

Design of a personalised learning evaluation model of an *e-schoolbag*, based on big data

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ABSTRACT: In the era of e-learning, evaluation for knowledge development is not only present in the evaluation process, but also in the learner's individuality. In this study, the author has first analysed the modules of educational big data in an e-schoolbag and, then, designed a personalised learning evaluation model. The model of personalised learning and an evaluation system has been designed by adopting the instrument and method of big data technology, in an effort to provide a theoretical guidance for a systematic design and development.

INTRODUCTION

Evaluation of learning is one of the most important processes of teaching and learning in the classroom. The evaluation content and how to undertake evaluations, have strongly influenced the teaching process [1]. In an era of e-learning, evaluation of knowledge development not only presents the evaluation process itself, but should also be a reflection of the learner's individuality. The essence lies in the learner's individual interaction via the available technology. In recent years, an e-schoolbag in which students can *carry*, so to speak, one by one e-learning and ubiquitous learning is widely applied in primary and secondary schools of different regions [2].

The appearance of e-schoolbag can not only support students in establishing personal e-learning space and learning activities, but it can also record students' personalised learning behaviour. The serialised record of this learning behaviour constitutes the big data of e-schoolbag. By adopting the instrument and method of big data technology, these data will make a learner's individual evaluation possible.

Such a type of personalised evaluation, based on educational big data can not only guarantee objectivity, but can also facilitate the scientific way of learning evaluation, as well as identifying the complete status of learning activity and mission according to each student's character and learning behaviour. In this way, it will be easier for the teachers to have insight into each student's thoughts and readjust their teaching method accordingly.

THE CONTENT CONSTITUTION AND ANALYSIS OF EDUCATIONAL BIG DATA IN E-SCHOOLBAG

Module Constitution and the Relation with Big Data Technology

With the rapid extension and convergence of datasets in recent years, big data have become a research front from data science [3]. It is mainly composed of three technology trends: 1) mass transaction data: in the system of on-line transaction processing and analysis from ERP (enterprise resourcing planning) application program to data warehouse application program, traditional relational data, as well as semi-structured and non-structured information is still on the rise; 2) mass interactive data: it is mainly composed of social network sites, microblogs, community forums, etc; and 3) mass data processing: the emergence of big data creates a platform for processing intensive data.

For example, Apache Hadoop (an open source software framework), with an open source code, can be used to conduct distributed processing on mass data in a reliable and scalable way. Big data covers content of four modules: data acquisition, data storage (including data index, storage, sharing and archiving), data analysis (including data cleaning and processing) and data application. The relationship between of each the module is shown in Figure 1.

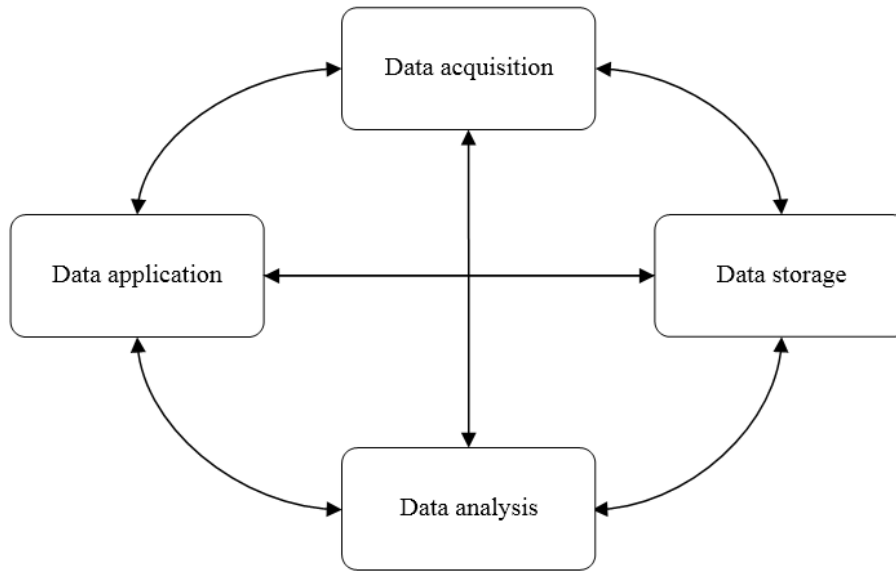


Figure 1: Module constitution and relation of big data technology.

