in terms of broader utilization and growing importance. The emerging trend of big data affects new approaches to explain existing phenomena and causality in different ways and show new forms of value. In the world of big data, all those different data gatherings provide new forms of value and generate new purposes for better fitted real world (Cukier and Mayer-Schoenberger, 2013). This new concept of the data includes a traditional interpretation of digits as well as the expression of diverse human traits. In the big data era, all kind of acceptable resources can be translated into meaningful data to interpret current figures of the real world. Many fields of study have already adopted the concept of big data to help their own boundary. For example, private companies in the business field have collected broader range of data about customers and meet their potential needs for generating better outcomes or long-term growth.

Although this big data model mainly discussed in computer science, informatics, or business field, there are rare studies to provide proper information about the adoption of big data mechanism in the education field. Each institutional function of internal structure provides detailed information to help the understanding of potential customers in the higher education market and diverse offices that have a responsibility to handle their institutional-level data generate useful information as regular reports or announcement, the more comprehensive strategy to reflect institutional effectiveness is still unclear. The big data make it possible to create learning information regarding student performance and learning approaches (West, 2012). Diverse tools and evaluations through broaden the range of data gathering enable to measure student actions, the effectiveness of instructor's teaching in a learning environment where they interact with each other.

Big data also have some advantage to understand the complicated higher education system and help to external holders who are interested in the institutional effectiveness in the competitive higher education market. Big data provides some implications for learning, assessment, and research in a higher education institution and generate a map of emerging potentials in the form of diverse data sources and modes such as traditional formats, brand new visualization tools, and the new value of disciplines (Cope and Kalantzis, 2016). Contemporary, he integrated the form of the data sources drives to require a self-regulating and sustainable system in order to reflect the reliability and validity of the resources (Wassan, 2015). This arises in a new research topic in educational big data and following discussions include the improvement of the validity of the qualitative and quantitative parts of the data structure that the researcher establishes.

1.2. Research Purpose

The purpose of this study is to provide the conceptual model that generates how big data resources create a better internal structure of the institution and reflect its institutional effectiveness. The proposed model shows three different entities that consist of the higher education system; student, parent, and institution. Those triangle combinations contribute to building the institutional effectiveness and the big data resources in this study supports how each entity represent their visible and invisible aspects of characteristics. In order to explain their property and causality with institutional effectiveness, the big data measures the connections between each entity and diverse

indicators in direct and indirect ways. For institution, the big data provides different institutional level variables in performance measures, such as college completion or alumni evaluation of college education. For students and parents, the new approach based on the big data provides some rationale behind their behavior that is related to the entire process of college education and make a representative internal property of individual demand. In this aspect, this study examines the balance between traditional measure and more comprehensive evaluation for the three entities through the format of big data. The concept of big data reveals a new image of each entity and generate a new value of standard for institutional effectiveness in this study.

1.3. Significance of the Study

The detailed variables and concepts in this study help the institutional leader to recognize its internal structure and make a long-term plan for better institutional effectiveness. Institutional leaders are considering a new standard of internal measurement for better performance in order to survive in the competitive higher education market. The proposed model to evaluate relevant stakeholders make the organization improve their internal decision making process and productivity through the broadening range of information by big data.

For potential educational consumers including students and parents, this conceptual model generates the rationale behind choosing a potential institution for their future career. The generated variables and information provide the standard of college choice to help potential consumers. The students and parents are considering more about their educational investment as the expected college costs have increased over time and the proposed model provides some clues which variable or standard can be used for their choice. This strategy eventually attracts more potential students to apply for a certain institution to meet their needs in terms of the expectation of future returns.

For policymaker, the organized conceptual framework provides the role of individual variables to reflect diverse characteristics and indicators between relevant stakeholders in the higher education system. The conceptual model implies how policy maker supports each entity for better institutional effectiveness. Big data approach helps to narrow down the cognitive gaps between practitioner's perspectives and position of social planner and generates some alternatives to measure a new value of assessment.

2. CONCEPTUAL FRAMEWORK

2.1. Definition of Big-Data

Some scholars have tried to define big data in different ways. [Drigas and Leliopoulos \(2014\)](#) simply emphasize it as the expansion of mobile networks, cloud computing and large amounts of data and especially it explores the larger scaled datasets with high speed and varied patterns that beyond the control of traditional data management. [Sigman et al. \(2014\)](#) defines it by two characteristics; 1) massive quantities of data with the real-time stream; and 2) various degrees of structure in the data, from the personal information and social networking involved resources. [Bihl et al. \(2016\)](#) focus more on the differences from the normal data and describe the notion as the accumulation of the data beyond given processing capabilities that users are overwhelmed. Although there is no agreed definition among scholars, recently [Gartner \(2013\)](#) interpretation is used to define the big data for a wide range of academic field. He mentions that the big data has three representative properties; high volume, high velocity, and high variety for their information assets. Those three "V" characteristics of big data easily explain its property as a simple way.

