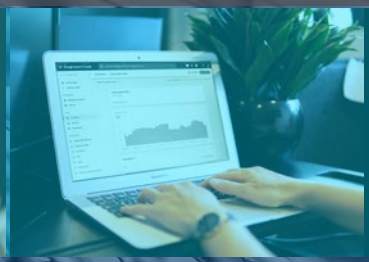
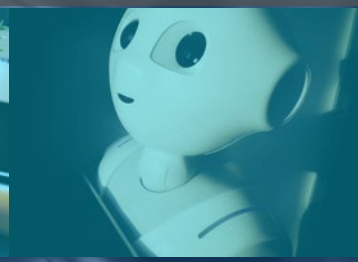
Technology

for Future Learning Ecosystem

Playbook



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Technology for Future Learning Ecosystem

Playbook

Reviews for Playbook Technology Future Learning Ecosystem

This Playbook is well illustrated and provides comprehensive references to the target readers. It also covers the next generation pedagogy in facilitating personalization, inclusivity and flexibility of learning pathways.

I believe the Playbook will be useful in leapfrogging the learning transformation through personalized learning required to address the gravity of the current crisis. We hope that this Playbook will spark discussion amongst educators, departments and institutions about their future learning ecosystem.

(Associate Professor Dr. Wan Zuhainis Saad, Director, Academic Excellence Division, Ministry of Higher Education, December 2021)

George Couros, educator and author of The Innovator's Mindset, says, "Technology will never replace great teachers, but technology in the hands of great teachers is transformational."

I couldn't agree with him more! However, I have always maintained that technology in education and learning is not a panacea. Its effectiveness would be contingent upon its seamless integration into the curriculum and effective implementation. This playbook—a valiant effort by a group of committed educators—is an attempt to provide guidance for the emerging culture of learning in the digital age.

This timely Playbook provides an overview of the processes involved in developing, adopting, adapting, and deploying emerging and future technologies within the context of the digital learning ecosystem. It incorporates cutting-edge educational technology advancements such as virtual reality, augmented reality, adaptive and assistive technology, and others, and conceptualises them as a model for a personalised learning ecosystem.
I believe the Playbook will provide a framework for educators to develop their digital competence in light of the rapidly changing skill sets and competencies required to succeed in today's fast-paced digital world. This aligns with the national agenda for globally connected online education.

(Prof. Dr. Abd Karim Alias, Universiti Sains Malaysia, Winner of many Educator Awards, December 2021)

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FOREWORD

This playbook was developed to present educational technologies for future learning ecosystem. It introduces potential approaches, tools and best practices of educational technologies in supporting teaching and learning ecosystems. Besides discussing the array of various technologies available, possible solutions are also recommended including the utilisation of artificial intelligence in learning and teaching.

The future learning ecosystem will be enhanced with the support of artificial intelligence covering chatbots and learning analytics for personalized learning. Other technological solutions include IoTs, gamification, mobile apps, learning management systems, hybrid virtual learning, robotics and other gadgets. This playbook provides the WHAT, WHY and HOW to implement personalized learning through the convergence of technology and human. Moodle is highlighted as the primary learning management system, and infusable tools are also described.

This playbook acts as a general guide for educators, practitioners, policy makers, entrepreneurs and relevant stakeholders to further expand the technological innovation in supporting the future learning ecosystem that empowers learners to be ready to learn at anytime and anywhere.

Prof. Dr. Ismi Arif Ismail
Project Leader, Enhancing Education for Human Capital Development through Establishing Future Learning Ecosystem, Malaysia Research University Network Grant, Ministry of Education Malaysia

PREFACE

This playbook is an output from a project on educational technology sponsored by the Ministry of Higher Education, Malaysia entitled "Enhancing Education for Human Capital Development through Establishing Future Learning Ecosystem". The playbook focuses on Artificial Intelligence, Internet of Things and Data Analytics, which are believed to be the pulse of the future learning ecosystem. Since educational material can cross geographical boundaries without limits, personalized education with precise recommendations that optimize outcomes and learner learning experiences is crucial.

The playbook presents the current learning advancements and future technologies that can support smart personalized learning. It lines up concepts, examples and guidelines for the planning, development and implementation of the future learning technology ecosystem. Existing works, services and applications are promoted while highlighting opportunities for improvement. Emphasis is given to assistive learning approaches that celebrate multi-intelligence, talent variations and diversified learner needs that empower humanized smart digital learning experiences beyond the classroom on-demand, anytime and anywhere. These principles are rooted based on the beliefs that a commitment for lifelong learning is a valuable asset for oneself and that technology is an important vehicle to ensure someone successfully travels along the route to wisdom.

With cloud-based learning bridges between the physical and digital worlds, the connections between learning providers, learners and instructors with knowledge become limitless. This presents new challenges when making significant learning experience choices. This is because human-guided activities can be complemented by a large range of customisable and automatically generated learning content, which also widens the opportunity for inclusive learning, celebrating unique learning experience characteristics which empower talaqqi-based learning further.

PREFACE

The playbook would not exist without the contributions and support of many people. We would like to extend our deepest appreciation to the members of other sub-projects in this grant from Universiti Putra Malaysia, Universiti Teknikal Melaka, Universiti Teknologi Petronas, Universiti Teknologi Mara, Taylor's University and International Islamic University of Malaysia. Special thanks to Prof. Dr. Ismi Arif Ismail as the project leader and for opening the doors of opportunities. We thank A.P. Dr. Waidah Ismail, Prof. Dr. Hamiruce Marhaban, Prof. Dr. Aida Suraya Md. Yunus, A.P. Dr. Habibah Abd. Jalil, and Dr. Mohd. Zairul Mohd Noor. Also, we are indebted to the following people:

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    - from Dr. Normalia Samian and A.P. Dr. Waidah Ismail's classes involving IOT experiments,
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    - from Dr Marzni Mohamed Mokhtar's class on augmented reality application for teaching Malay language.

PREFACE

- Respondents to our surveys
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Last but not least, we thank the editor, Dr. Khairul Azhar Kasmiran and our reviewers for their constructive critique and positive review of our paper. We are proud and appreciative of the support by the Faculty of Computer Science and Information Technology, Universiti Putra Malaysia for publishing this e-book as its first baby.

The playbook has been written by authors from three institutions and we thank our employers: Universiti Putra Malaysia, Universiti Teknikal Melaka Malaysia and Universiti Teknologi Petronas for the various support provided. We wish to also express our gratitude to our colleagues for their understanding and encouragement in completing this publication. Finally, we thank our sponsor, the Ministry of Higher Education, Malaysia for awarding and trusting us on the project, and anyone who have contributed directly or indirectly to the project and the production of this book.

It is hoped that the playbook could be a reference and guide for educationists, researchers, technologists, policy makers, entrepreneurs and relevant teaching and learning stakeholders to further provide quality inclusive education for sustainable love of knowledge.

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Nurfadhlina Mohd Sharef's main research interests are in artificial intelligence and data science especially in solving sentiment analysis, question answering chatbots and recommendation system problems. Her current research focuses on digital twins, deep reinforcement learning and various deep neural network architecture for multi-tasking, multi-criteria and multi-objective optimization. She has also been active in eLearning projects revolving around learning analytics, personalized learning, and active learning.

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01

INTRODUCTION

INTRODUCTION

As cloud-based learning bridges between both the physical and digital worlds connection between the learning actors-the learners and the instructors with knowledge becomes unlimited but bringing new challenges of making up choices for meaningful learning experience. Dependency towards human instructor guided activities is complemented with an array of personalisable and automatically generated learning contents. However, this has now also widen the opportunity for inclusive learning that celebrates unique learning experience characteristics which empowers talaqqi-based learning further.

The first chapter introduces the concept of future learning technologies that emphasizes on the learning compass, followed by an illustration of that laid out the mapping of four future learning ecosystem models namely the Malaysian Education Blueprint (MEB), Malaysian Higher Education Framework 4.0, UNESCO Four Pillars of Education, and the World Economic Forum Education 4.0 Framework which have been the main aspirations of the project that leads to the production of this book. The setting of the project also revolves closely to the needs of preparing a future-proof learning ecosystem for the Gen-Z learners. The chapter furnishes the concept of personalized learning ecosystem through implementation framework, characteristics of the learning environment and the components of the ecosystem model.