Real-time processing can be adopted on data as big data are characterised by quantisation, diversification and rapidity. Hence, the relation between each module not only includes the progressive relation from data acquisition to data application, but covers the interaction and feedback relation between two modules.

Analysis of the Module Content of Educational Big Data

According to the module constitution of big data technology and based on the system and function included in the e-schoolbag, the module content of educational big data of is analysed from the microcosmic perspective.

Analysis of the Data Acquisition Module

The acquisition of educational big data of e-schoolbag mainly comes from data acquisition, multi-perception data and real-time sensor data. The way of acquisition and software support are shown in Table 1.

Table 1: Analysis of the content of data acquisition module.

Acquisition category	Ways of acquisition	Software support
Data acquisition	Key logger, auto click typing, touch screen capturer	Monitoring software, Web site track, mobile terminal application
Multi-perception data	Visual detection, gravity sensor, remote video interaction	Camera, interactive communication, telepresence system
Real-time sensor data	Real-time positioning data, real-time image display, real time feedback	GPS, image sensor, intelligent network

In terms of data capturing, the educational cloud service platform of e-schoolbag can capture a student's learning behaviour when he/she operates different terminals. Such data include data generated when a student uses an input device, such as a mouse and keyword on a desktop computer or laptop, as well as data produced by using touching operations in a tablet PC and a smart phone.

In terms of multi-perception data, the camera shooting and response functions of e-schoolbag are applied to record a student's external behaviour. Remote video interactive data are formed when the student uses interactive communication software and preferential data held by students, when they use mobile terminal are included.

In terms of real-time sensor data, an e-schoolbag positioning system and a sensor are adopted to record a student's activity, and the data obtained from the record is the real-time feedback data generated, when students engage in social activity on a mobile terminal.

Analysis on Data Storage Module

After collecting various educational big data from multi-aspects, when a student uses the e-schoolbag, data storage is needed from aspects, such as data service, data management, platform management and cloud computing. Ways of storing data and providing service support are shown in Table 2.

Table 2: Analysis of data storage module content.

Storage category	Way of storage	Service support
Data service	Platform data service, software data service, terminal equipment data service	Study management system
Data management	Data index, data warehouse, data retrieval and navigation	Electronic learning portfolio database
Platform management	Usability, expansibility, quantum computing	Educational cloud service platform
Cloud computing	Private cloud, public cloud, mixed cloud	Hadoop distributed file system

In terms of data service, it is required that a storage service be provided for the data from the educational cloud service platform, data from various teaching and learning software, and data from terminal equipment. In terms of data management, index, retrieval and navigation can be made on data through the e-learning portfolio system. In terms of platform management, the educational cloud service platform should be adapted to different terminal systems, and rapid calculations should be applied to various data. In terms of cloud computing, data can be stored as private cloud, public cloud and mixed cloud, etc, and the Hadoop distributed file system can be used to distribute data.

Analysis of Data Analysis Module

In the data analysis module, correlation analysis, mode identification, predictive analysis and text mining are adopted for analysis and exploration. The analysis method and tool support are shown in Table 3.

Table 3: Analysis of the content of data analysis module.

Analysis category	Analysis method	Tool support
Correlation analysis	Association rules analysis, sequence nodal analysis, social network analysis	SSAS, UCINET
Mode recognition	Data modelling, analogue simulation, topology analysis	MATLAB, Stprtool
Predictive analysis	Decision-making tree, regression analysis, timing analysis	SSAS, WEKA, SPSS
Text mining	Text clustering, viewpoint analysis, concept excavation	RapidMiner, ICTCLAS

In correlation analysis, co-occurrence relationships that appear in a certain space at the same time and the sequence relation that generates from a certain time period can be explored. By adopting association rules mining and sequence mode mining, relevant rules can be excavated from the learning behaviour sequence which will be generated when a learner uses the e-schoolbag. While showing what knowledge point the student is learning, it also presents the students with other knowledge points that they have learnt, as well as the learning content they browse during the learning process, and the relationship between the learning activities they participate in and learning results.

In terms of mode recognition, the learner's image, voice and communication can be recognised and analysed through data moulding, analogue simulation and topology analysis. In this way, intelligent automatic processing and interpretation can be realised. In terms of predictive analysis, according to the known record formed in the student's learning process, decision-making tree, regression analysis and timing sequence can be adopted to predict the learner's study achievement. In terms of text analysis, text clustering, concept excavation and document abstract are adopted to excavate a large number of collections generated by the learner. The module can discover the process implied with the knowledge and understand student's knowledge level and option orientation.

