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Combining Key Performance Indicators and Signs of Changes in Students to Improve the Quality of Education in Institutional Research based on Eduinformatics

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Abstract

In recent years, most Japanese universities have started to operate departments of institutional research (IR). In IR fields, Key Performance Indicator (KPI) is important to evaluate the quality of education. Eduinformatics, a novel interdisciplinary field proposed by us, provides good analyses that will help us to solve educational problems. This paper emphasizes that we have to consider whether the evaluation of KPIs is the best method to check the quality of education in universities. We discuss the problem of evaluating KPIs to check the quality of higher education and suggest that we have to recognize and understand the limitations of evaluating KPIs. We propose that it is better to evaluate the combination of both KPIs and signs of changes in students to improve the quality of education.

Keywords: Institutional Research (IR), higher education, Eduinformatics, Key Performance Indicators (KPI)

1 Introduction

In recent years, most Japanese universities have started to operate departments of institutional research (IR) because of the request by Ministry of Education, Culture, Sports, Science and Technology (MEXT)[1]. In particular, private universities directed to begin IR activities by comprehensive support projects aimed at the reform of private universities[1]. In the U.S.A., Prof. Joe Saupe published the article "The functions of institutional research" in 1981, in which IR was defined as follows, "Institutional research is research conducted within an institution of higher education to provide information which supports institutional planning,

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policy formation, and decision making" [2]. Therefore, in the U.S.A., research on IR started 40 years ago.

To perform university reform in Kobe Tokiwa University, we established a team called "Significant Other Groups (SOGRs)" comprising students, graduate students, and third parties. In 2020, we presented our report on a new visualization of competency-based education (CBE) in IR of higher education[3]. The combination of SOGRs and the new visualization led to the new visualization of learning outcomes of students in Kobe Tokiwa University [4]. This result initiated the second university reform in Kobe Tokiwa University.

About five years ago, a novel interdisciplinary field called "eduinformatics" was introduced by us [5]. This word combines the fields of both education and informatics. We show the concept of Eduinformatics in Figure 1 [6]. We incorporated not only the relationship between Eduinformatics and information and communications technology (ICT) [7][8], but also the relationship between Eduinformatics and digital transformation (DX) [9]. We reported the importance of Eduinformatics with a specific usage example and developed new informatics analytical methods to solve educational issues [7][8][9]. Moreover, we proposed new analysis methods called feasibility-sustainability analytics (FS Analytics) to improve sustainability in IR [10] and reported some practical findings of FS analytics [11].

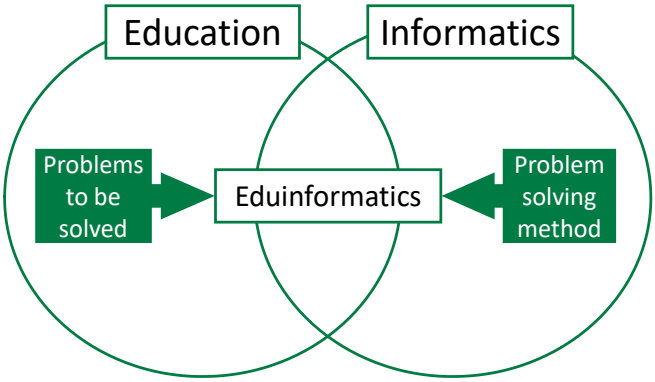

Figure 1: Concept of eduinformatics (from [5])

2 Key Performance Indicator in IR and Higher Education

In IR fields, there are many Key Performance Indicators (KPI) [12]. A book [12] introduced 139 KPIs in IR fields. IR is primarily composed of three fields: enrollment management IR, research IR, and management IR. Actually, we developed some novel KPIs for enrollment management IR and visualization methods to evaluate the quality of education in higher education [3][13][14][15]. In higher education, evidence-based evaluation or improvement is very important. Therefore, eduinformatics is useful to analyze education data. In particular, we developed new KPIs for learning outcomes of students based on CBE in Kobe Tokiwa University[3], aimed at university reform.