The emphasis of the book is on assistive learning technologies that revolves around universal design learning encompassing immersive learning, smart monitoring and interactive classroom. The second chapter provides examples and guides for setting up the learning environments by considering multiple intelligences. Some specifications for the hardware and software, as well as learning techniques are covered.

In chapter three, focus is given on artificial intelligence (AI) applications in learning, covering robots and virtual assistants. The chapter provides the concepts, example applications, types and advantages of AI as well as some basic of chatbot “how-to”.

Learning analytics as both a product and process is presented in chapter four which encompasses the types and example solutions. personalized learning implementation through learning analytics is also discussed. The book is concluded in chapter five with various way forward strategies to transform existing ecosystem towards a coordinated practice that emphasizes not only policy, human needs but also integration of machine with human.

Concept

The expansion of e-learning technologies such as mobile learning devices, student information systems, and learning management systems (LMSs) has made it easier for the education sector to access vast quantities of data related to teaching and learning practices, which has in turn spurred the growth of learning analytics (LA).

Andreas Schleicher, Director of the OECD Directorate for Education and Skills, commented in 2019 that "Education is no longer about teaching students something alone; it is more important to be **teaching them to develop a reliable compass and the navigation tools to find their own way** in a world that is becoming increasingly complex, volatile and uncertain."

The rising demand for such interactive education and LA is parallel to the improved data visualization using charts and graphs. The increased use of 3D animation techniques for visualization also enhances the efficacy of LA tools. The arrival of AI in higher education has opened Pandora's box, especially in creating an ideal learning experience for the future that is characterized by personalization. The emergence of machine learning and AI in data analytics creates major opportunities for players in the education and learning analytics industry. Virtual environments for learning and research offer more imaginative and immersive experiences for students and instructors alike.

The emergence of machine learning and AI in data analytics creates major opportunities for players in the education and LA industry. AI is appearing throughout higher education teaching and learning, in domains such as learning management systems, proctoring, grading/assessment, student information systems, office productivity, library services, admissions, disability support, and mobile apps. LA could improve learners' experiences and outcomes through the provision of meaningful data that can be acted upon before, during and after the course life cycle.

FUTURE LEARNING ECOSYSTEM MODEL

Personalized and self-paced learning

Problem-based and collaborative learning

Lifelong and student driven learning

Redesigning higher education initiatives

Fluid and organic curriculum

Transformative L&T delivery

Alternative assessments

Future Ready Curriculum

Holistic entrepreneurial and balance graduates

Global citizenship skills

Talent excellence

Neoteric value-driven academia

Cognitive flexibility

Talent Planning

Research and Innovation

Pioneer culture

Research alliance and partnership

Translational research

Commercialisation on research and innovation

Innovation ecosystem

Global prominence

Agile Governance

Digital ethics and values

Autonomous governance

Ace delivery

Sustainability

Smart campus

Accessible and inclusive learning

Empowered governance

The Malaysian Education Blueprint (MEB), Malaysian Higher Education Framework 4.0, UNESCO Four Pillars of Education, and the World Economic Forum Education 4.0 Framework, have laid out the aspirations that form the basis of the future learning ecosystem model that highlights personalized learning as one of its main components.

UNESCO 4 Pillars of Education

- Learning to do
- Learning to be
- Learning to live
- Learning to know

Legend:

- Malaysian Education Blueprint
- MOHE 4.0
- World Economic Forum Education 4.0 Framework

GEN-Z CHARACTERISTICS & Aspirations as Future Learners

- Demand for 24/7 Internet access
- The desire to be heard
- Engaged to social media
- Preference for bite-sized learning
- Entertainment addicts
- Been using technologies at tender age
- Associated with online entertainment
- Short focus time span

- Learners as content producers and connectors
- Innovative problem solvers with emotional intelligence
- Creative and critical thinking with entrepreneurial mindset
- Open access to information
- The Web as a curriculum
- Diversity of network
- Learner as teachers
- Access to experts

The generation that we are currently teaching are digital natives, with the characteristics and behaviors that demand for learning on-the-go and learning-on-demand. Therefore, educators are expected to take advantage and maximize student's learning experience by leveraging modern tools.

Learners have an abundance of readily-available options for seeking knowledge, and they prefer personalisation:

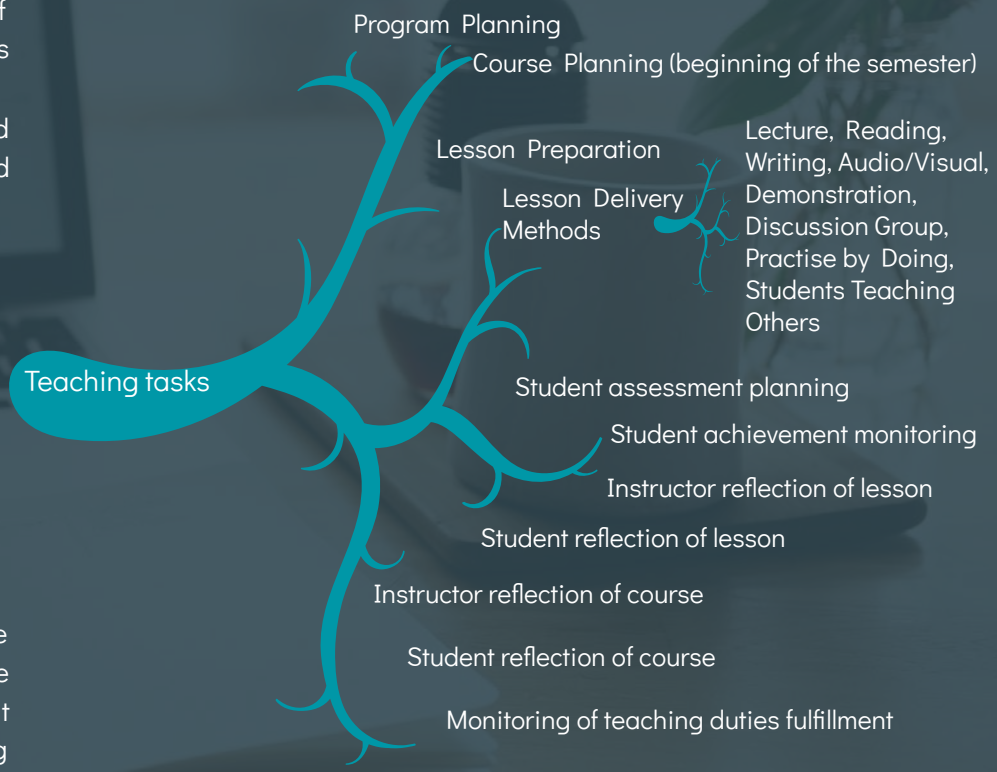
- Set their own goals
- Learn at their own pace
- Choose their learning modality (i.e. listening to audio vs. reading)
- Choose how their learning is assessed (i.e. quiz vs. game)
- Customize their learning environment (how the material looks)

PERSONALIZED LEARNING

Personalized learning refers to instructions in which the pace of learning and the instructional approach are optimized for the needs of each learner individually.

- Learning objectives, instructional approaches, and instructional content (and its sequencing) may all vary based on the learner's tailored needs
- Learning is dynamic—learners can advance quickly through instructions or slow down as needed; there is no uniform pace
- Learning objectives, approaches, content, and tools are tailored for each learner
- Learning is driven by learner abilities and interests, often in a calibrated and systematic manner
- Learning gives learners the choice for what, how, when, and where they learn
- Learning is often supported by technology