Analysis of Data Application Module

The result of data analysis is decided and applied by data application module. Its application category, application content and system support are shown in Table 4.

Table 4: Analysis of the content of data application module.

Application category	Application content	System support
Learning analysis	Set up learning portfolio, learning behaviour modelling, intelligent assessment feedback	Electronic learning portfolio system
Personalised service	Personalised learning solution, personalised learning assessment, personalised learning resource recommendation	Learning management system
Data-based decision making	Readjust teaching target, implement intervention management, carry out after-class remediation	Teaching management system

In terms of learning analysis, the student's course learning record file, knowledge point and complete status of homework can be found in the electronic learning portfolio system of e-schoolbag, and intelligent assessment and feedback can be made to learners. In terms of personalised service, based on the analysis of the individual learning behaviour data generated in the learning management system, it can provide a learner with personalised learning solutions according to their learning conditions, and make personalised evaluations of their learning results. Finally, it can provide personalised learning resource recommendations according to the evaluation result. Based on the decision-making of data and analysis of the data of a student's learning process and results, the teacher can improve a student's learning effect by adjusting the teaching target, implementing teaching intervention management and carrying out after-class remediation in the teaching management system.

It can be seen from module information analysis of educational big data from the e-schoolbag that a large amount of big data information with low value density can be recorded by the e-schoolbag. Hence, to realise an effective personalised learning evolution, evaluation point of information should be extracted from mass database information before it can evaluate the learning behaviour data generated from the e-schoolbag.

PERSONALISED LEARNING EVALUATION MODEL OF E-SCHOOLBAG

To realise personalised evaluation based on educational big data, evaluation should be based on the evaluation content. Thus, it will be completed by setting up a personalised evaluation model. A personalised learning evaluation model carries out personalised learning activity and confirms the evaluation point of information through personalised learning activity conducted by the e-schoolbag. By analysing the content of learning links and learning activity supported by the e-schoolbag, as well as arranging and classifying the system function of different e-schoolbags, one can subdivide and cluster the learning content of an e-schoolbag's learning management system, and construct a personalised learning evaluation model (as shown in Figure 2).

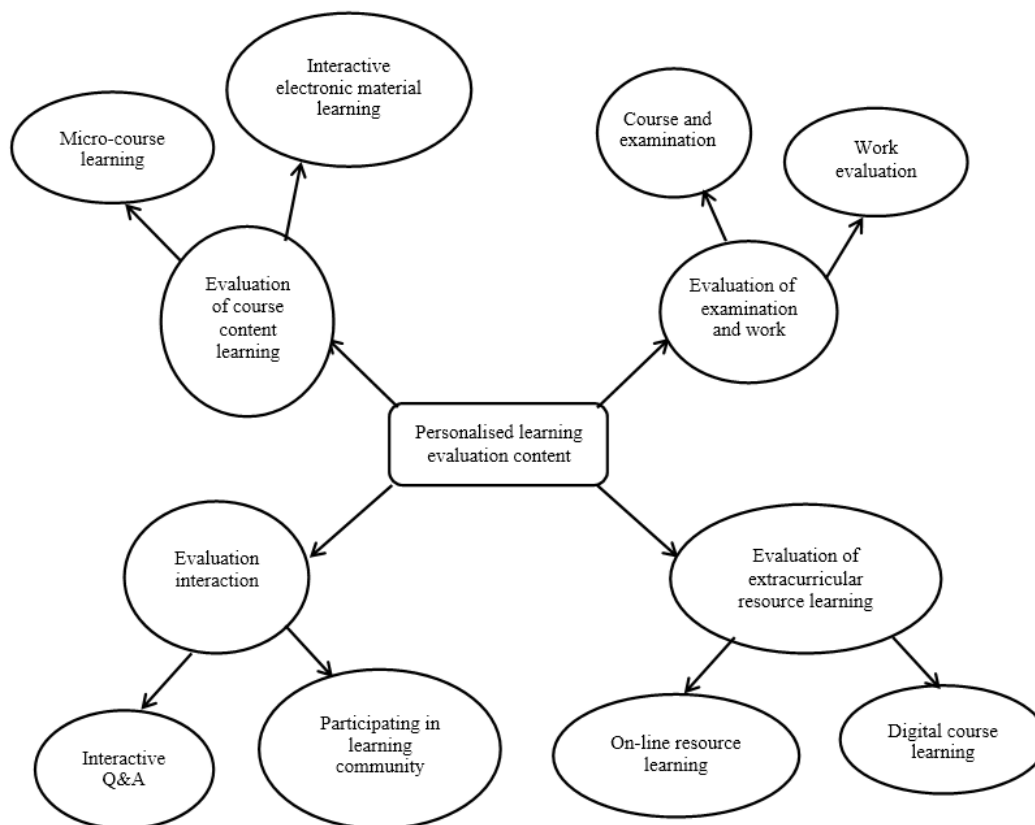


Figure 2: Personalised learning evaluation model based on the electronic schoolbag.

