

# The Development of an e-Workload Distribution System: A Focus on the Fair Distribution of Teaching Workloads of Lecturers

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**Abstract:** Studies have shown excessive teaching workloads of teachers and lecturers have become a contentious issue in the academic realm, making them physically and emotionally strained. Therefore, this study was carried out to develop a workload distribution management system called *e-WLOAD* to help the management of universities in distributing workloads that are fair and acceptable to all lecturers. In this study, the researchers used the Evolutionary Prototyping method for the development of *e-WLOAD*. A series of interviews involving a head of a department, a faculty dean and an academic registrar as well as the analysis of the Academic Workload Guidance Document of the Malaysian Qualifications Agency (MQA) and the academic Annual Performance Assessment Report were carried out to reveal the relevant criteria for the distribution of lecturers' workloads, namely Status, Minimum and maximum credits, Lecturer classification, Current Teaching Status, and Teaching Load Requirements. After running the system, the results of the functionality test indicated that the prototype had fulfilled all system requirements successfully based on such distribution criteria.

**Keywords:** Evolutionary Prototyping, Lecturers' teaching workloads, Workload distribution criteria, Workload distribution system

## 1. Introduction

The human resource management of an institution is defined as a complex activity that needs to be handled transparently, efficiently, and fairly by administrators (Rusnock & Borghetti, 2018). Specifically in the educational sector, the distribution of teaching workload is one of the most important activities that needs to be carefully carried out by the management of educational institutions to ensure teachers, instructors, and lecturers can discharge their duties efficiently, which surely can lead to the development quality students (Awanis, Ainon Madiah & Siti Nor, 2016; Nugraha, Triyanto, Arifin, Rahayu, 2019). Hence, there is a pressing need to put in place a system that can help the management to fairly distribute teaching workloads of their academic staff, the failure of which can give rise to many issues, such as dissatisfactions or frustrations. Against this backdrop, this study was carried out to develop and test a workload management system to distribute lecturers' teaching workloads by taking into account various factors (such as existing workloads, allocated teaching times, expertise, experiences, and the difficulty of contents).

In this preliminary case study, the researchers developed a prototype of such a system to help the management of a university to efficiently and fairly distribute teaching workloads of lecturers, which would be similar to those of primary education. Relevant, important criteria stipulated by the university directive and Code of Practice for Programs Accreditation (COPPA), such as the status of lecturers, minimum and maximum credits, expertise classification, current teaching status, and departmental teaching needs, were factored in the development of the proposed prototype based on the Evolutionary Model. From the practical and psychological perspectives, the use of this prototype could help the university management to distribute teaching workloads more fairly among lecturers that effectively can help them to teach more effectively, potentially helping to improve teaching efficacy.

The remaining discussion of this paper is organized into several sections. Section 2 presents the background of the study. Section 3 highlights the research objectives and the methodology used in system development. Section 4 discusses the findings in relation to specific research objectives, highlights the conclusion, and suggests further studies.

## **2. Background of Study**

Globally, technological advancements have drastically impacted almost every aspect of human life, encompassing a wide spectrum of sectors, including economics, social, and education. Notably, in education, a myriad of technological tools or applications have been employed to improve every aspect of education, especially teaching and learning. Admittedly, educational institutions, such as universities, are facing numerous, complex issues in running their organizational operations, entailing all the stakeholders to effectively address each issue. For example, many university lecturers have been voicing their dissatisfactions over their teaching workload, alleging that they have to teach too many courses or to handle too many classes. Consequently, they will have little time to focus on their other duties, such as carrying out research, writing and publishing academic papers, and providing consultations to other agencies (Steenkamp & Roberts, 2020).

Ideally, lecturers must be assigned with manageable, flexible teaching workloads to ensure they can also perform other important (non-teaching) tasks without too much of a burden. Thus, it is important to distribute teaching workloads among lecturers transparently using acceptable criteria lest there will be dissatisfaction or allegation of unfairness (Azita, 2012; Arzizul & Dg Norizah, 2018). The fair distribution of teaching workloads should not be treated lightly as too much work that can lead to a myriad of physiological and emotional problems, such as anxiety or depressions, which on a long term can adversely affect the teaching and learning process, compromising the reputation and productivity of educational institutions (Azita, 2012; Arzizul & Dg Norizah, 2018; Erdogan & Topuz, 2020). A case in point is exemplified by findings by Saporita Sipon (2007) and Bowden & Green (2019) who found too much teaching workload resulted in negative, uncondusive working environments, making teachers unwilling to do extra work.