When we developed these new KPIs in 2020, our primary aim was to use them for IR research. Therefore, we did not consider providing these new KPIs to students in order to enable them to understand their learning outcomes on their own. However, MEXT directed universities to provide learning outcomes that included not only grades, but also many activities such as internship, studying abroad, and so on when students pursue higher education. Moreover, in MEXT nomenclature, this portfolio was labelled as a diploma supplement.

We tried to use the new KPIs and visualization of new KPIs for the diploma supplement. However, it is difficult to use it as a diploma supplement [16]. Kobe Tokiwa University conducted 19 Tokiwa competencies (Table 1)[17]. In the syllabi, teachers show the relationship between their classes and 19 Tokiwa competencies. However, some of the Tokiwa competencies did not show the syllabi in whole classes and missed data analysis [16]. This result shows that it is difficult to evaluate the quality of education using KPIs such as Tokiwa competencies.

We evaluated the quality of education for both first year education [18] and "culture and art" in liberal arts[19]. We analyzed reports of students by quantitative text analysis or text mining that has developed rapidly of late. The data for both studies were visualized by keyword analyses (cooccurrence network). These studies led to new evaluation methods, in this case text mining and cooccurrence network, and KPIs in IR to evaluate the quality of higher education [20].

This paper emphasizes that we have to consider whether the evaluation of KPIs is the best method to check the quality of education in universities. We discuss the problem of evaluating KPIs to check the quality of higher education and suggest that we have to recognize and understand the limitations of evaluating KPIs. We propose that it is better to evaluate the combination of both KPIs and signs of changes in students to improve the quality of education.

Table 1: Competencies from the Student Handbook of Kobe Tokiwa University from [17]

Abbreviated Name of Competency	**Competency**
1. Culture	Ability to use liberal arts as the foundation of human nature, which can involve a variety of people
2. Common Sense	Ability to behave sensibly and show sound judgment in practical matters
3. Professionalism/Expertise	Having the necessary knowledge and skills to perform the duties of each profession
4. Media Literacy	Ability to collect, organize, and analyze necessary information from various media sources for proper thinking and judgment
5. Logical Thinking	Ability to consider situations logically based on evidence.
6. Critical Thinking	Ability to have a multilateral, critical perspective that can grasp and consider various ideas
7. Intellectual Curiosity	Ability to be curious, to learn and remember things, and to have fun and take pleasure in learning
8. Exploration	Ability to think deeply about things and methods
9. Continuity	Ability to maintain a consistent stance on issues and act knowledgeably and thoughtfully
10. Self-Management	Ability to manage one's physical and mental health appropriately
11. Reflection	Ability to continually seek ways to improve oneself by reflecting on one's thinking and behavior
12. Design Thinking	Ability to design solutions and develop comprehensive knowledge
13. Presentation	Ability to appropriately communicate one's personal feelings and thoughts to others
14. Judgment	Ability to make appropriate decisions given the circumstances, based on valid information and sound thinking
15. Implementation	Ability to take specific actions based on one's feelings and thoughts and without fear of failure
16. Responsibility	Ability to behave and face things responsibly as a member of society
17. Contribution	Ability to feel happy for others and take actions that are useful for others
18. Communication	Ability to listen to others' opinions, without which it is impossible to have a creative dialogue
19. Cooperation & Collaboration	Ability to set aside personal and individual interests to work together harmoniously

3 Results and Discussions

The United Nations Educational, Scientific and Cultural Organization (UNESCO) proposed "three layers of learning analytics" in a report on learning analytics in 2012 [21] (Figure 2). We show the definition of three layers in Figure 1 from [21].

In the meso level, we show the new evaluation methods using text mining and co-occurrence network in the previous section. In this section, we show two examples of the problems of evaluation using KPI to improve the quality of higher education.