In all, the scholars are challenging on the new type of data world to explain the reality. This type of data is not easy to handle and covers a lot of different characteristics to provide a multi-dimensional aspect of certain information. However, as Gartner mentioned, this study accepts that the clear aspect of the big data is its

complexity and variety, and flexibility. First, any kind of simple analysis methods is not usually acceptable to deal in the big data and especially, the higher education system should be careful when they interpret the data. Higher education system collects the different type of data from diverse sources and it covers structured and unstructured dataset together. The complexity of big data regulates researcher in higher education about how they handle and what type of data sources are acceptable or transfer into real information. Next, researchers draw a big picture to combine each type of data source and consider a reciprocal combination to avoid any redundant tasks and unnecessary data collection. These works vitalize the vague big data for making suitable information to interpret. Lastly, the real-time trend of data creation in the current changing society make yesterday's big data more old-fashioned one at this time. The flexible environment around higher education system generates a new value of education variables and sometimes shows a new paradigm to require a change of existing custom.

2.2. Data-Driven Analysis

The big data includes two different approaches for its data collection. First is to get the data from objective observation or empirical evidence. The second one is to get the data from more subjective reports or theory-based construction. Those different perspectives in higher education reflect the property of targeted variables and contribute to making the representative score for showing institutional effectiveness.

The objective observations generally provide its meaning as a numeric value or visible measures to represent certain information of a subject. The approach to making data is based on visible measures such as accumulated individual records, stored digits of a certain variable, and other objective evidence. The traditional type of data in higher education has been those style of data over time and they had had a role to make well-known indicators such as graduation, financial aids, and tuition. This type of data is mainly collected by the institution through diverse tools such as some paperwork or online survey and this has been backed up the relevant documents to confirm the information. Different educational resources collect the data from colleges and universities and provide an entire level of the dataset by a certain type of indicators. In the data transfer and process of storing them, this data is frequently reviewed and corrected based on several troubleshooting. This series of process enforces the data be more objective and build the credibility to the potential customers. Following empirical studies based on these data make several norms or acceptable hypothesis to explain student life or institutional performance in higher education. These confer each data source to give some validity or credibility when a potential consumer considers using a specific dataset. This approach is more direct and straight-forward to interpret the meaning of digits for research purposes.

On the other hand, the subjective character of data may come from theoretical frameworks. This includes self-reported data, survey-oriented data collection, and other interview types of data gathering. Although the validity of self-reported data is still controversial, it is useful to support to explain real campus life as one of the indicators in higher education (Pike, 1996). This type of data shows invisible aspects of individual behavior and captures several missing links between numeric record and practical responses. While some field of social sciences such as economics, business prefer to use a more objective type of data above, it was still a limitation to explain the individual process of complicated decision making based on psychological or emotional status. This approach borrows some rationale behind having certain responses from the well-known theoretical lens among prior studies and try to transfer the data into useful information. This series of data-driven analysis contribute to support why an individual does a certain behavior or how their perspectives affect to make certain outcomes. However, it also has a lack of validity that comes from the constraint of internal designs such as flexible individual response, time lags, and uncontrolled external environment.

2.3. Big-Data Adoption in Higher Education

The different type of big data adopts diverse stakeholders who are engaged in institutional functioning. Higher education system used to adopt it in order to make an institutional difference as well as to enforce their basis of institutional mission. In the process, the different entities-institution as an educational supplier and students or parents as one of the potential educational consumers- provide certain data to evaluate institutional effectiveness. First, the institution utilizes it for better organizational behavior through the diverse decision-making process, governance, and other daily tasks that they should complete for their missions. While the traditional data at the institutional level tend to show an entire performance measure to represent institutional effectiveness. The representative measures include graduation, retention, and other evaluations from campus members. This exists respectively to provide an aspect of certain institutional measurement and does not properly provide some connections that why the practical performance appears and how certain results come from. The big data fulfill the missing links form different perspectives. For example, the big data measure the individual perspective of campus members and provides behavioral components, value, and another relevant mechanism in different ways. Broaden the range of data gathering from individual lens make institution have different insights to overview their function and effectiveness in the higher education market.

Next, big data support the new institutional values from potential consumers. This is a more indirect way to gather the data from outside, rather than the data collection from campus members. In addition, it has some risks to violate individual privacy or some private information. In general, the institution collects the required information to measure potential students' ability such as their high school GPA, extracurricular activities, and other traditional measurement indicators. The institution also gets some financial information to measure the individual financial ability for possible institutional supports. This traditional ways to get a data collection have been a certain standard to decide some institutional policy such as financial aids, affirmative action, and other supportive strategies for students. While the method of data gathering help to make a guideline of institutional policy as a whole, it does not provide the de-centralized solutions to meet individual needs and case by case approach to support the student. The big data-based data try to capture the beyond traditional lenses such as individual concerns of college education, future planning, and potential direction after graduation. Currently, the certain research center has collected the dataset to measure individual perspective toward a college education. However, it was still a limitation to collect the proper resources and be focused only for a private, limited number of institutions that follow any protection of data gathering.