Research by Inegbedion, Inegbodion, Peter & Harry (2020) which focused on workload balance and employee satisfaction stated that “organisations should constantly review workload balance as a matter of priority concern in their organisations”. Therefore, based on Inegbedion et al. (2020) findings and the above mentioned researches, there is a need for a tool that can assist the management team of any organisation to provide recommendations towards fair distribution of workload, based on specific requirements that are identified from the targeted users.

## **3. Methodology**

In this study, the researchers used the Evolutionary Prototyping for the development of an electronic workload management system called e-WLOAD to help the management of universities in assigning fairly balanced teaching workloads to lecturers. Therefore, the main objective of the study is to develop a prototype of a workload management system (e-WLOAD).

The study done by Anjum, Azam, Anwar & Amjad (2019) had discovered that evolutionary prototyping technique for the main requirements of users which can be used to develop various software systems. In addition, it can also overcome weaknesses in other self-generated or manual prototyping. Essentially, the Evolutionary Prototyping method consists of two cycles or iterations, as shown in Table 1, with each cycle consisting of five processes, namely requirement analysis, data collection, system

design, system development, and testing.

**Table 1.** The Evolutionary Prototyping methodology

Cycle / phase	Cycle 1	Cycle 2
<b>System requirements analysis</b>	The identification of the criteria for distributing the workloads of lecturers through interviews and document analysis.	The collection of system requirements for lecturers and courses modules.
<b>Data collection</b>	The collection of data related to lecturers' teaching workloads (7 years), courses, and programs; information on lecturers' 5P; the processing, cleaning, benchmarking, and validation of data; and the collection of data samples.	
<b>System design</b>	A preliminary experiment of several algorithms, the design classification of courses, lecturers, and workload distribution, and database design.	The design of system interfaces and components, and the improvement of the database.
<b>System development</b>	The developments of a classification and workload generation engine and database.	The overall development of the system (prototype); involving all the essential components based on GUI and the improvement of the database.
<b>Testing</b>	The testing of the classification and workload generation engine using data samples for the improvement of the prototype.	System testing involving functionality test, test-case and user testing.

#### 4. Findings and Discussion

For this paper, the discussion of the findings only focuses on the system requirements analysis phase, development phase and the testing phase, involving the functionality test of the system prototype.

##### 4.1 System Requirements Analysis: The Criteria for the Distribution of Lecturers' Workload

The feedback elicited through a series of interviews involving a head of a department, a faculty dean and an academic registrar as well as the analysis of the Academic Workload Guidance Document (issued by the Malaysian Qualifications Agency or MQA) and the academic Annual Performance Assessment Report (known as LNPT) helped reveal the relevant criteria for the distribution of lecturers' workloads as follows:

###### 4.1.1 Status

This criterion highlights available lecturers who will be assigned appropriate teaching

workloads. In contrast, lecturers who are on study leave, unpaid leave, or maternity leave will be deemed unavailable for teaching assignments.

#### 4.1.2 Minimum and maximum credits

Each lecturer will be assigned a maximum limit of eligible teaching credit based on his or her position at the departmental, faculty, or university level.

#### 4.1.3 Lecturer Classification

This criterion refers to the teaching expertise of lecturers in various disciplines or fields. The classification process is based on lecturers' academic qualifications, expertise based on the focus of specific research and publications, teaching experience (teaching frequency for a particular course), Special Interest Group (SIG), and development training, and courses attended. The use of this criterion helps ensure lecturers will only be assigned courses that are related to their expertise. The category classification of courses and lecturers used in this system is based on the Computing Classification System recommended by the Association Computing Machinery (ACM), 2012 (The ACM Digital Library, 2012).

