

Multi-layer and Multi-level Dynamic Evaluation System for Teachers' Data Literacy Ability

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Abstract: This paper establishes a dynamic evaluation model of teachers' data literacy ability by building three levels of indicators and seven characteristics, namely, Data Awareness Literacy, Data Knowledge and Cultural Literacy, and Data Technology Literacy. In addition, the data literacy is divided into four levels of ABCD, pointing out the specific requirements of different levels, and introducing a dynamic weight matrix into the model to build a complete multi-level dynamic evaluation model of teachers' data literacy ability.

Keywords: Data Literacy, Dynamic Evaluation, Multi-level Indicators.

1. Introduction

With the advent of the era of big data, traditional education and online education are seamlessly connected, the status of big data in the field of higher education has become more and more important, and the ability of data literacy has increasingly become the basic ability in various fields today. Therefore, the construction of data literacy ability evaluation system has become a topic that emerges as the times require in the era of big data. At present, many researchers have conducted in-depth research on such issues.

At present, many developed countries have begun to pay attention to the development of teachers' ability to use data to improve teaching, and put forward a variety of views on the concept and connotation of data literacy. Put the model into practice.

American scholars Mandinach and Gummer put forward the concept of Data Literacy for Teachers (DLFT), starting from the aspect of data-guided teaching practice, which is defined as "teacher converts information into actionable teaching knowledge by collecting, analyzing and interpreting various types of data. and practical competencies to help define instructional steps"[1]. The ABS model was proposed in 2015 [2]. The Australian Bureau of Statistics believes that all practitioners should have data statistics ability, so the ABS evaluation model is designed to evaluate data statistics ability. The model has three levels of evaluation indicators, which are evaluated from the statistical context, the statistical process corresponding to each statistical context, and the specific capabilities required in the statistical process. The DWIP model [3] developed by Harvard University in the United States is a relatively mature big data teaching model. The model consists of 3 stages and 8 steps to help teachers better identify students' needs and adjust teaching plans in a timely manner. It is a self-evolving model. In addition, Mandinacci proposed the "continuum from data to knowledge" model [4], which is also a relatively complete model.

2. Evaluation Model Establishment

The improvement of data literacy is not achieved overnight, and requires continuous training, self-training, and gradual

improvement. In order to improve the effect of teachers in colleges and universities in stages, teachers' literacy ability must be divided into multiple levels. How to divide the levels, what data skills teachers are required to master at each level, and how to build an evaluation model.

(1) Level division

The evaluation indicators of data literacy ability are divided into three levels, that is, three-level indicators are used for evaluation. The three-level indicators are: Data Awareness Literacy(I_1), Data Knowledge and Cultural Literacy(I_2), and Data Technology Literacy(I_3). Data knowledge and cultural literacy include: Data Ethics Legal Knowledge(I_{21}), Data Acquisition Knowledge(I_{22}) and Data Tool Knowledge(I_{23}). Data technical literacy includes: Data Integration Ability(I_{31}), Data Mining Ability(I_{32}), Data Application Ability(I_{33}) and Data Evaluation Ability(I_{34}). The structure diagram of the evaluation index system is shown in Figure 1.

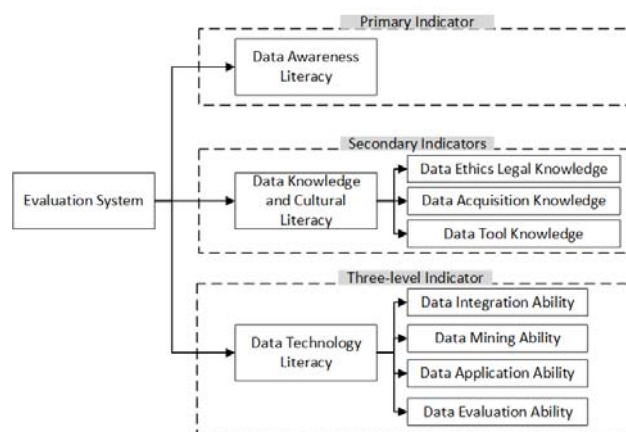


Figure 1. The Structure Diagram of the Evaluation Index

(2) Explanation of indicators

The three-level indicators of data literacy capabilities are

from the shallower to the deeper: the first-level indicator data awareness is the basic condition for improving data literacy capabilities; the second-level indicators show teachers' basic understanding of data and the basic ability to use data tools, including moral and legal knowledge. Constraints on the

basic bottom line of data use; the third-level indicator data technical literacy is the deepest level, showing teachers' full mining and application of data. The detailed index explanations are shown in Table 1.