3. LITERATURE REVIEW

3.1. Big Data Adoption in the Education Field

Prior studies overview the role of big data in the education field. Education field provides academic curricular which is related to big data for broad conceptual scope (Paweloszek and Wiczorkowski, 2015). The interest in big data technologies is used to improve the level of education and requires to understand the massive data processing for better performance. This should not be isolated from the social aspect of big data and make an establishment of legal regulation significantly for protecting individual rights. Baig and Jabeen (2016) extend the discussion of privacy issue based on the behavior monitoring of students. They point out that big data analytics have capacities to help us monitor and predict whether some personal characteristics influence criminals. These data gatherings include monitoring the physiological signs of person or range of alarm based on mental status. The big data adoption provides chances to detect or monitor the possibility of specific events when something unusual happens and increase the reliability of the analytical models to estimate the following results on campus. Vaitis *et al.* (2016)

examines the roles of big data in terms of quality improvement. They acknowledge two factors of the improvement: 1) the different process of learning and academic gaining and 2) practical application and realization of the analytical concepts. This adoption of big data enables to go through popular techniques for data manipulation for readers and contribute to training potential workers for the future workplace.

Some studies focus more on the use of big data at an institutional level. [Cope and Kalantzis \(2016\)](#) acknowledge the concept of big data vitalize the optimistic views of information-rich future and especially explores the impact of adoption on student writing. They map the complicated intellectual activity to generate unprecedented amounts of data. This use of big data collect unstructured data to the learning activity and provide significant implications for [Vollenbroek et al. \(2014\)](#) the relationship between traditional assessment and instruction. recognize the emerging concept, “learning education” by using the big data. They use the term of learning education that defines as the “phenomenon where educational stakeholders can learn from each other in order to ultimately improve education” (p.21). In the process, big data operate diverse platforms, resources, and digital applications to monitor, steer and assess students’ behavior. An institutional approach based on the big data provide the possibilities, reliability, and validity for measuring a certain type of dataset within the educational setting. The data sources for big data include different media, social networks, interviews, monitoring others, and other panel research. [Wassan \(2015\)](#) shows the successful analysis of the educational big data within an institution generally depends on the way of editing and processing the data. He acknowledges the distribution of big data handles some sensor, pattern, and other relations between actors for clear and visually appealing way insights into these analyses.

3.2. Bid Data Utilization for Higher Education System

There are rare studies about the big data use for the higher education system. Recent conferences and several informatics papers are partially dealing with the possibility of big data adoption for the higher education system. [Duan et al. \(2013\)](#) confirm the value of big data in student engagement in a higher education institution. They acknowledge that the student engagement tracking system based on big data improve student experiences and help to involve a more diverse range of stakeholders. Institutions can use the system based on the big data for better learning analytics and predictive tools and provide smart tracking information to individuals in a timely manner. [Daniel \(2017\)](#) also confirms the importance of big data for better institutional performance to meet flexible externality. He acknowledges the recent stream that the big data and analytics have a possibility to examine the institution’s present challenges and to create actionable insights to estimate predictable future outcomes. [Dede et al. \(2016\)](#) argue that the current data-intensive research and analysis today drive to require the invention of the comparable data collection and assessment techniques. The new type of data that is never before accessible generate the shift of traditional evaluation and provide more personalized feedbacks through complex measurements. The development of tools for understanding the big data accelerates fulfills the needs of diverse campus members in higher education and this process make the coherent picture of the targeted institution. [Drigas and Leliopoulos \(2014\)](#) discuss how to use big data in education. They emphasize the modification to simplify the interpretation of the large dataset and the connection and networking with the raw data. Through those ways, the big data shape the more dynamic education system and individual student gain better educational benefits within the evolved structure. The big data also enable the institution to cope with unexpected challenges and can provide parallel techniques for comprehensive data analysis. The new type of data has a possibility to provided enriched new learning ways, making more efficient and targeted within the education system. [Gibson and Ifenthaler \(2017\)](#) show the way to interpret the big data for better higher education research. They confirm that the complex adaptive systems based on data science are evolving diverse terms, tools, practices, and community, but there is still a remarkable

connection between the system and ever-changing models in the form of computational representations. From the exploratory analytics and hypothesis testing, the approaches to interpreting the data provide the data validity as well as model construction for more open, transparent, and amendable scientific problem-solving process. In addition, the potential for big data is not only for the data intelligence but also affect the fulfillment of proper information is responding in the way of new academic and research programs (Landon-Murray, 2016).