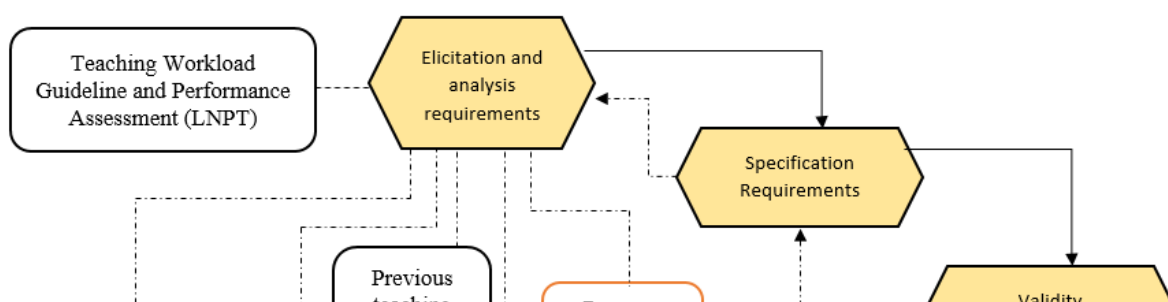
#### 4.1.4 Current Teaching Status

This criterion refers to the current credit and type of current program offered.

#### 4.1.5 Teaching Load Requirements

This criterion highlights the number of courses and classes required for a particular semester.

The researchers used the Requirement Engineering Strategy to generate the System Functional Requirements (Suliana, Rohaizah, Asma & Marzita, 2019), which effectively helped address the system requirement analysis phase. In principle, such a process consists of three sub-processes as follows: (a) Elicitation and Requirement analysis using documents and interview evaluation techniques, (b) Specification Validation, and (c) Development of Requirement Specifications (Udousoro, 2020; Pandey, Suman & Ramany, 2010). From the perspective of data processing, such a process helped the researchers to generate detailed system's functional requirements (as illustrated in Figure 1 and Table 2).



**Fig. 1 The Requirement Engineering Strategy of e-WLOAD**

(Suliana Suliana et al, 2019)

**Table 2.** System requirements and descriptions of e-WLOAD (Suliana et al, 2019)

<b>System requirement</b>	<b>Requirement Description</b>
<b>Requirement 1: Workload schedule generation</b>	Generate a workload schedule for a designated semester.
<b>Requirement 1.1: System input validation</b>	Confirm the code of a list of courses entered is valid and non-overlapping, and the codes of the number of lecture groups included (value > = 1) as well as the semester code are not past codes (sem code > current sem code).
<b>Requirement 1.2: Assignments of lecturers with appropriate courses.</b>	Assign individual groups of lectures with appropriate courses.
<b>Requirement 1.2.1: Course designation based on the priority of important courses.</b>	Designate a lecturer with a course based on its level of importance and his/her teaching experiences.
<b>Requirement 1.2.2: Formation of lecturers based on specific fields</b>	Determine that a designated lecturer has expertise in the same field of the course program.
<b>Requirement 1.2.3: Formation of lecturers based on specific experiences</b>	Determine that a lecturer assigned with a course or other related courses of the same category has sufficient relevant teaching experiences.
<b>Requirement 1.2.4: Formation of lecture groups based on credit loads.</b>	Assign the exact number of lecture groups to lecturers based on a current credit balance without exceeding the maximum teaching credit load.
<b>Requirement 1.3: Formulation of workload schedule</b>	Develop a lecture workload schedule for lecturers for a current semester based on selected criteria.

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<b>Requirement 1.3.1: Formation of lecture groups based on semester</b>	Ensure all courses assigned to lecturers are in the same or related semester. For example, bachelor's degree (A) and master's degree (M) courses for semesters 141, 141S, 142, and 142S are in the same group while diploma (E) courses 141, 141S, and 142 are in another group.
<b>Requirement 1.3.2: Balanced teaching credit load per semester</b>	Balance the current amount of credit loads for all lecturers by group. For example, lecturers with administrative posts will have a balance of 3 -6 credit load hours as opposed to regular lecturers with 9 – 12 credit load hours. If the majority has a credit load of 10 hours, then all the lecturers in the same group will be assigned ten (10) credit load hours.
<b>Requirement 1.4: Display of a current workload schedule.</b>	Display the complete lecture workload schedule and courses offered to users.
<b>Requirement 1.5: Update of workload schedule</b>	Update all information based on the changes made by users on a workload schedule.
<b>Requirement 2: Recommendation of lecturers for administrative posts. For departmental administrative tasks</b>	Recommend a list of qualified lecturers for administrative posts as an input.
<b>Requirement 2.1: Selection of lecturers based their expertise in specific fields.</b>	Select a list of lecturers with relevant expertise, SIG, academic qualifications, research experience, and courses in the same or related fields.
<b>Requirement 2.2: Selection of lecturers based on the criteria for workload credit.</b>	Filter a list of selected lecturers based on their workload credit of administrative tasks.
<b>Requirement 2.3: Compilation of recommendations based on priority.</b>	Rank results based on priority over expertise or workload score.
<b>Requirement 2.4: Display of the results of recommendations.</b>	Display a list of lecturers qualified for a specified task.
<b>Requirement 2.5: Assignment of lecturers with administrative tasks.</b>	Update the system with information on the selection of a particular lecturer by a user for a specific task.