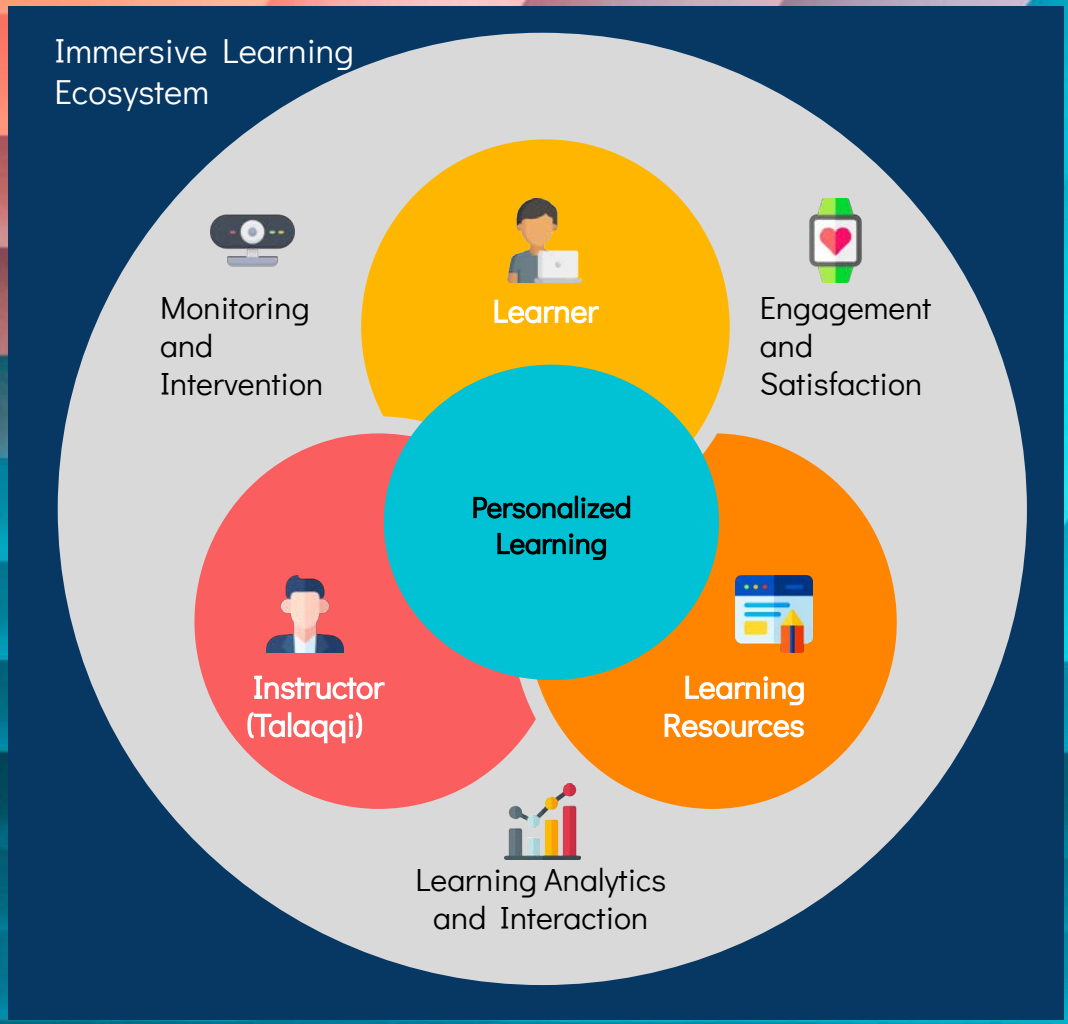
Personalization is to help students achieve learning objectives more effectively and efficiently. The ideal learning ecosystem for the future is characterised by personalisation, where adaptable and intelligent applications and hardware contributes towards quality learning experience, both in digital and non-digital environments.



Challenges in Implementing
Personalized Learning

	Learner	Instructor	Institution
			
Personalized learning WISHLIST	Get certification, get materials matching interests and personal goals	Engaging delivery, focused feedback, understand their learners	Increase student retention, produce excellent students, provide quality courses
CURRENT personalized learning implementation	Limited personalized guide, not much feedback and learning materials	Unproficient to design personalized learning, lacking assistive technology to automate tasks	One-size-fits-all learning design, lacking evidence-based decision making
RESULTS of current scenario	Trial and error enrolment, low interest in learning	Trial and error pedagogy, limited knowledge on students' preferences	Trial and error engagement and program improvement

Conceptual Model for
PERSONALIZED LEARNING ECOSYSTEM



Personalized learning requires an informative learning analytics dashboard that allows the instructors to be able to:

- Understand the needs of the learners;
- Understand the preferences of the learners;
- Get recommendation of teaching intervention and perform teaching plan customization to personalize the teaching; and
- Always monitor and adapt to optimise learners' achievements, engagement and satisfaction.

Learners benefit from learning analytics dashboard by:

- Viewing their achievements information;
- Comparing themselves against some benchmarks; and
- Obtain guidance to progress in the learning path.

IMPLEMENTATION FRAMEWORK FOR PERSONALIZED LEARNING

Education Elements

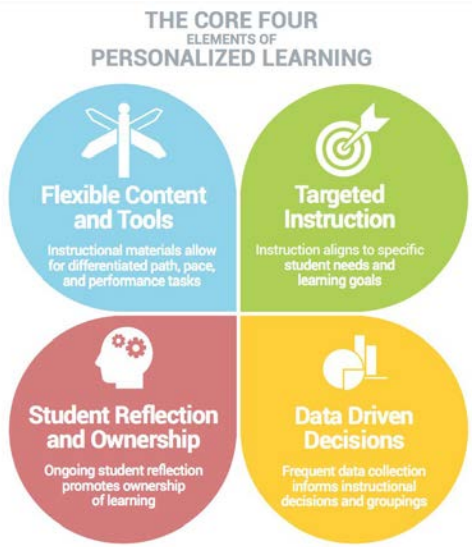
Read more at
https://www.edelements.com/personalized-learning

PERSONALIZED LEARNING IMPLEMENTATION FRAMEWORK

STRATEGY	DESIGN	CURRICULUM & INSTRUCTION	SUPPORT	OPERATIONS
PL Vision Alignment	Culture of Innovation	Curriculum Inventory	Roles to Support PL Teachers	Devices and Digital Tools
PL Rollout Plan	PL Instructional Models	Online & Offline Curriculum Alignment	PL Professional Learning Plan	IT Support Plan
Multi-Year Roadmap	Students As Self-Directed Learners	Digital Portfolio and Usage	PL Resource Bank	Infrastructure Upgrade Plan
Initiative Alignment	Schedule Aligned to PL Design	Grading, Assessment, and Data Culture	PL Coaching and Evaluation System	3-5 Year Budget
PL Expectations & Success Indicators	Teacher Role in PL Instructional Model	Strategy for Special Student Populations	PL Communication Plan	Workforce Plan

DATA ANALYSIS TO MONITOR SUCCESS AND CONTINUALLY IMPROVE

Education Elements believe that personalized learning means that students get the core instructions they need, whenever they need them. The Four Cores of Personalized Learning identifies the four major shifts in the instructions we would expect to consider: (1) the flexible use of online and offline content, (2) targeted instructions, (3) data-driven decisions, and (4) increasing student ownership and reflection.



Assistive Technology Framework Supporting
FUTURE LEARNING ECOSYSTEM

Actors

Instructor

Learner

Teaching and Learning Activities

Assistive Learning Devices for Inclusive Learning

Microlearning

Gamification

Smart Vision

Augmented Reality

Augmented Reality

Edubots

Drones

Capture Student Learning Events

Learning Interaction Captured in Learning Management system

Learning Resources

IoT

Smart Watch

Camera

CCTV

Profile

Monitoring and Intervention

Personalized Learning

Learning Analytics

Personalized Learning Plan

UNIVERSAL DESIGN LEARNING (UDL)

UDL provides an educator with multiple lenses for thinking through the learning experiences created for the students. While incredibly important in face-to-face and hybrid teaching environments, UDL becomes critically more important as learning shift into online environments so suitable measures are taken when develop content and experiences by considering variety of learner.

Since there is no one method that is optimal for all learners, one must remember to structure content delivery and demonstrations of understanding in a way that supports access to content and sharing through multiple means:

- How will learners experience the content?
- How will learners contribute to the content?
- In what ways can learners demonstrate their understanding?