3.3. How Big Data Inflow into Practical Higher Education Structure

Researchers in other academic field have shown some interest in how the growing big data approach inflow into the higher education system for better institutional performance in different ways. This big data analytics based on the teaching and learning strategy to sustain innovative learning experiences to the students with a broader range of opportunities and provide useful guidelines for incorporating social interactions (Huda *et al.*, 2016). With the growing big data influences to both individuals and institutions, some risks from information ethics are still ongoing and it is required to protect actors involved in data mining (Johnson, 2014; Kalota, 2015). This makes the institutions maximize the potential benefits of big data within an organization and provide bigger opportunities to produce data-driven research and learning experiences. Recent Manohar *et al.* (2016) pointed out some advantages when the campus members consider using big data. They argue that this type of data analytics is helpful in predictive modeling for faculty, administrator and students groups who are investigating in a real figure of institutional actions or movements such as ranking, internal policy, and decision-making process. Prinsloo and Slade (2017) focus on the increase of student engagement, retention and success by the use of big data. The potential of learning analytics based on the big data provides the possibility to measure the student behaviors on campus and it intertwined with diverse social, political, economic and cultural information around them. The utilization of big data drag the connections into a set of reporting images for an individual student. This data enables the institution to make its responsive and sensitive student contexts more dynamic and multidimensional. Through the help of analytical modeling, the institution make the huge size of separate data into meaning information for top management and outlines future directions related to the implementation and development of diverse institutional projects (Santoso, 2017). The big data is useful the longitudinal analysis and diverse adjustment for different campus issues (Sigman *et al.*, 2014). As Gartner (2013) mentioned, "Big data is high volume, high velocity, and/or high variety information assets that require new forms of processing to enable enhanced decision making, insight discovery, and process optimization". Faculty save their troubleshooting time by technical abilities outside and gain a direction of better internal decisions as how to best educate students. The accumulated knowledge and broaden adoption of new technology create potential effective workers on campus and instructor easily trained well-prepared potential employees to society. One of higher education purpose is transforming (Tulasi, 2013) and the synergy in academy-industry strengthening the capabilities of sustainability for both fields that facing on unexpected challenges in the competitive market.

4. PROPOSED MODELING FOR BETTER INSTITUTIONAL EFFECTIVENESS

4.1. Foundation of Data-Driven Coherence

Understanding of data property. The adoption of big data is necessary to get a comprehensive combination of three stakeholders (student, faculty, institution) for a better institution and one of the preceding conditions is the understanding of data property. Different data sources reflect a diverse aspect of characteristics for the three entities and the data shows the specific property of the targeted group. In the process, it is important to clarify certain ways to explain the data gathering, such as how to collect the data, who to respond it, and what purpose the

data be organized. To be more specific, the big data is constructed by the intention of covering a more diverse, complicated situation and the detailed understanding of each data sources make the researchers handle the combined data linkages more easily. For the institution, the data property not only includes the traditional type of institutional indicators such as performance measure, financial aid policy, and reputation but also have invisible missions, goal, and long-term planning. For faculty, the big data approach imbues their traditional evaluation tools such as teaching, research, and service with interactions, collaborative works, and other potential local linkages. While the data property for students surely have traditional characteristics such as student engagement, academic performance, and student satisfaction, the one-step forwarded approach including tracking career path theirs after graduation, cost-benefit analysis from the educational investment are considered as one of the important indicators. After all, the big data adoption follows the meaning of traditional indicators and attached the new value of flexibility to meet diverse needs outside.

Handling for data measurement issues. When the researcher tries to connect the traditional role of existing data with new data sources, they are usually faced on conflicts. One of the frequent cases is changing the role of the existing indicator by new concepts of the data source. For example, the accessibility of higher education was one of the most important indicators to evaluate the institutional performance for a long time and the state government had supported the better accessible institutions through diverse financial resources. As time went on, the concept of accessibility has become more diverse and required to have different data resources including student social/economic capitals beyond traditional demographic backgrounds. The concept of college access is not only the accountability of college attendance at previous era but also generate other possibilities to reflect possible relevant components such as student background, local economy, community engagement at this time. The other representative issue in data handling is to convert the existing knowledge into an entirely new concept of information. The introduction of a new paradigm, theoretical development, and other distinguished empirical evidence accompany with the new change of concepts from data. While the huge size of data shows up rapidly, the foundation of academic support tend to be late and there are unavoidable time lags between two discrete periods. When the researcher considers the adoption of big data, they should be careful not to use immediately and just make sure to check the rationale behind this data use.