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#### **4.2 System Development Phase: The Prototype of Workload Distribution System (e-WLOAD)**

Essentially, the prototype of the Workload Distribution System (e-WLOAD) were done based on functionalities listed in System Requirement Diagram (Use Case Diagram) in Figure 2. Therefore, the snapshots of e-WLOAD presented in Figure 4 to Figure 9, are the sets of expected outputs for this prototype. Figure 3 shows the entity-relationship diagrams of the database, respectively. In general, e-

WLOAD has three main menus, namely Lecturers, Courses, and Schedules menus. The Lecturers and Courses menus, are management menus that carry out the manipulation functions of lecturers' general data and coursework, such as creating, accessing, deleting, and updating information. For example, new course data entered onto the system will be classified based on relevant categories (e.g., programming, data management, mathematics, etc.) and related status (major, minor, general, or elective). Finally, based on the input and several distribution criteria set up between the Lecturer and Courses module, the Schedules menu has a key component that assigns lecturers with teaching assignments or work load specifically on teaching (Figure 9).

#### 4.3 Testing phase: Functionality Test of Workload Distribution System (e-WLOAD)

As stated by Kumar (2019) which focuses his research's article on design and functionality testing, whether the quality factors chosen are Functionality, Engineering or Adaptability, this software testing approach can provide users about the quality of the service and to certify that the list of features to be successfully operated.

Table 3 shows the summary results of the functionality test which indicated the prototype had fulfilled all system requirements successfully. Prototype Functionality Testing were done based on functionalities listed in System Requirement Diagram (Use Case diagram) in Figure 2.

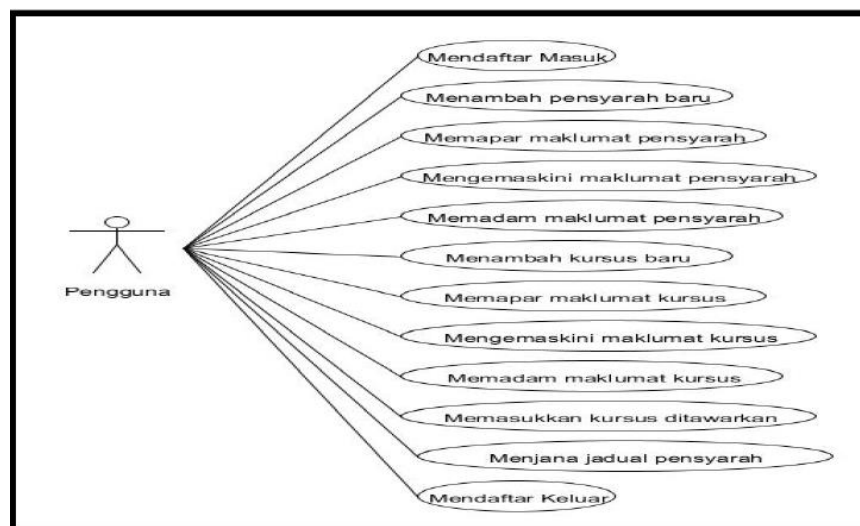


Fig. 2 System Requirement Diagram (Use Case Diagram)