Guidelines to offer multiple intelligences

Provide multiple means of engagement	For purposeful, motivated learners, stimulate interest and motivation for learning
Provide multiple means of representation	For resourceful, knowledgeable learners, present information and content in different ways
Provide multiple means of action and expression	For strategic, goal-directed learners, differentiate the ways that students can express what they know

Characteristics & Approaches

- Learner focused: needs, strengths, aspirations and interests
- Progress at own pace on basis of competency
- Adjust dynamically to the goals, curiosity and skills of the learner

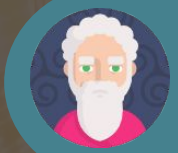
Adaptive Learning
Students get the instructions and practice they need – it is provided just-in-time as students work to complete assignments

Individual Learning
The pace of learning is adjusted to meet the needs of individual students (persona)

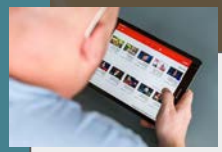
Differentiated Learning
Learning is adjusted to meet the needs of individual students

Competency-based Learning
Learners advance through a learning pathway based on their ability to demonstrate competency

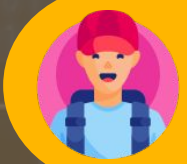
User Persona



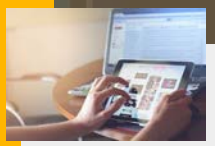
Who : Elderly
Age : 60s
Reason : Self enrichment
Interest : Informal education
Device : Desktop
Channel : Website



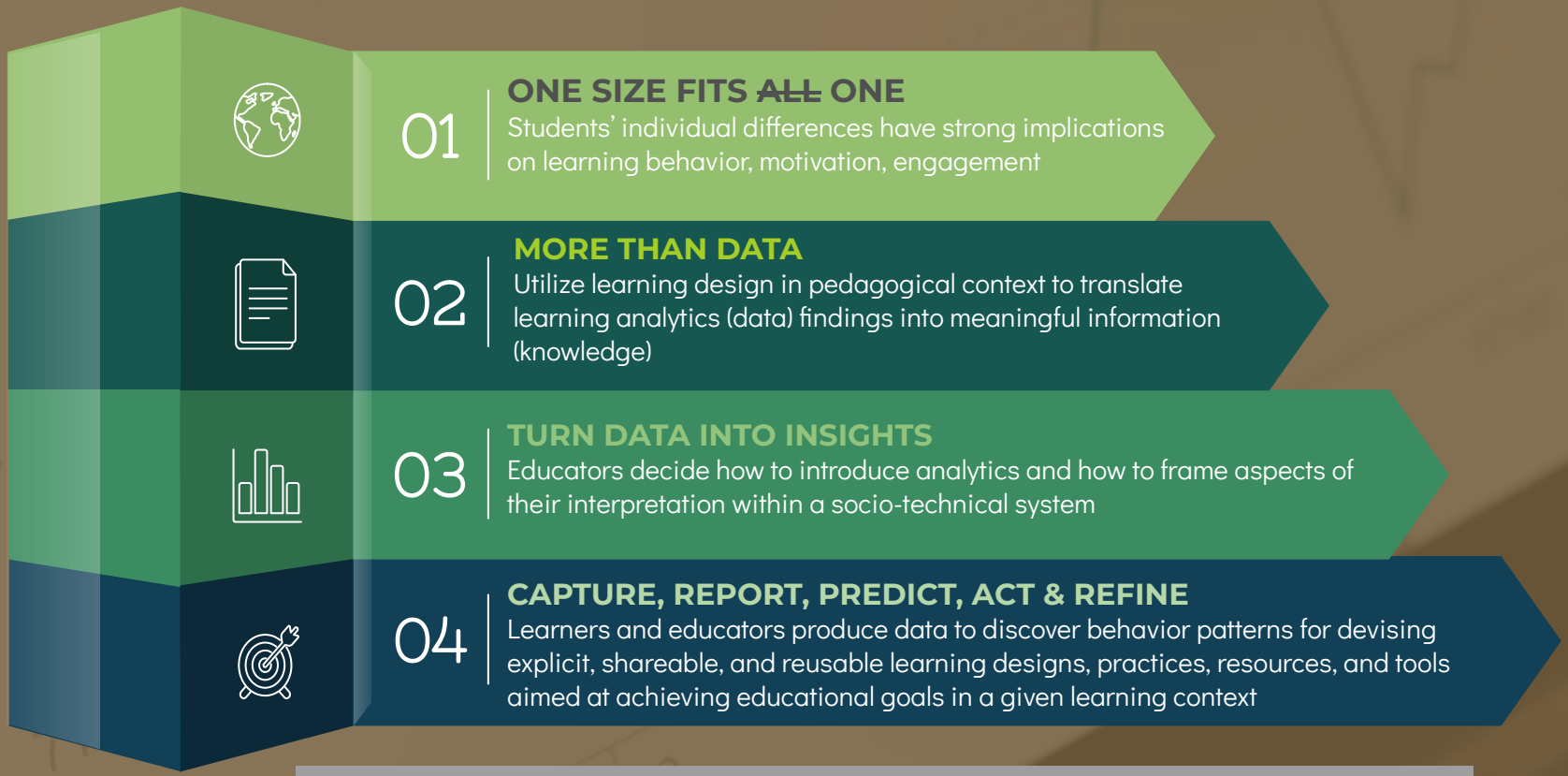
Who : Working Adult
Age : 30s
Reason : Upskilling
Interest : Microcredential
Device : Mobile
Channel : Website



Who : Teenager
Age : 20s
Reason : Certification
Interest : Full program
Device : Mobile
Channel : Apps



LEARNING ANALYTICS CHARACTERISTICS
For Personalizing Learning Design



01 ONE SIZE FITS ~~ALL~~ ONE
Students' individual differences have strong implications on learning behavior, motivation, engagement

02 MORE THAN DATA
Utilize learning design in pedagogical context to translate learning analytics (data) findings into meaningful information (knowledge)

03 TURN DATA INTO INSIGHTS
Educators decide how to introduce analytics and how to frame aspects of their interpretation within a socio-technical system

04 CAPTURE, REPORT, PREDICT, ACT & REFINE
Learners and educators produce data to discover behavior patterns for devising explicit, shareable, and reusable learning designs, practices, resources, and tools aimed at achieving educational goals in a given learning context

Benefits:
Personalized learning could improve students' overall performance and learning progress and ensures course retention

02

ASSISTIVE TECHNOLOGY FOR LEARNING

Concept

Educators need to be equipped with technological competencies to ensure learning experience will be meaningful and personalized to the students' needs. Assistive technology can support teachers to provide teaching and learning that is accessible to all students. Assistive technology supports students with diverse learning needs within an inclusive learning environment by: delivering information to students in a way that is more appropriate to their needs.

The generation that we are currently teaching, and the coming academic hall benchers, are, unsurprisingly, digital natives, with the characteristics and behaviors that demand for learning on-the-go and learning-on-demand. Therefore, educators are expected to be fluent in leveraging the tools and technologies to maximize student learning experience.

Personalized learning is an educational approach that aims to customize learning for each student's strengths, needs, skills, and interests. Each student gets a learning plan that is based on what they know and how they learn best. The inclusive education concept that 'no one is left behind' can also be implemented through multi-modal technology that suits various learners' needs, including learning achievement, coping strategies, variation of learning modalities from live broadcasts to 'educational influencers' to virtual reality experience, and mobility. This chapter highlights the variation of assistive learning technologies in supporting personalized and inclusive learning.

ASSISTIVE TECHNOLOGY

Empower educators to implement inclusive and immersive learning to cater the varied learning needs and personas

Technologies can be applied in the curriculum implementation to support learning face-to-face, blended, online and remote, so learning is more engaging and meaningful

Implementation of learning at scale (where ratio of learner to facilitator is big) programs are still picking up, so technologies meet the learners demand for engaging and personalized attention, and scaffolding, to help them succeed

How to Incorporate Assistive Technology Into Teaching & Learning?