4.2. Networking Based on Different Sources

The decision of key indicators. Next step to create the conceptual framework based on the big data is to determine the representative indicators for better institutional effectiveness. For institution, the big data can indicate the two type of performance indicators; internal quality measure and external evaluation component. While a different type of internal surveys among campus members, college satisfactions from alumni, and peer evaluation of governance structure are more related to the internal quality measure, traditional performance variables such as graduation rate, retention, college reputation reflect more the views of outside. In this process, the big data have a role to buffer one of the performance indicators from adopting the other. For example, the detailed evaluations such as an additional measure of social network or employment outcome from graduates have a possibility to transfer the internal satisfaction to the external evaluation. For faculty and students, the most evaluation shows up in the learning process and the big data have a possibility to support their interaction from outside. Their performance indicators such as research activities or presentation experience measure their potential abilities to contribute to the entire level of institutional performance.

Representative scores. After the decision of key indicators, representative scores are created in terms of multidimensional aspects of the huge data gathering. At the institutional level, the representative scores should

provide information about their level of performance in terms of certain areas such as teaching, research, administration. At the individual level, the weighted scores have to represent the individual ability, satisfaction, and entire level of potential through the college education. Additional data for each level, create combined the representative score to reflect a broader range of performance measures. In the process, the created score has two functions: the recursive evaluation of current performance and the forecasting of potentiality.

4.3. Strategies for Enhancing Institutional Effectiveness

Collaboration between three main entities. Three entities-student, faculty, institution- contribute to the growth of entire institutional effectiveness. Big data play a role to link one entity with other functional characteristics and ultimately converged them into representative parts of core institutional value. The collaboration between the entities covers the two-direction of the combination as well as the circulation of all three entities. For the relationship between institution and faculty or students, the big data may narrow down some possible cognitive gaps that individual targeting does not match with the institutional direction for a long-term goal. For example, advanced big data show the campus members' behavioral characteristics, interests, and other preferences by using new type of data sources such as video, web-based communication, and other media. This helps institutional leader clarify the stream of campus members' intention and manipulate the organizational strategic planning to maximize internal resources for common goals.

Balanced data support. When the institutional leader considers using big data for enhancing institutional effectiveness, a balanced view is necessary to avoid any conceptual/theoretical bias. This affects the decision of weighted representative scores and classification of key indicators for the evaluation of entire institutional performance. The controlled variables include representative scores, key indicators, data size, and others. One of the important things, when the researcher set the controlled variables, is the consideration of each characteristic of data. The collected big data could come from more self-reported, institutional-oriented, or even mixed analytics. While the balanced weighted score is more related to the use of indicators to reflect individual characteristics of a targeted group, the balanced data use is relevant to choose how the researcher considers the methodology to generate the way of bug data use. In general, an acceptable range of data choice is to consider the availability of data validity from outside. Business, informatics, and other data-driven research field have developed a diverse standard of the assessment for data validity and higher education field may consider the advanced rule of data gathering.

4.4. Proposed Conceptual Model of Data Inflow for Better Institutional Effectiveness

Three entities' weighted score model for institutional performance. From the above discussion, this study proposed the conceptual model of data inflow for better institutional effectiveness in terms of certain evaluation standard [Figure 1](#). Based on the three entities (institution, student, faculty), the proposed model suggests how each stakeholder generates representative data in a certain way and how the relationship between entities has through their property. The rationale behind this mainly comes from the individual growing perspectives and planning through a college education. A goal of one entity may collaborate with others' intention and on the other hand, when they face on certain challenges, they can consider under contracts between them or cognitive buffering by themselves. While the relationship between individual and organization such as student-institution is more likely to be sustainable under clarified document or contract, the relationship between individuals more depends on the invisible components, such as attitude, perspective, and satisfaction. The big data support the importance of tricky invisible data collection and enforces the traditional role of existing performance indicators for three entities. When the researcher considers the triangle relationship between entities, one of the important things is to be careful the

interpretation of representative measurement score. The reciprocal interaction between two stakeholders mainly for the indicators of both contractors, not the third party's behavior. However, the interactions on campus are not isolated and may have multiple relevances with another measurement. In addition, one positive growth for an entity does not guarantee the entire level of the weighted score and may go through a complex process of investigation for ripple effect under big data adoption. The weighted score in entities indicated the comprehensive mean of each relevant behavioral information for institutional effectiveness and the complicated analysis and new methodologies are required to interpret it.

