# Supporting e-Learning with Intelligent Features

## Abstract

In part 1 [...], we introduced an adaptive e-Learning model that utilized different information systems for different e-Learning functionalities. In this paper, we introduce innovatively intelligent features in e-Learning systems to empower our adaptive e-Learning model. Presented intelligent services are categorized into two categories based on their aim to be: Instructor services, and student services. Instructor intelligent services are: Intelligent Time-to-Learn Topic Calculator, Intelligent Study Plan Advisor, and Intelligent Learning Objects (LOs) Advisor. Student intelligent services are: Intelligent Agenda Study Time Planner, Intelligent Meeting Manager for Suspended Students, and Intelligent Los Recommender.

## Introduction

Three different learning models are: traditional, distance, and blended learning. Depending on the type of learning provided in the educational institution, different scenarios for intelligent features can be presented. There are always doubts in students’ capabilities in identifying their learning path. The same shortage was found in intelligent systems capability to identify personalized learning paths without the need for instructors. Our proposed model presents different intelligent features in supporting curriculum sequencing technologies to present adaptive group e-Learning that is fine-tuned by instructor.

Pre-assumptions of our proposed blended e-Learning model are:

* Students are grouped. Each group is delimited by the same start date. Student who don’t catch this start date, are delayed to the next group which is 15 days later.
* Learning goals are identified by instructors. Based on those learning goals, instructors define learning paths through Intelligent Study Plan Advisor. However, in this phase intelligent service is only advisory for the instructor.
* Intelligent time to learn topic calculator is the service that is used to advise instructor about the time needed for this group of students to study certain topic. Based on the time taken to study previous topics, and the available Los for this topic, this service can intelligently advise instructor with this issue.
* Students attend one or more adaptive online lecture within the same learning goal. Adaptive online lecture make use of the intelligent adaptive online lecture LOs advisor to recommend LOs for the instructor to use during the lecture based on students learning profiles.
* Intelligent Los recommender is the intelligent service that will recommend Los for students based on their learning profiles. Recommended Los list is approved by instructor. Recommended Los list is then reordered based on students’ preferences.
* Intelligent agenda study time planner is used to help students organize their time table and organize different activities. This agenda doesn’t just identify study times; however it also considers time for activities and hobbies.
* Learning path is marked by different learning checkpoints. At each checkpoint, students attend an online exam. Students who pass will continue the learning path, but those who don’t will re-attend the exam within 4 days. If they don’t pass again, they re-attend the exam within 2 days. If they don’t pass, they are suspended.
* Suspended students drop behind their group. Intelligent meeting manager for suspended students is the service responsible for managing a meeting between an instructor and the suspended student to handle the learning issues that is preventing this student from coping with her/his group.

The aforesaid services are the result of utilizing Service Oriented Architecture (SOA) in analysis and design of e-Learning systems.

## Instructor Intelligent Services

Intelligent services aimed to help instructor through teaching are: intelligent time to learn topic calculator, intelligent study plan advisor, and Intelligent Learning Objects Advisor.

### Intelligent Study Plan Advisor

Intelligent study plan advisor is an intelligent advisory service used by instructor to help her/him identify points of strength and weakness in older study plan, and to identify different study plans for elder groups, so they can be used in recommending a study plan for current group. Since students differ in their learning behavior, the intelligent study plan advisor service considers different students’ classes based on their learning preferences. Intelligent study plan advisor can be used in enhancing the Los repository content by being able to identify learning topics that don’t have efficient Los for different student classes. Figure 1 illustrates the detailed flow chart of intelligent study plan advisor while Table 1 presents its’ specifications.

### Intelligent Time-to-Learn Topic Calculator

Intelligent time to learn topic calculator can help instructor during planning the course. Time to learn topic is the summation of time needed to learn Los composing this topic. By tracking different students’ learning progress, system can identify learning time shift between instructor identified learning time and the time student consumes learning. This time shift for current students and for elder group students is used in helping instructor identifying the time required for student to learn further topic. Table 2 presents the intelligent time to learn topic calculator specifications and figure 2 depicts a detailed flow chart.