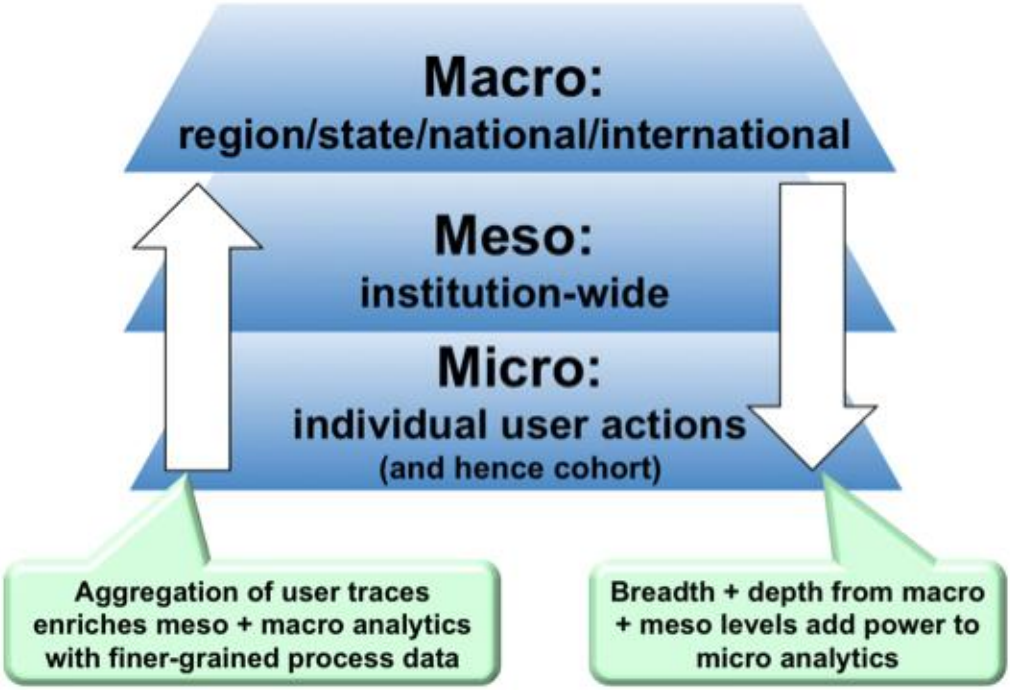

Figure 2: Layers of Learning Analytics from UNESCO IITE, Learning Analytics from [21]

The first example is that we use the self-efficacy scale for students. About 10 years ago, we organized a special training program to teach crisis response among students in Kobe Tokiwa university. The program had three steps. In the first step, students learned about a particular disaster. In the second step, students gained a detailed understanding of the disaster. During the third step, students could try to help someone or teach them about a disaster. These classes were called Nagata and disaster I, II, III (NDI, NDII, NDIII). Nagata was one of most severely damaged places during the Great Hanshin-Awaji Earthquake of 1995. Kobe Tokiwa University is located in the Nagata ward.

Over the course of NDI to NDIII, we employed the generalized self-efficacy scale for Japanese [22] among students. The concept of self-efficacy was first proposed by Prof. Albert Bandura in 1977 [23]. This scale is the central concept in social learning theory or social cognitive theory [23]. The self-efficacy scale was developed by Prof. Mark Sherer *et al.* in 1982 [24]. Prof. Kenichi Narita *et al.* developed generalized self-efficacy scale for use in the Japanese context in 1995. We used this self-efficacy scale.

We employed the generalized self-efficacy scale six times: before NDI, after NDI, before NDII, after NDII, before NDIII, and after NDIII. The average of the generalized self-efficacy of students slightly decreased (data not shown) [25]. We formulated a hypothesis to increase the generalized self-efficacy of students because the program had a positive effect on students. However, the data showed the opposite result.