01 Immersive Learning

- Virtual Reality
- Augmented Reality
- Mixed Reality
- Green Screen
- 3D Modeling
- Smart Glass
- Hologram

02 Smart Monitoring

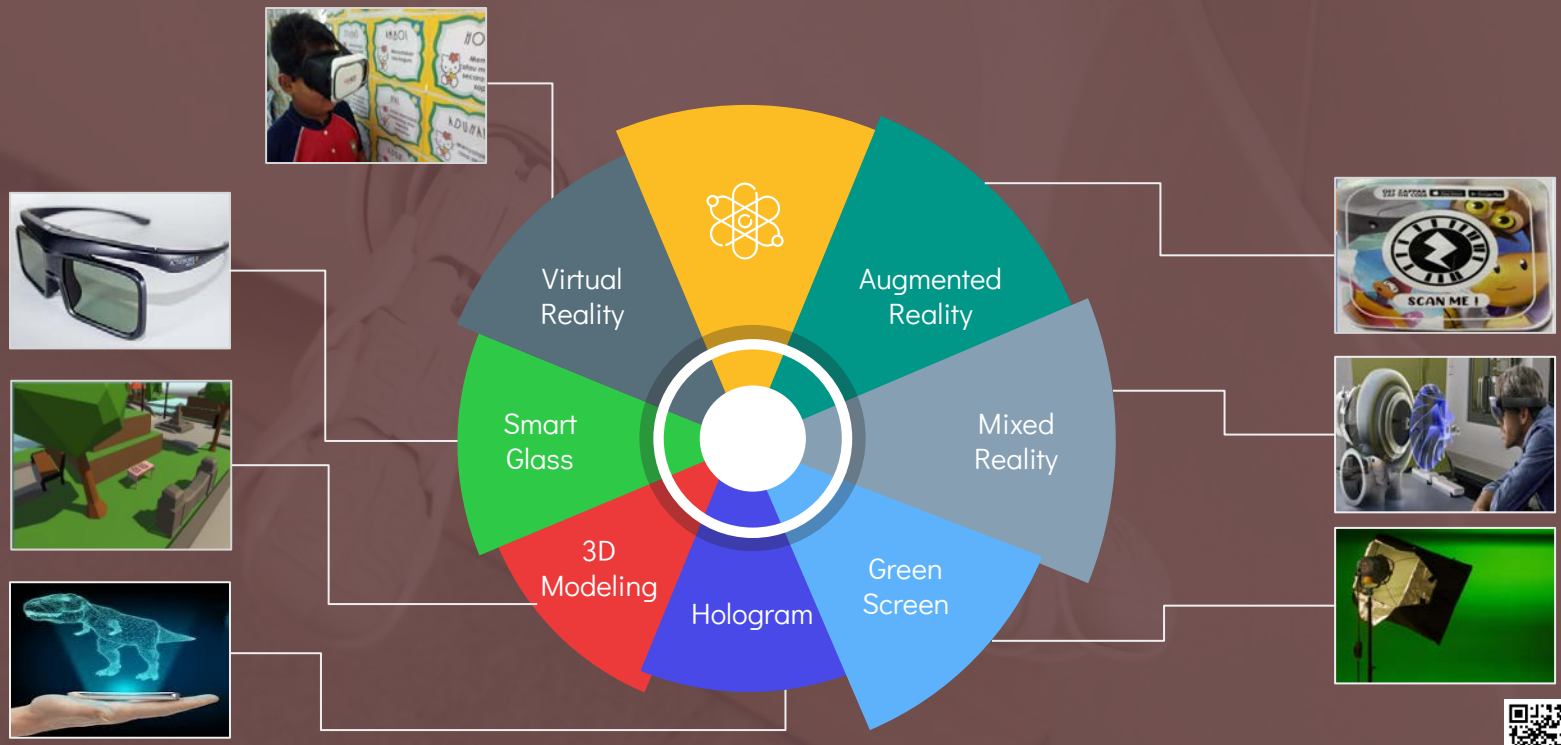
- Biometric Authentication
- Analytics/Dashboard
- Robot/Drone
- Webcam/CCTV
- Smart Watch
- EEG Device

03 Interactive Classroom

- Device Pairing
- Chatbot
- Gamification
- On-Demand Online Meeting
- Interactive Learning Display
- Learning Management System (LMS)

01. IMMERSIVE LEARNING

- Social presence
- Real-world situation
- Active, authentic and contextual
- Context and content
- Mental modeling
- Experience of medium



GREEN SCREEN STUDIO
For Creating Virtual Effects Video

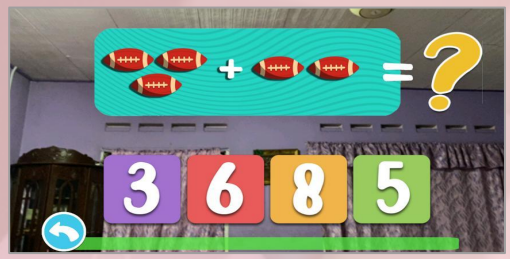
Recording Studio at the Center for Excellence in Teaching and Learning (CETaL), Universiti Teknologi PETRONAS

AP Dr Noreen Izza Arshad and her video for Knowledge Management courses that utilize green screen technology

Green screen technology applies cinematographic techniques for educators to add a variety of visual effects to their educational videos. These effects include adding virtual backgrounds, animating backdrops, placing subjects and objects, adding other background videos, and many more. This makes learning via video content more engaging and meaningful.

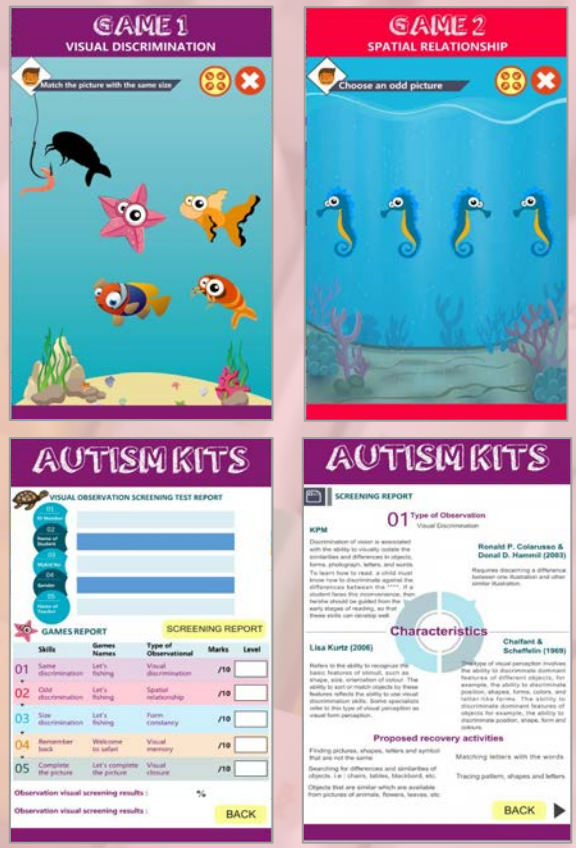
GAMIFICATION

Gamification ensures engaging learning experience through the application of game-design elements and game principles in non-game contexts. It can also be defined as a set of activities and processes to solve problems by using or applying the characteristics of game elements. Students compete to accomplish learning objectives as they progress through the levels and obtain rewards or penalties.



Mathematics for Autistic Learners

Integrated Assistive Learning Model for Autistic Learners: Bakery Production Competency



Autikit Apps

Images are taken from several projects on assistive learning at Universiti Teknikal Melaka

VIRTUAL REALITY SETUP

Virtual Reality (VR) refers to a computer-generated simulation where students can interact within an artificial three-dimensional environment through electronic devices, such as head mounted displays and gloves fitted with sensors.

By building a fully-immersive virtual environment, educators could give their students a walk-through experience and feeling of being in places they have never visited such as in a refinery, ocean, power plant, cave or others.

VR Active Wall

ART Flystick

3D Glass

3D Glass 1

3D Glass 2

3D Glass Tracker

ART Tracking System

ART Flystick

Head Mounted Devices

The facilities brand:

VIRTALIS
CONNECTED IMMERSIVE VISUALISATION

Space Mouse Pro

2 x Sensors

Head Mounted Device

2 x Controller

The facilities brand

oculus

These facilities are available at Universiti Teknologi PETRONAS (UTP). Images are taken at the Oculus Rift Room located at the Center for Excellence in Teaching & Learning (CETaL) building.

AUGMENTED REALITY

Augmented reality (AR) is an enhanced version of the real physical world that is achieved through digital visual elements, sound, or other sensory stimuli. It is capable of augmenting computer-generated graphics into real environments, on-screen.

Educators can utilize mobile AR applications, which allows them to teach about mechanics, machinery, components, equipment, body parts, human anatomy and many more.

For example, when pointing a mobile device to a machine, those parts can glow to indicate the name of the components and time for them to be changed. AR module can even include details about how to change those parts.