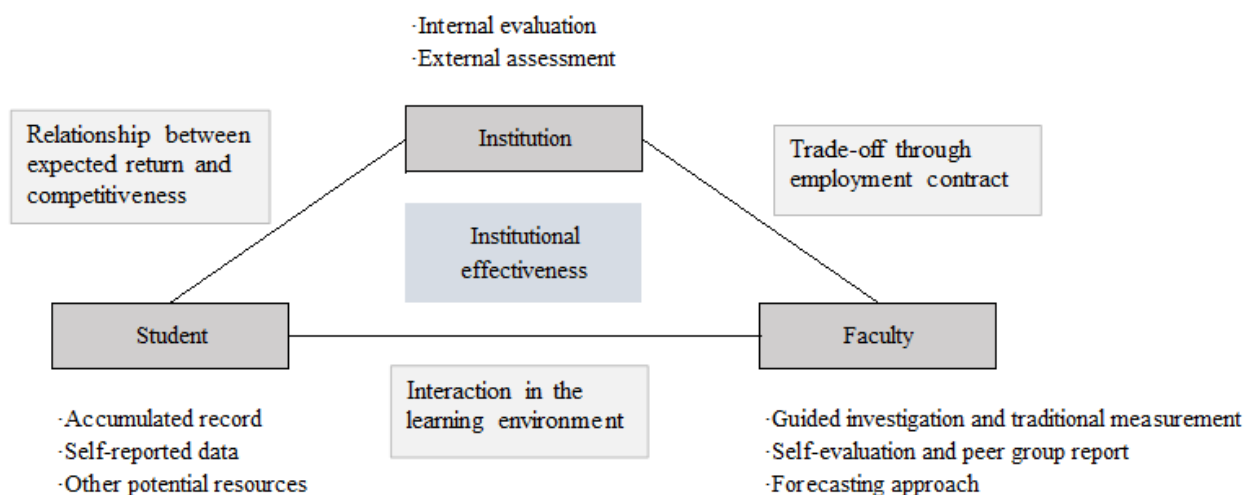


Figure-1. Three entities' weighted score model for institutional performance.

Guideline for properties of the targeted variable for institutional effectiveness. In order to respond to the proposed conceptual model, operational modeling is required. The targeted variables for institutional effectiveness provide the empirical evidence to support the proposed model directly and make sure why the proposed suggestion is reasonable. In this aspect, Table 1 shows representative variables to support the role of each entity's behavioral contribution for institutional effectiveness and generate possible combined weighted scores. First of all, the institution should consider two components of measures: a traditional approach of institutional effectiveness and collected information about campus members including student, faculty, and staff members. While existing data use traditional measures for each characteristic of well-known indicators, the newly adopted big data-driven approach requires a more comprehensive understanding for combining the weighted construct score of campus members. One of the possible suggestions for obtaining them is to consider the key indicator to bind different resources of each entity. An institution could categorize certain indicators by specific types such as research, curricular activity, and other external collaboration by campus members. Those variables are weighted according to a specific standard of evaluation based on organizational mission or targeted long-term goal and create the comprehensive weighted scores for institution sector. For campus members including students, faculty, and other staffs, there are two different types of indicators for their evaluation: internal review and external views. This reflects the characteristics of each variable. Internal review originally comes from the people within an institution and the review data is accumulated by their responses. On the other hand, the external views are calculated outside in terms of the perspective of the evaluators and it includes institutional reputation, assessment, and another external measurement. Based on the combination among the three entities, finalized weighted scores are consist of three measurement: internal agreement, external reputation, and sustainability. While the weighted score for internal agreement and

external reputation come from the relevant variables of each entity, the sustainability is relevant to flexible change outside such as economic fluctuation, government policy, and other externality.

Table-1. The weighted score of big data for institutional effectiveness.

Institution
·Traditional value of college indicators for institutional performance
·Faculty/staff evaluation based on new standard
·Student support measures
Student
·Objective measures (background, performance, etc.)
·Subjective indicators (satisfaction, engagement, etc.)
·Linkages with campus members
Faculty
·Productivity/contribution for institution
·Peer evaluation and internal activity
·External collaboration and community engagement
Combined property
·Internal agreement
·External reputation
·Sustainability

5. DISCUSSION

5.1. Summary

Internal collaboration: campus-driven data collection. This study proposed the conceptual model to use the big data for institutional effectiveness in the higher education system and focus more on the collaboration between three entities as a first step. The collaboration is not only for a merged dataset for common targeting but also includes a comprehensive understanding of each role. In addition, reciprocal exchanges between two entities are based on each need and networking with relevant internal functions. Most internal collaboration within the institution is considered as one of the important big data collections and cross-checking between campus members and a certain level of internal evaluation is essential to increase the entire level of institutional effectiveness. The collected internal data drive the institution to help to clarify their institutional mission and future direction for organizational growth by generating the endogenous efforts within the institution.

External lens: evaluation and expectation. While the internal efforts to use the big data contribute to boosting the institutional effectiveness, the consideration of external lens including physical, psychological aspects of evaluation and expectation also play a role to increase the institutional effectiveness. The learning analytics based on the big data changes the behavior of society in general and the potential students generate how to look the higher education system and how to manage habits of the daily lives in a different way (Moreira *et al.*, 2017). Through the adoption of big data, the external stakeholders can overview the real figure of institutional behavior under broadening range of indicators and this drives the researchers to another interpretation of the same situation. As Ong (2016) points out, big data analytics can provide unique and valuable insights into diverse higher education issues including student admission, engagement, and retention. Additionally, he emphasizes on the importance of behavioral analytics for expanding social, economic and cognitive dimensions of the institution based on the big data analytics. This consideration of externality should accompany with the strategic planning to handle the big data alignment, knowledge management, and business process transformation to help the organizational leadership and governance.