Table 1. Explanation of Indicators and Characteristics

Level	Level Interpretation	Feature	Feature Explanation
Primary Indicator	The basics of data literacy		
Secondary Indicators	Basic understanding of data and basic use of data tools	Data Ethics Legal Knowledge	Whether the data is used flexibly and safely within the scope permitted by law, and the data information is effectively protected
		Data Acquisition Knowledge Knowledge of Data Tools	Whether to learn to obtain data, such as through APP or learning platform, etc. Do you have some data acquisition or processing tools, such as spss, python
Three-level Indicator	Data mining and application	Data Integration Capabilities	Whether it is possible to organize the existing data in hand and eliminate useless data
		Data Mining Capabilities	Whether it is possible to use data mining technology to mine the integrated effective data and extract knowledge
		Data Application Ability Data Evaluation Ability	Whether the results of data mining can be used in practical applications Whether it is possible to establish a model to evaluate the existing data

(3) Establishment of multi-level dynamic evaluation system

This model uses the scoring method to achieve the purpose of evaluating teachers' data literacy ability through scoring. The full score of the three indicators is 100 respectively, and the full score of each feature within the indicator is also 100. Because teachers at different levels have different requirements, in order to achieve the purpose of multi-level and multi-level dynamic evaluation, the model sets up the weights between different three-level indicators, and realizes dynamic evaluation through weight changes. The specific explanation of the model is given below.

If the total scores of the first, second and third level

indicators are S_1 , S_2 and S_3 respectively, and the weights are ω_1 , ω_2 and ω_3 respectively, the final total score:

$$S = \sum_{i=1}^3 S_i \omega_i \quad (1)$$

S_2 is composed of three parts and S_3 is composed of four parts. The operation mode of the scoring system is shown in Figure 2.

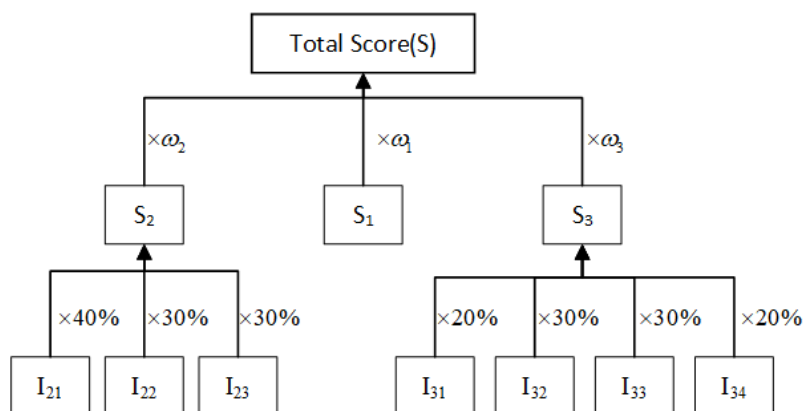


Figure 2. The Operation Mode of the Scoring System

(4) Classification of teachers' quality and ability

Because different teachers have different fields of knowledge and teaching methods, it is necessary to divide the level of teachers in order to get a better evaluation and enable

them to improve their data literacy ability step by step. In this model, teachers' quality and ability are divided into four levels of A,B,C,D, and the requirements and weights of the four levels are shown in Table 2.

Table 2. Weights and Requirements

Grade	ω_1 ω_2 ω_3	Requirements for Teachers
D	[0.5,0.3,0.2]	Teachers are required to have the awareness of data literacy and understand the importance of data in the teaching process
C	[0.4,0.3,0.3]	Teachers are required to have basic cognitive and processing abilities on data
B	[0.3,0.3,0.4]	Teachers are required to skillfully use data and master data mining knowledge
A	[0.2,0.3,0.5]	Teachers are required to make full use of data, combine data with teaching, and evaluate data to truly achieve data based teaching

3. Conclusion

Based on the analysis of the research status of other university teachers' data literacy, combined with the survey results of our university teachers' data literacy ability, this paper digs out the core elements of university teachers' data literacy ability; Further use the scoring method to build a multi-level dynamic evaluation system of teachers' data literacy ability; With regard to data literacy capabilities at different levels, it is hoped that teaching and self can be adjusted in time through evaluation results to achieve the goal of continuous improvement of data literacy, so as to adapt to the arrival of the big data era.

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