Scanning the product to be viewed

The VR app (view in mobile or tablet)

AR experience – Explore in 360

Explore View

Operation

Internal Components

3D Model

Pump Specification 1

Images taken are from a joint project between the Positive Computing Research Center, Institute of Autonomous System, Universiti Teknologi PETRONAS and PETRONAS Technical Training Sdn Bhd (PTTSB)

02. SMART MONITORING

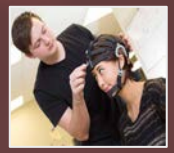
Biometric Authentication

Analytics and Robot

Drone Technology

Webcam

Smart Watch



EEG Device

Data Upload

Data Download

Student's progress can be viewed by the parents and teachers

Tools can be used while participating in gamification activities

CCTV - Capture the student's movement
EEG - Capture the brain concentration
Heartbeat - Capturing anxiety
Webcam - Detect eye movement

Gamification consists of

Levelling up - Low, Medium or Hard
Reward - Point of excellence
Unlocking - Games, new features for levels
Competition - Playing between two students

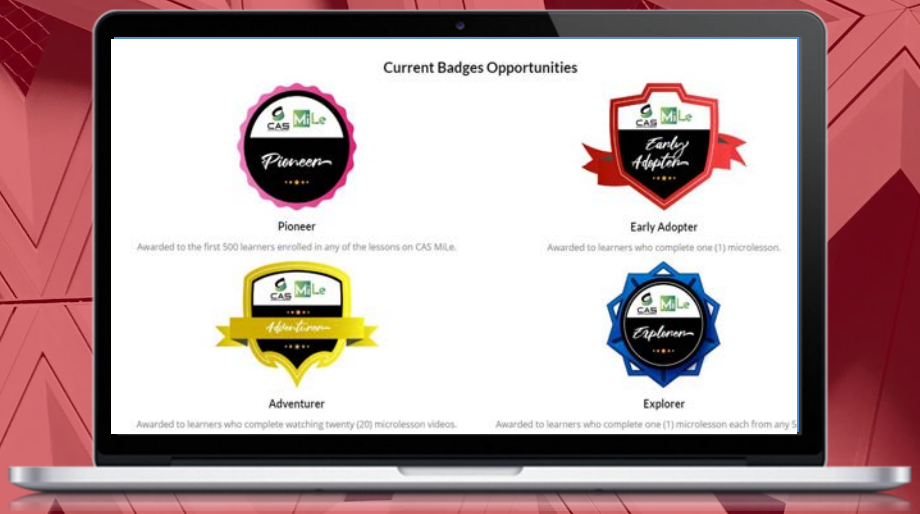
The above diagram is the concept of IOT in learning using CCTV, EEG, heartbeat and webcam.

- CCTV to capture the movement of the students
- EEG to capture the concentration of the students
- Heartbeat to capture the anxiety of the students towards the subjects
- Webcam to monitor the focus of the students using eye movement

All the variables will be uploaded in the cloud for processing, and the result will be sent to lecturers and patients. Students can learn using normal lecturer slides or to make it interesting using gamification studies.

LEARNING MANAGEMENT SYSTEM

Personalizing Competency-based Microlearning



Microlearning

IEEE CASSMiLe is a platform where learning content is in bite-sized units for a more digestible learning experience and learners receive badges for their achievements

Competency-based learning

Learning level is raised based on learner's demonstration of knowledge/skills, rather than time spent on a course

Benefit

- Personalized learning, anywhere-anytime;
- Learn from renowned experts and peers;
- Build competencies and become experts in the chosen field; and
- Reaching out at-scale to (non)-members.

Digital learning passport

Platforms such as 'Accredible' for certificates, diplomas, badges and blockchain credentials can be integrated into online portfolios such as LinkedIn

CAS MiCRO Learning

Personalizing bite-sized knowledge for Competency Development

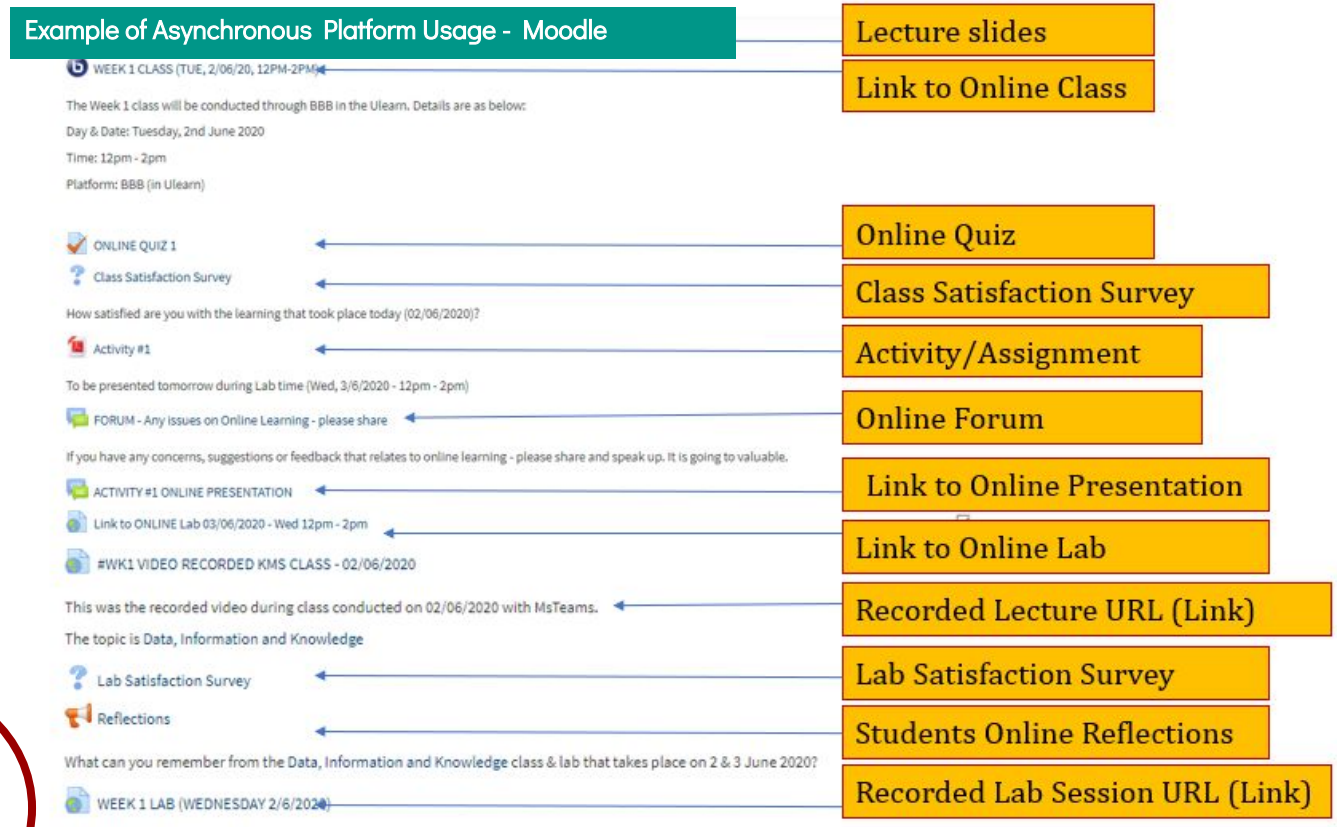
MICROCOURSES

- *Artificial Intelligence/ Machine Learning*
- *Biomedical Research* (2-minute Paper)
- *Journey of an IEEE fellow* (Making an Impact)
- *Women in CAS* (Making an Impact)

badgr Accredible LinkedIn KOPERE DASHBOARD

Scan me!

Features of Learning Management System



- ✓ Simplify lesson-building
- ✓ Organize eLearning content in one location
- ✓ Track learner progress and performance

Using Moodle for PERSONALIZED LEARNING

For information on PLD, visit https://www.facebook.com/watch/?v=10151340934743255

Personalized Learning Designer (PLD) is Moodle's course assistant tool that allows instructors to automate elements of their course, to personalize the learning of students based on their interaction with the course.

Benefits:

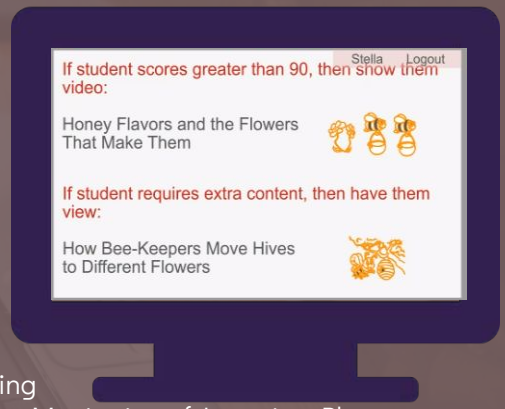
1. Quickly identify key behaviors and then take action to remediate or accelerate learning paths, based on an individual student's performance within a course.
2. Provide every student the attention they need within a course.
3. Automate feedback, reminders or follow-up processes, and recommend training, based on a student's specific performance within the course, so they can get the most benefit out of it.