Table : Intelligent Study Plan Advisor Service Specifications

|  |  |
| --- | --- |
| Input | |
| Student Preferences | Proposed Model stores different learning preferences that identify student learning behavior. Those preferences are considered for identifying different study plans. |
| Learning Class | Students are grouped into Classes to ease some educational tasks. Classes include: Auditory, Visual, and other classes that are discussed in detail in Learning Profile section. |
| Related Los Specifications | Los satisfy students’ classes by percentage. The higher Los available that matches students’ preferences, the higher recommended this topic for teaching. |
| Study Plans for Previous Students | Instructor might need to take a closer look on previous instructor plans, grades that students scored by following certain plans, and other data. |
| Processing | |
| By assigning different Weights to the different inputs, intelligent methods can be used to generate a weighted list summary report. | |
| Output | |
| Summary Report | Recommended Study plan for current study group. |

Table : Intelligent Time To Learn Topic Calculator Specifications

|  |  |
| --- | --- |
| Input | |
| Instructor Defined Learning Time | LO author defines learning time for each LO. This time is used as the standard time required for learning. Later, different instructors can identify learning times for the same LO. |
| Student Learning Time Shift | Tracking student learning progress helped the system to calculate the time to learn shift between the defined time and the student actual time to learn. Group consists of different students, average time to learn calculator will be presented. |
| Previous Groups Time To Learn Topic | Elder groups time to learn the same topic is used as an input in the calculation process |
| Processing | |
| By assigning different Weights to the different inputs, intelligent methods can be used to generate a weighted list summary report. | |
| Output | |
| Time To Learn Topic | Time estimation for current group to learn certain topic. |



Figure : Intelligent Study Plan Advisor Flowchart



Figure : Intelligent Time-to-Learn Topic Calculator Flowchart

### Intelligent Adaptive Online Lecture Los Advisor

Intelligent adaptive online lecture Los advisor accesses student profiles and learning preferences side by side with data from previous online lectures and course specification data. This service provides instructor with a recommended list of Los based on attending students. This list can be used during the lecture. Table 3 presents intelligent adaptive online lecture Los advisor specifications and figure 4 presents its detailed flowchart.

Table : Intelligent Adaptive Online Lecture LOs Advisor Specifications

|  |  |
| --- | --- |
| Input | |
| Student Preferences | Proposed Model stores different learning preferences that identify student learning behavior. Those preferences are considered for identifying different study plans. |
| Related Los Specifications | Los satisfy students’ classes by percentage. The higher Los available that matches students’ preferences, the higher recommended this topic for teaching. |
| Learning Topics Data | Proposed Model stores data about courses and topics to be pedagogically used in learning scenarios. |
| Previous Adaptive Online Lectures Data | Los that previous instructors used during online lectures for the same topic, and students feedback for those Los are important data for this recommendation process. |
| Processing | |
| By assigning different Weights to the different inputs, intelligent methods can be used to generate a weighted list summary report. | |
| Output | |
| Summary Report | Instructor can use this report for identifying strength and weakness points of utilizing certain LOs |

## Student Intelligent Services

Student intelligent services are: Intelligent Agenda Study Time Planner, Intelligent Meeting Manager for Suspended Students, and Intelligent Los Recommender.

### Intelligent Los Recommender

Recommender system in an e-Learning context is a software agent that tries to “intelligently” recommend actions to a learner based on the actions of previous learners. Table 4 presents intelligent Los recommender service specifications and figure 4 presents its detailed flowchart. Proposed intelligent Los recommender processes data in two phases: phase 1 where intelligent Los recommender actually recommends Los list based on student preferences and Los coverage for topics. Instructor approves recommended list, and when modifications are needed, instructors update weights causing the list to be generated not the list itself. This way, instructors are enhancing the system. Phase 2 includes reordering the generated recommended list based on students’ preferences. Users like to find their preferred material directly, and this phase is responsible for achieving this objective.