5.2. Study Limitation

Empirical back-up to have the rationale. One of the limitation to create the conceptual model for institutional effectiveness based on big data is to collect the empirical evidence for the reasoning of certain data sources. Although the diversity of data sources may extend the possible explanation of certain characteristics for institutional indicators, there is rare evidence of broadly accepted justification. In other words, it requires to have a proven standard of evaluation for each data to convert them into the real information. The use of big data for institutional effectiveness is a brand-new concept in the higher education field and tend to borrow certain knowledge and skills from other advanced academic fields such as business, informatics, and computer engineering. The adoption of different concepts or notion from outside should be careful to avoid distortion of real educational meaning and in this aspect, the foundation of rational choice for each data collection is important. The flexible higher education environment requires to have time-sensitive learning analytics application for the diversity of emerging student groups and the utilization of information are moving into the more extensive and interchangeable figures for audiences (Picciano, 2012). This data-driven decision making on campus should identify and evaluate the property of targeted indicator and could be a part of the possible suggestion to make better institutional effectiveness.

Potential matching the traditional measures with a new type of data. Another possible limitation is the difficulty of matching the different type of data for common institutional goal. While the proposed model suggests the possible property of indicators and characteristics, there is no clear description of how the potential conflicts from the difference of data property. For obtaining better institutional effectiveness, the institution should consider the intersection of big data, advanced analytics, college administration, and data-related ethical reflection is essential (Willis *et al.*, 2013). Eventually, an institution has a burden to manage the diverse type of college indicators as well as to balance the weights of three entities' contribution. In the meantime, taking a proper theoretical lens enforces the institutional decision for their goal and allow researchers to explore more the nuanced metrics of complex learning processes on campus (Wise and Shaffer, 2015). The mixed approach to finding the linkage between new values of variable and traditional indicators are important to back up the conceptual model in this study.

5.3. Further Research Direction

Growth of big data enable many fields to broaden their researches, experiments, and other possible applications. Even though there are rare studies about the data adoption in higher education field, The practical implement and utilization provide diverse opportunities to reform traditional role of existing college indicators. Institution could use the big data for their own intention and the possible applications are required to have certain supports such as institutional policy, data-relevant standards of institution, and other internal agreement among campus members. In this aspect, the investigation for development of supportive internal, external policy to extend current big data adoption for higher education could be considered for one of further research themes.

In addition, the data collection issues should be examined for better institutional performance based on big data. The human being have developed their intellectual abilities and have tried to meet practical needs through diverse activities such as invention and the new technologies, AI, and other advanced skills and knowledge have increased their role though the accumulated efforts of human being. While the human being has some limitation of research activity at some point, the ability of new technology also limited adoptions for bunch of different fields. The foundation of clarified standards for the utilization of big data may help the researchers to save their resources and to avoid redundant boring tasks or limited data access.

While the big data may clarify the complex measurement issues, individual characteristics of different college indicators, and other campus relevant issues with their specialty, they have a possibility to hamper us from capturing of real value for the current situation. The point is, people are constantly distracted-by concept of big data such as news and different communication entrances and they are always struggling to keep up with others and they easily forget to communicate with themselves. So, they sometimes lost sight of who they are, what they want and what they need. In this aspect, the clarification of purpose when researcher consider using the big data is really important and one of the key prerequisite to examine the big data in higher education would investigation of several conditions to narrow the range of big data in certain purpose and further research would consider the precondition at the initial stage.