Course assistant using Personalized Learning Designer:

1. Participation reminder
2. Quiz or assignment not submitted reminder
3. Failed quiz alert with a link to a resource
4. Welcome message
5. Announcements
6. Release of additional content

Other components in Moodle that can be used to support personalized learning:

1. Competency framework
2. Lesson
3. Workshop
4. Restrict access
5. Activity completion
6. Reports
7. Analytics
8. Badges
9. Certificate
10. Learning plan
11. Rules
12. Plugins: Personalized Learning Designer, Task Chain, Monitoring of Learning Plans



03. INTERACTIVE CLASSROOM

An interactive learning environment allows students to engage with the learning process and participate immersively. Peers and technologies surrounding them, either co-located physically or virtually, allow learners to be connected with each other while accessing additional learning materials tailored to their preferences.

Device Pairing

- Headphone/earphone
- Airplay
- Chromecast
- Android Box
- Mobile
- Keyboard

Chatbot

- Rule-based chatbots
- Artificial Intelligence
- Intellectual Independence

On Demand Online Meeting

- Lightboard
- Tabletop
- Projection Mapping

Interactive Learning Display

- Zoom
- Google Meet
- Microsoft Teams

Gamification

- Avatar
- Badges
- Live scoring
- Challenge-based learning

Learning Management System (LMS)

- Moodle
- Blackboard
- Google Classroom
- Canvas
- Microsoft Teams
- Edmodo

Learning Environments

Face to Face

Learning experiences are designed around a physical environment. Learning is conducted in the same space, at the same time.

Online at a Distance

Learning experiences are designed around virtual participation. The class may require different time, different place or same time, different place attendance.

Hybrid Learning

The environments range from partially-online to almost fully-online, and students both attending online and physical meetings attend the learning sessions synchronously, together with the instructor.

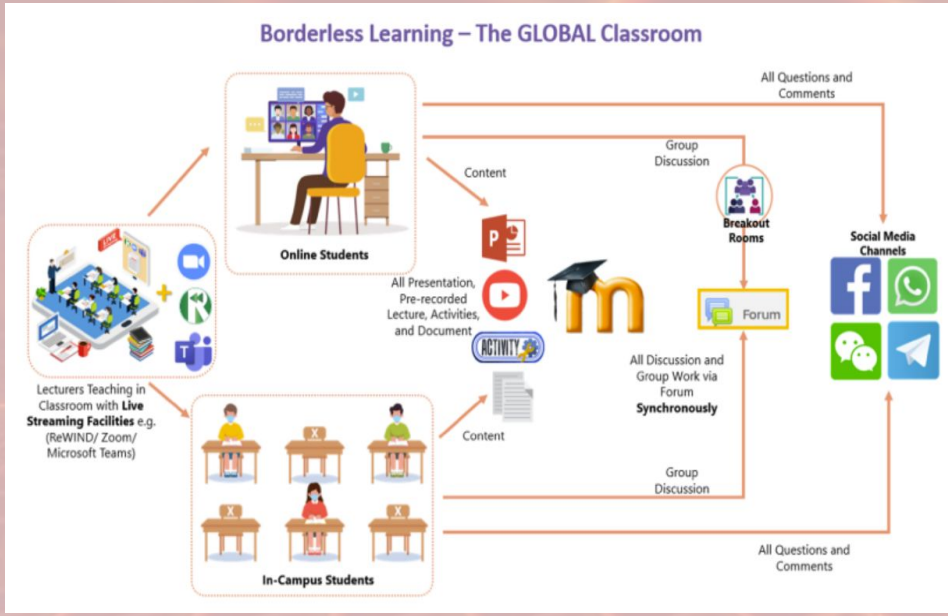
HyFlex

Provides students with the opportunity to attend fully online, face-to-face, or somewhere on the spectrum between the two, depending on personal choice or need.

Reference: Beatty, B. J. (2019). *Hybrid-Flexible Course Design (1st ed.).* EdTech Books. https://edtechbooks.org/hyflex

HYBRID VIRTUAL CLASSROOM

See example at https://www.youtube.com/watch?v=dERsNYgV8EY&t=51s



What

Some students attend the class physically with the instructor , while others choose to participate remotely online.

How

Students at both locations can choose panoramic view and ask questions directly to the instructor and interact with each other.

Read more at https://university.taylors.edu.my/en/study/study-enrichment/borderless-learning.html

HYBRID VIRTUAL CLASSROOM

KU LEUVEN

Read more at https://kulak.kuleuven.be/nl/over_kulak/diensten/dienst-informatica/platformen/tecol/student/course-in-i029

The Remote Classroom

The Hybrid Virtual Classroom

Fig. 1 Two models of synchronous hybrid learning at Edulab, the living lab of KU Leuven Campus Kulak Kortrijk

How

In the Hybrid Virtual Classroom, one group follows the course on campus, while individuals simultaneously follow the course remotely from the location of their choice.

What

In the Remote Classroom setting, one group follows the course on campus, while another group follows the course synchronously from another campus .

What

A program or a course that is **conventionally offered face-to-face**, joined by students or participants who will only take part **online in real-time, together** with students who are learning **in the classroom** with educators (Beatty, 2019).

Picture and description referred from Raes, A., Detienne, L., Windey, I., Depaepe, F., (2020), A systematic literature review on synchronous hybrid learning: gaps identified, Learning Environments Research (2020) 23:269–290

HYBRID VIRTUAL CLASSROOM

KU LEUVEN

Read more at https://kulak.kuleuven.be/nl/over_kulak/diensten/dienst-informatica/ict-services/online-onderwijs/hybridvirtualclassroom

Why

Some higher educational institutions are dealing with a decline in student enrollment numbers because of the increased offering of distance and online education. The synchronous hybrid learning environment could provide an answer to this problem, and help to increase enrolment.

Fig. 2 Hybrid virtual classroom including both F2F and remote individual students (upper pictures) and the platform visible for the students (lower pictures)

How

Students are equipped with innovative educational technology, and all students have access to the same interactive platform, allowing them to participate in the course, either on-site or from a remote location.

The platform gives access to the sources that teachers are using during lectures (e.g. PowerPoint slides or annotations made on the digital whiteboard), quizzes or polls, and a chat room which enables students to chat with each other or with the teacher during the lecture.

Lectures in the Hybrid Virtual Classroom are mostly assisted by a room controller who follows up on the chat, can launch the quizes or polls, and can mute or unmute remote students.

Figure and caption from Raes, A., Detienne, L., Windey, I., Depaepe, F., (2020), A systematic literature review on synchronous hybrid learning: gaps identified, Learning Environments Research (2020) 23:269–290

03

ARTIFICIAL INTELLIGENCE (AI) FOR PERSONALIZED LEARNING

Concept

Picture this: a machine that can prepare you breakfast every morning or a virtual personal tutor to help you adapt to your learning style or pace. This technology is known as artificial intelligence (AI).

AI simulates the human intellect in machines to be programed to learn, think, analyze and make decisions. The idea is to produce technology that functions intelligently and independently, and behaves like a human. Yet, we interact with AI in our daily lives without realizing it. For example, Siri, a voice-controlled personal assistant to answer questions or provide recommendations, Google to give query results, Netflix to provide movie recommendations, Waze to provide live navigation and traffic alerts, and a phone that uses face recognition for authentication.

There are four kinds of personalized learning: (i) customization by learners, (ii) instructor-led learning designs, (iii) adaptive-based learning content based on predefined rules and templated feedback, and (iv) recommendation based systems that continuously learn the interaction between humans and machines. Harnessing AI, data analytics and chatbots could examine the temporal changes in student learning processes and how learners use and orchestrate different learning components and resources to support their learning.

AI applies machine learning to learn to find patterns in massive amounts of data to make decisions and predictions based on new data, without human intervention. As a result, AI will continue to grow and will have an enormous impact on our quality of life through digital assistance, faster decisions, less human errors, and new inventions. But, how do we determine how well a particular system—its data, analyses, and adaptive interventions performs? The first question to ask is whether a system is functional, i.e., does it give different learners experiences that fit their needs? Can we verify that it performs as designed and expected? This chapter presents various AI-based solutions for personalized learning.