The content of this model includes evaluation on course content learning, evaluation on interaction and analysis, evaluation on examination and learning, and evaluation on extracurricular resource learning. The evaluation process of the model can be divided into a student's formal learning and their informal learning. The evaluation content includes evaluation of disciplinary knowledge and non-disciplinary knowledge, and the evaluation method covers quantitative evaluation and qualitative analysis.

Evaluation of Course Content Learning

Evaluation of course content learning refers to evaluation of the knowledge point of a unit that the learner studies from the learning management system of the e-schoolbag. Interactive electronic learning material learning and micro-course

learning are included. Such learning behaviour data evaluation information is recorded and analysed by the course content database of the personalised evaluation system. In terms of the study module of electronic material, the learner's evaluation point includes learning hours, knowledge points that have been learned, times of learning knowledge point, learning notes and content, etc. In terms of the micro-course learning module, evaluation is made of the micro-video learning hours, complete status of various micro-video learning interactions and times of playing the videos.

Analysis of Evaluation of Participating Interaction and Analysis

The analysis of evaluation of participating interaction refers to carrying out an analysis evaluation of the learner's condition of answering questions in class and on the interactions after class. Interactive question-answering and participating learning community are included. The evaluation information of such learning behaviour data will be recorded and analysed by the interactive data of the personalised evaluation system. In terms of the interactive question-answering module, the learner's evaluation point includes questions released and answered by the student inside the question-answering room, the number of questions with a detailed inquiry, the number of questions selected and the number of questions with high quality answers. In terms of the learning community, evaluation will be made on the number of exchange topics the learner participated in, the number of messages posted, as well as the number of essence posts.

Evaluation of Examination and Learning

Evaluation of examination and learning refers to evaluating the student's exercises and unit examinations, as well as the learning work done after class based on the program. Course examination evaluation and learning work evaluation are included. The data evaluation information of such learning behaviour is recorded and analysed by the examination and work database of the personalised evaluation system. In terms of the evaluation and examination module, the learner's evaluation point includes scoring of objective questions and subjective questions from the student's homework exercises and examinations. More specifically, objective questions include statistics of correct knowledge points and error knowledge points, as well as the difficulty of the questions. The subjective questions mainly review a student's scoring of certain knowledge groups and integrity of contents. The work evaluation module is divided into individual work evaluations and group work evaluations, among which evaluation is made of the performance and content design of individual works, while in group work, a student's degree of participation, contribution of achievement, problem solving, as well as the collaboration and communication among team members, will be taken into consideration. Thus, evaluation is made not only based on the student's subject knowledge, but also on their program procedural knowledge.

Evaluation of Extracurricular Resource Learning

Evaluation of extracurricular resource learning mainly refers to evaluating the course extension resources that the learner learned during the non-formal study process. It includes evaluation of digital course learning and on-line resource learning. Such learning behaviour data evaluation information will be recorded and analysed by the extracurricular resource learning database of the personalised evaluation system. In terms of the evaluation module of digital course learning, the evaluation point of the learner includes the knowledge point of books that the student has read, video course he/she has played and exercise results of on-line items. In addition, on-line resource learning is divided into on-line reading and resource downloading. In terms of on-line reading party, evaluation is made on how many times the student browses on-line learning documents and the number of remarks they make. In terms of resource downloading, the times of browsing, favourites and downloading of learning resources will be taken into consideration.

CONCLUSIONS

Personalised learning evaluation is an important part of digital learning processes, while the development of e-schoolbag and appearance of educational big data make the evaluation of personalised learning possible. This study probed into the module of educational big data of e-schoolbag, and constructed an e-schoolbag, based on a personalised learning evaluation model.

In the next move, this research will endeavour to improve and optimise the personalised learning evaluation model. Research design and development on personalised evaluation system should be applied to an experimental school for practice and feedback, so as to further improve the accuracy of the system.

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