REFERENCES

- Baig, A.R. and H. Jabeen, 2016. Big data analytics for behavior monitoring of students. *Procedia Computer Science*, 82: 43-48. Available at: <https://doi.org/10.1016/j.procs.2016.04.007>.
- Bihl, T.J., I.W.A. Young and G.R. Weckman, 2016. Defining, understanding, and addressing big data. *International Journal of Business Analytics (IJBAN)*, 3(2): 1-32. Available at: <https://doi.org/10.4018/ijban.2016040101>.
- Cope, B. and M. Kalantzis, 2016. Big data comes to school: Implications for learning, assessment, and research. *AERA Open*, 2(2): 2332858416641907. Available at: <https://doi.org/10.1177/2332858416641907>.
- Cukier, K. and V. Mayer-Schoenberger, 2013. The rise of big data: How it's changing the way we think about the world. *Foreign Aff*, 92(28): 1-10.
- Daniel, B.K., 2017. Big data in higher education: The big picture. In *big data and learning analytics in higher education*. Switzerland: Springer International Publishing. pp: 19-28.
- Dede, C.J., P. Mitros and A.D. Ho, 2016. Big data analysis in higher education: Promises and pitfalls. *Educause Review*, 51(5).
- Drigas, A.S. and P. Leliopoulos, 2014. The use of big data in education. *International Journal of Computer Science Issues*, 11(5): 58.
- Duan, Y., G. Cao, V.K. Ong and M. Woolley, 2013. Big data in higher education: An action research on managing student engagement with business intelligence.
- Gartner, 2013. IT glossary – crowdsourcing. Available from <http://www.gartner.com/it-glossary/crowdsourcing>.
- Gibson, D.C. and D. Ifenthaler, 2017. Preparing the next generation of education researchers for big data in higher education. In *big data and learning analytics in higher education*. Cham, Switzerland: Springer, International Publishing. pp: 29-42.
- Huda, M., M. Anshari, M.N. Almunawar, M. Shahrill, A. Tan, J.H. Jaidin, S. Daud and M. Masri, 2016. Innovative teaching in higher education: The big data approach. *TOJET*.
- Johnson, J.A., 2014. The ethics of big data in higher education. *International Review of Information Ethics*, 21(21): 3-10.
- Kalota, F., 2015. Applications of big data in education. *International Journal of Social, Behavioral, Educational, Economic, Business and Industrial Engineering*, 9(5): 1602-1607.
- Landon-Murray, M., 2016. Big data and intelligence: Applications, human capital, and education. *Journal of Strategic Security*, 9(2): 92-121.
- Manohar, A., P. Gupta, V. Priyanka and M.F. Uddin, 2016. Utilizing big data analytics to improve education. *ASEE*, 4(1): 1-23.
- Moreira, F., M.J. Ferreira and A. Cardoso, 2017. Higher education disruption through IoT and big data: A conceptual approach. *Learning and Collaboration Technologies. Novel Learning Ecosystems, Part I, LNCS 10295*. pp: 389- 405. Available from https://doi.org/10.1007/978-3-319-58509-3_31.
- Ong, V.K., 2016. Business intelligence and big data analytics for higher education: Cases from UK higher education institutions. *Information Engineering Express*, 2(1): 65-75.

- Pawełszek, I. and J. Wiczorkowski, 2015. Big data as a business opportunity: An educational perspective. In 2015 Federated Conference on Computer Science and Information Systems (FedCSIS). IEEE. pp: 1563-1568.
- Picciano, A.G., 2012. The evolution of big data and learning analytics in American higher education. *Journal of Asynchronous Learning Networks*, 16(3): 9-20. Available at: <https://doi.org/10.24059/olj.v16i3.267>.
- Pike, G.R., 1996. Limitations of using students' self-reports of academic development as proxies for traditional achievement measures. *Research in Higher Education*, 37(1): 89-114.
- Prinsloo, P. and S. Slade, 2017. Big data, higher education and learning analytics: beyond justice, towards an ethics of care, in Kei Daniel, B. (Ed.), *Big Data and Learning Analytics in Higher Education*. Cham: Springer. pp: 109-124.
- Santoso, L.W., 2017. Data warehouse with big data technology for higher education. *Procedia Computer Science*, 124: 93-99. Available at: <https://doi.org/10.1016/j.procs.2017.12.134>.
- Sigman, B.P., W. Garr, R. Pongsajapan, M. Selvanadin, K. Bolling and G. Marsh, 2014. Teaching big data: Experiences, lessons learned, and future directions. *Decision Line*, 45(1): 10-15.
- Tulasi, B., 2013. Significance of big data and analytics in higher education. *International Journal of Computer Applications*, 68(14): 21-23. Available at: <https://doi.org/10.5120/11648-7142>.
- Vaitsis, C., V. Hervatis and N. Zary, 2016. Introduction to big data in education and its contribution to the quality improvement processes. In: Ventura SS (Ed.). *Big Data Real-World Appl. InTech*. pp: 41-64.
- Vollenbroek, W., K. Jägersberg, S. De Vries and E. Constantinides, 2014. Learning education: An educational big data approach for monitoring, steering and assessment of the process of continuous improvement of education. In *European Conference in the Applications of Enabling Technologies*, 20: 21.
- Wassan, J.T., 2015. Discovering big data modelling for educational world. *Procedia-Social and Behavioral Sciences*, 176: 642-649. Available at: <https://doi.org/10.1016/j.sbspro.2015.01.522>.
- West, D.M., 2012. Big data for education: Data mining, data analytics, and web dashboards. *Governance Studies at Brookings*, 4(1): 1-10.
- Willis, J.E., J.P. Campbell and M.D. Pistilli, 2013. Ethics, big data, and analytics: A model for application. *EDUCAUSE Review Online*.
- Wise, A.F. and D.W. Shaffer, 2015. Why theory matters more than ever in the age of big data. *Journal of Learning Analytics*, 2(2): 5-13. Available at: <https://doi.org/10.18608/jla.2015.22.2>.

Online Science Publishing is not responsible or answerable for any loss, damage or liability, etc. caused in relation to/arising out of the use of the content. Any queries should be directed to the corresponding author of the article.