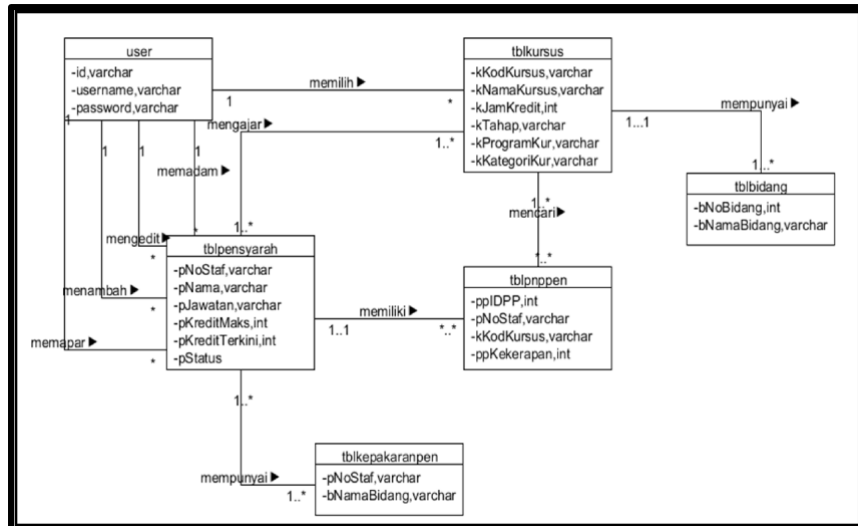


Fig. 3 The Entity-Relationship diagram

**SISTEM AGIHAN BEBAN TUGAS PENSYARAH**

ID PENGGUNA :

KATA LALUAN :

Fig. 4 A snapshot of Function “Mendaftar masuk / Logging in”

**SISTEM AGIHAN BEBAN TUGAS PENSYARAH**

Menu

- Pensyarah
  - Senarai Pensyarah
  - Pendaftaran Pensyarah
- Kursus
- Jadual

**DAFTAR KELUAR**

KEMASKINI MAKLUMAT PENSYARAH

No Staf :

Nama :

Jawatan :

Jam Kredit Wajib :

Jam Kredit Terkini :

Status :



**Fig. 5** A snapshot of Function “Mengemaskini maklumat pensyarah / Updating lecturer’s information”

No Staf	Nama Pensyarah	Jawatan	Jam Kredit Muat	Jam Kredit Tindakan	Status	Tindakan
K00090	Puan Noriza binti Nayan	Pensyarah Kanan	12	0	Aktif	Edit   Padam
K00168	Tn. Hj. Md Zahar bin عثمان	Pensyarah Kanan	12	0	Aktif	Edit   Padam
K00329	Dr. Azniah binti Ismail	Pensyarah Kanan	12	0	Aktif	Edit   Padam

**Fig. 6** A snapshot of Function “Memadam maklumat pensyarah / Deleting lecturer’s information”

MAKLUMAT KURSUS

Kod Kursus :

Nama Kursus :

Jam Kredit :

Peringkat :

Program Kursus :

Kategori Kursus :

**Fig. 7** A snapshot of Function “Menambah kursus baru / Adding a new course”

Kod Kursus	Nama Kursus	Jam Kredit	Peringkat	Program Kursus	Kategori Kursus	Tindakan
GRU6014	Educational Research Methods	4	MSC	MSC	Penyelidikan	Edit   Padam
GRU6024	Analisis Varians Multivariat (MANOVA)	4	MSC	MSC	Penyelidikan	Edit   Padam
KPD3026	Pengajaran, Teknologi Dan Penaksiran 2	6	Deg	AC10	Pendidikan	Edit   Padam

**Fig. 8** A snapshot of Function “Memapar maklumat kursus / Displaying the information of a course”

Bil.	Kod Kursus	Nama Kursus	Kumpulan	No. Staf	Nama Staf	Beban Kredit Terkini
1	MKN1023	Komunikasi Data	2	K02667	Dr. Abu Bakar bin Ibrahim	6
2	MKS1073	Asas Pengaturcaraan Objek	1	K01146	Dr. Shamsul Arrieya bin Ariffin	12
3	MKS1103	Asas Pengaturcaraan	3	K01146	Dr. Shamsul Arrieya bin Ariffin	12
4	MKA2013	Kompetensi Teknologi Maklumat Dan Komunikasi Digital	4	K01139	Dr. Hafizul Fahri bin Hanafi	12

**Fig. 9** A snapshot of Function “Menjana jadual beban tugas pensyarah / Generating lecturers workload schedule”

Table 3 Summary of Functionality Test Results (based on Fig. 2)