Figure : Intelligent Adaptive Online Lecture LOs Advisor Flowchart



Figure : Intelligent LOs Recommender Flowchart

Table : Intelligent LOs Recommender (Phase 1) Specifications

|  |  |
| --- | --- |
| Input | |
| Student Preferences | Proposed Model stores different learning preferences that identify student learning behavior. Those preferences are considered for identifying different study plans. |
| Related Los Specifications | Los satisfy students’ classes by percentage. The higher Los available that matches students’ preferences, the higher recommended this topic for teaching. |
| Learning Topics Data | Extract Topics related Keywords to match Los with topics. |
| Instructors Recommended Los list | Previous instructors’ recommended Los list for certain topics. In the beginning, instructors will need to approve generated lists every time to fine tune the system, then a database of approved lists will be used for approval. Instructor’s approval will be required from time to time. |
| Processing | |
| By assigning different Weights to the different inputs, intelligent methods can be used to generate a weighted list summary report. | |
| Output | |
| Los Recommended List | If this is the first time for the system to generate this list, Instructor’s approval is needed; otherwise system compares this list to previously stored lists. Matching percent less than 100% is allowed for systems adaptivity. |

### Intelligent Agenda Study Time Planner

This service provides three main functionalities that are important to the student:

* General agenda that excepts vacations and holidays.
* Personalized agenda that takes into consideration time required to study a topic based on the time shift between instructor identified time to study and the actual time that student needs to study. An estimate is calculated and addressed on the agenda. This time varies from student to another. Bloom (1984) showed twenty-five years ago, as reported in his 2 sigma paper, that almost all students can learn to the mastery level, given the right learning environment. One of the important factors of the right learning environment is the "Time Factor". Bloom showed that all students reached mastery level for certain topics after different time intervals of learning.
* General agenda for different activities that is customized for each student based on their preferences. Students who prefer football are encouraged to participate in football games, and the same for other activities.

Table 5 presents the intelligent agenda study time planner specifications and figure 5 presents detailed flowchart.



Figure : Intelligent Agenda Study Time Planner Flowchart

Table : Intelligent Agenda Study Time Planner Specifications

|  |  |
| --- | --- |
| Input | |
| Student Preferences | Proposed Model stores different learning preferences that identify student learning behavior. Those preferences are considered for identifying different study plans. |
| Related Los Specifications | Los satisfy students’ classes by percentage. The higher Los available that matches students’ preferences, the higher recommended this topic for teaching. |
| Processing | |
| By assigning different Weights to the different inputs, intelligent methods can be used to generate a weighted list summary report. | |
| Output | |
| Personalized Agenda | Personalized agenda for each student that help her/him organize their time between different activities and study. |

### Intelligent Meeting Manager for Suspended Students

Suspended students must meet one of the instructors to help them identify and work on solving their challenges. Table 6 presents the intelligent meeting manager for suspended students specifications, and figure 6 depicts its detailed flowchart.

Table : Intelligent Meeting Manager for Suspended Students Specifications

|  |  |
| --- | --- |
| Input | |
| Student Preferences | Proposed Model stores different learning preferences that identify student learning behavior. Those preferences are considered for identifying different study plans. |
| Related Los Specifications | Los satisfy students’ classes by percentage. The higher Los available that matches students’ preferences, the higher recommended this topic for teaching. |
| Processing | |
| By assigning different Weights to the different inputs, intelligent methods can be used to generate a weighted list summary report. | |
| Output | |
| Los Recommended List | If this is the first time for the system to generate this list, Instructor’s approval is needed; otherwise system compares this list to previously stored lists. Matching percent less than 100% is allowed for systems adaptivity. |



Figure : Intelligent Meeting Manager for Suspended Students Flowchart