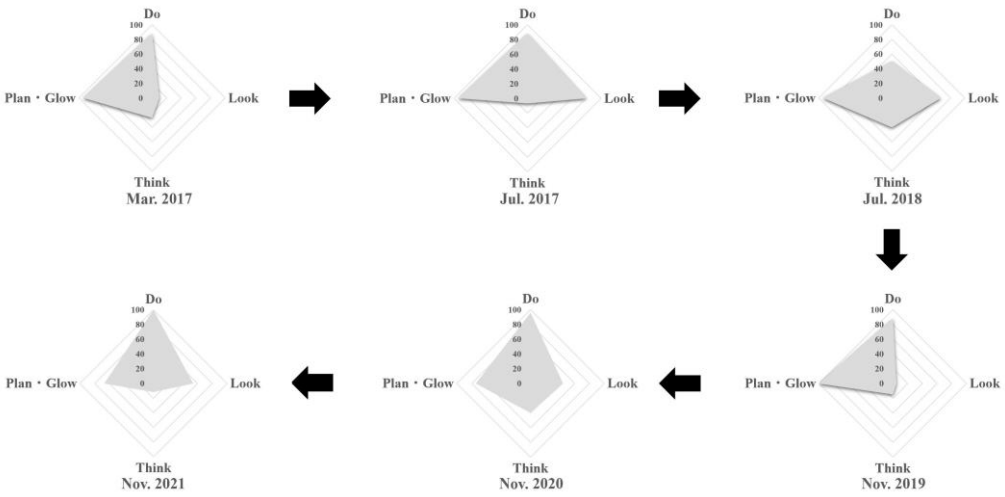

Figure 3: The style of your learning scale of the same person.

The second example is a result of "the style of your learning" scale that was provided by the Press Time Company [26]. This scale was employed in the first-year program "Manaburu" in Kobe Tokiwa University in 2017 [18]. Figure 3 shows the results of one person.

When students answered nine questionnaire items and calculated them, they could obtain four values: Do, Look, Think, and Plan・Glow. The values of these items show that students prefer them when they learn something. Figure 3 shows that the results of an individual changes over the course of time.

The result of the first example may seem counterintuitive because we expected that the more students understood the content of the course, the higher their self-esteem scores would be. However, the early increase of their self-esteem may have occurred due to the Dunning–Kruger effect [27] and the late decrease could have been caused by the impostor syndrome [28].

The Dunning–Kruger effect hypothesizes that individuals with low ability tend to overestimate their ability. This appears to be similar to the cognitive process of the students who were in an early phase of understanding the course. It is possible that they may have made errors regarding self-evaluation during the early phase.

The impostor syndrome is the feeling when successful individuals do not appreciate their own competency due to fears of criticism or rejection. The students may be in such a situation during the later phase of the course because they have obtained an accurate self-evaluation due to a detailed understanding of the course.

The first example shows that the self-evaluation data (in this case, scale) includes positive

(Dunning–Kruger effect) or negative (impostor syndrome) errors. These errors can not only occur in the scale of evaluation, but also between consciousness and physical movement. It is important to eliminate various sensory deviations that the learner experiences to achieve skill acquisition in sports. The reduction of the deviations between the consciousness of the learner and actual movement of the learner is the task of the coach or teacher [29][30].

The second example shows that the evaluation result of a scale (in this case, shape of square) is differs over time even for the same individual. In particular, when students or teachers use rubrics to evaluate the effect of learning, the second case has serious problems. This happens because rubrics are generally defined through small sentences, but evaluation includes positive or negative errors when students self-evaluate.

Which evaluation is better? From the result of example 2, the evaluation value of scale differs over the course of time even for the same individual. In these situations, it is difficult to discuss the value of self-evaluation.

Therefore, it is important to understand the limitation of evaluation through KPIs and it is clear that KPIs include errors. Moreover, we have to understand that it is more important to understand the signs of changes than evaluation values.

4 Conclusion

In higher education, IR is important to improve the quality of higher education. Key Performance Indicators (KPI) are important to evaluate the quality of education. This paper emphasizes that we have to consider whether the evaluation of KPIs is the best method to check the quality of education in universities. We discuss the problem of evaluating KPIs to check the quality of higher education and suggest that we have to recognize and understand the limitations of evaluating KPIs. We propose that it is better to evaluate the combination of both KPIs and signs of changes in students to improve the quality of education.

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