	<b>Fungsi / Function</b>	<b>Keputusan / Result</b>
1	Mendaftar masuk / Logging in	Lulus / Passed <input type="checkbox"/>
2	Menambah pensyarah baru / Adding new lecturer	Lulus / Passed <input type="checkbox"/>
3	Memapar maklumat pensyarah / Displaying lecturer’s information	Lulus / Passed <input type="checkbox"/>
4	Mengemaskini maklumat pensyarah / Updating lecturer’s information	Lulus / Passed <input type="checkbox"/>
5	Memadam maklumat pensyarah / Deleting lecturer’s information	Lulus / Passed <input type="checkbox"/>
6	Menambah kursus baru / Adding a new course	Lulus / Passed <input type="checkbox"/>
7	Memapar maklumat kursus / Displaying the information of a course	Lulus / Passed <input type="checkbox"/>
8	Mengemaskini maklumat kursus / Updating information on a course	Lulus / Passed <input type="checkbox"/>
9	Memadam maklumat pensyarah / Deleting lecturer’s information	Lulus / Passed <input type="checkbox"/>

10	Memasukkan kursus ditawarkan / Entering offered courses	Lulus / Passed <input type="checkbox"/>
11	Menjana jadual pensyarah / Generating lecturer's schedule	Lulus / Passed <input type="checkbox"/>
12	Mendaftar keluar / Logging out	Lulus / Passed <input type="checkbox"/>

For the preliminary prototype of e-WLOAD, testing phase involved functionality testing by using unit test, test script and distributed post-task questionnaires. The functional unit testing process involved five general steps. First, the process started with identifying functions that are to be performed. Based on e-WLOAD's use case diagram presented in Figure 2, there are twelve main functions that are tested. Secondly, all the functions are tested by creating input data based on the specifications of functions. Parallel to that, the third step of the testing process involved determining the output based on the specifications of functions. The fourth step took the testing process into executing the test cases, where finally the cases assisted the tester to compare the actual and expected output. In addition, the testing process also involved sets of interview sessions using distributed post-task questionnaires respectively to the dean, head of department, assistant registrar and two lecturers in this targeted faculty which is Faculty of Art, Computing and Creative Industry, Universiti Pendidikan Sultan Idris. However, this article summarized all the findings in the testing process, into Table 3 on Summary of Functionality Test Results, based on twelve main functions in e-WLOAD.

## 5. Discussion

Basically, the key findings of this study was successfully achieved, which focused on development of a workload distribution management system called e-WLOAD to help the management of universities in distributing workloads that are fair and acceptable to all lecturers. The timeframe for designing and developing this first e-WLOAD prototype, with its basic testing, was adequate for reaching a satisfactory functionality of the end product.

However, there are two limitations and challenges that can potentially be improved for the next version of this e-WLOAD. Firstly, this e-WLOAD only focused on one main commitment of a lecturer which is teaching. Therefore, the next version should include other lecturer's commitment and factors affecting their work performance which are on skills of writing articles for publication, discussing ideas with other academies or industrial partners for collaboration as well as community services, and also psychological empowerment towards affective commitment in all tasks (Muda and Fook, 2020; Aziz, Seman, Hashim, Roslin, & Ishar, 2019). Secondly, the next focus of this study should be on further functionality testing processes by comparing the findings based on different functional testing tools such as Selenium, QTP, JUnit, SoapUI and Watir. Similar to what had been carried out by Kumar (2019), the next study of e-WLOAD also can focus on details of functionality analysis of every main function. The findings can be presented based on every step in the functional unit testing process, which may include test case reports and different views of testing and validation results.

## 6. Conclusion

Potentially, the use of the e-WLOAD will not only assist in solving complex human resources management issues but also provide greater satisfaction for lecturers through the distribution of courses according to their expertise and experience with suitable, fair average credit load per lecturer. Being assigned with a reasonable number of courses as prescribed by COPPA guidelines, lecturers will surely be able to teach more effectively as they will have sufficient time to prepare their lecturers and attend to students' needs. Likewise, having additional time can help them focus on other academic responsibilities, namely research, consultation, and publication, which collectively have a major impact on their career advancements. Thus, such a novel system should be featured as another important tool in the existing management's suite of applications to help administrative officials distribute teaching workloads that are acceptable to all.

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