UTILIZING ROBOTS
For Inclusive Personalized Teaching

The usage of robot as an additional teaching modality offers personalisation for students. It aims to increase student engagement while encouraging the design thinking approach. Robots for teaching have been used for inclusive learning, for both normal and disabled students.

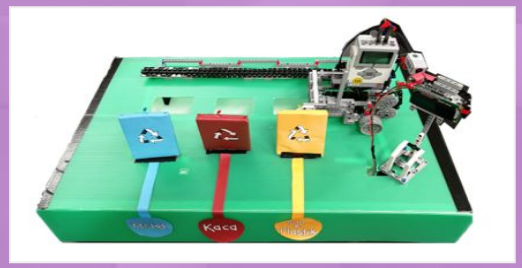
The features that the robot has, which are mobility, light, sound, and sensors, allow it to be customized for supporting teaching.

The picture was taken during one of the testing sessions conducted with children with autism at the SK Kg Boyan, Taiping Perak

PvBOT
An assistive technology to learn about mathematical place values

AUTIBOT
Identifying coins, animal sounds and human body parts in a fun way

ROBOTEACH
Learn through identifying facial expression to know human's emotions such as happy, sad, angry and greedy to improve social interaction and communication skills



RECYCLE-BOT
Teaching how to recycle

ROBOTS

Robots can contribute in teaching and learning, especially in repetitive tasks. Robots in the classroom can have diverse tasks. Some are objects of study for students to practice programming, can act as tools which assist a teacher, can be learning companions, or can be autonomous teachers which provide some unit of instruction more or less in its entirely.

Instead of anxiously interacting with a human teacher or another students, talking with a robot can be less emotive, and so it provides a potentially useful bridge to conversational proficiency, less anxiety and more positive attitudes to learning.

Robots can support language development, writing skills, teach sign language, enhance reasoning and some kinds of problem solving, support self-regulated learning (SLR), foster SLR skills using prompts, and help with small group work by answering questions, thus freeing the teacher to give more time to other groups and to individuals.

Reference: *Newton, D.P., and Newton, L. D., (2019), Humanoid Robots as Teachers and a Proposed Code of Practice, Front. Educ. 4:125. doi: 10.3389/feduc.2019.00125*

CHATBOTS

CHATBOT

A computer program that communicates and interacts with people using natural language (for example, English) sentences to accomplish specific tasks in a certain domain or on a certain topic.

ADVANTAGES

- Instant
- Timely
- Engaging
- Simultaneous service to unlimited users
- Personalized feedback to the users

IMPLEMENTATION

Chatbots can be implemented through various platforms:

- Instant messaging service (e.g. Whatsapp, Telegram, Messenger)
- Web-based applications (e.g. popup window with customer service help)
- Standalone applications

EXAMPLES OF CHATBOT

Educational

Ask Frank
Personal Assistant

mondly languages

Health self diagnosis

YOUR.MD

World Health Organization

buoy

General purposes

crisp

kommunicate

cleverbot

@kuki_ai

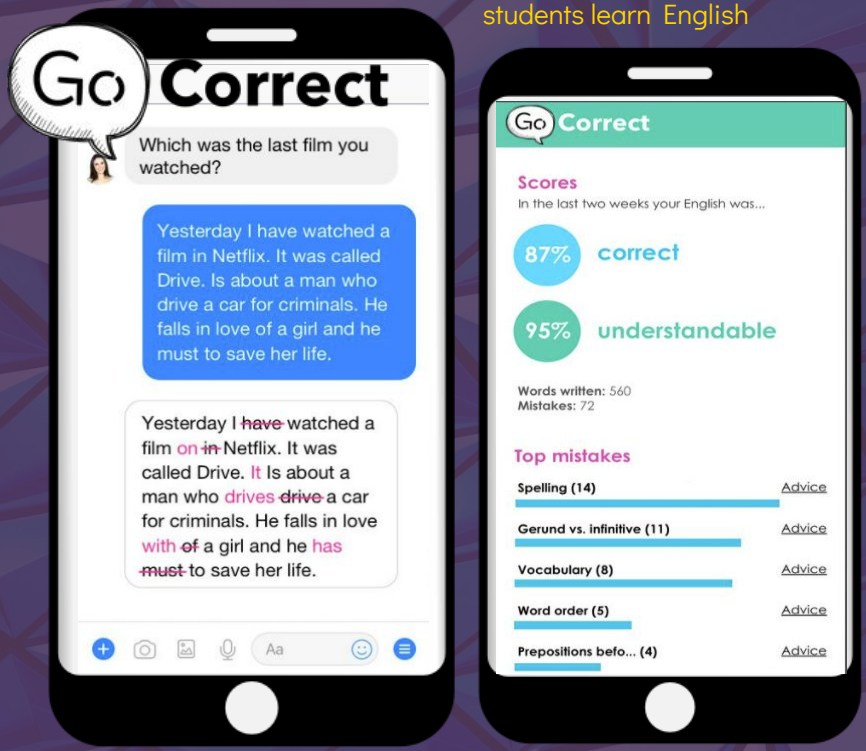
EDUCATIONAL CHATBOTS

Educational chatbots are time-saving alternatives to their repetitive processes because they can be the teaching assistant when designed to answer queries students generally ask like about lesson plans, course modules, assignments, and their deadlines.

Similarly, chatbots with artificial intelligence technology can be used to teach students by turning a lecture into a series of messages, to make it look like a standardized chat conversation. Educational roles of a chatbot include:

- Provide students with access to information 24 / 7;
- Provide administrative support;
- Offer proactive feedback and assistance in answering students topic specific questions;
- Help in evaluating students' progress and performance;
- Send mass reminders and notifications;
- Act as personal tutors and provide individual didactic supports;
- Medium for student to communicate with teachers and peers;
- Give recommendations to students about learning materials;
- Engage students; and
- Help teachers teach

Go Correct is a bot that helps students learn English



Get more info on Go Correct at https://chatfuel.com/blog/posts/chatbots-for-language-learning-businesses

TYPES OF EDUCATIONAL CHATBOT

Learning / pedagogical

Learning buddy

Advisorial

FAQ

BENEFITS

Individual Learning
Support self-regulated learning

Help Students 24/7
Promote just-in-time learning: available anytime, anywhere, anyhow

Intuitive Platform
Platform chosen provide a sense of familiarity to the users

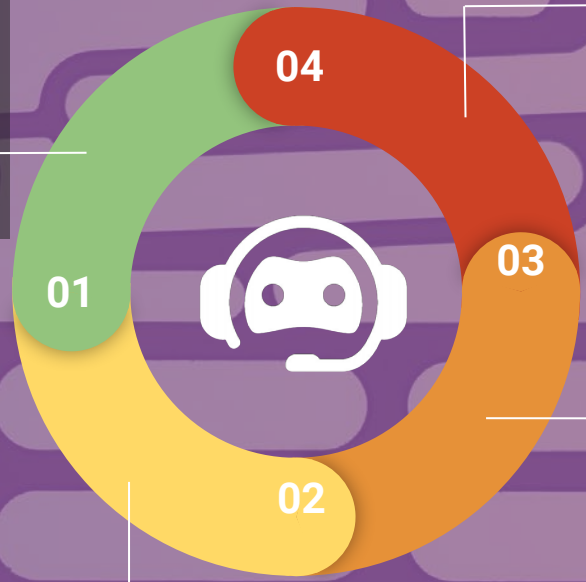
Improve Learning Effectiveness & Satisfaction
Decrease routine and repetitive task

Personalized Interaction & Engagement
Decrease routine and repetitive task

HOW-TO:
DEVELOP AN EDUCATIONAL CHATBOT

Step 1: Analysis of the Educational Chatbot Features

- Students' characteristics, e.g. technological skills, social skills, learning characteristics and self-regulation skills;
- E-learning contents and media; and
- Platform / encompassing system.



Step 2: Designing Chatbots

- Conversational strategies, e.g. personification, onboarding, feedback and error handling;
- Conversation scripting and flows;
- Context and memory of conversations; and
- Rich interactions, e.g. audio, video, images, files, links and formatting, emojis, persistent menus, and typing indications.

Step 3: Implementation

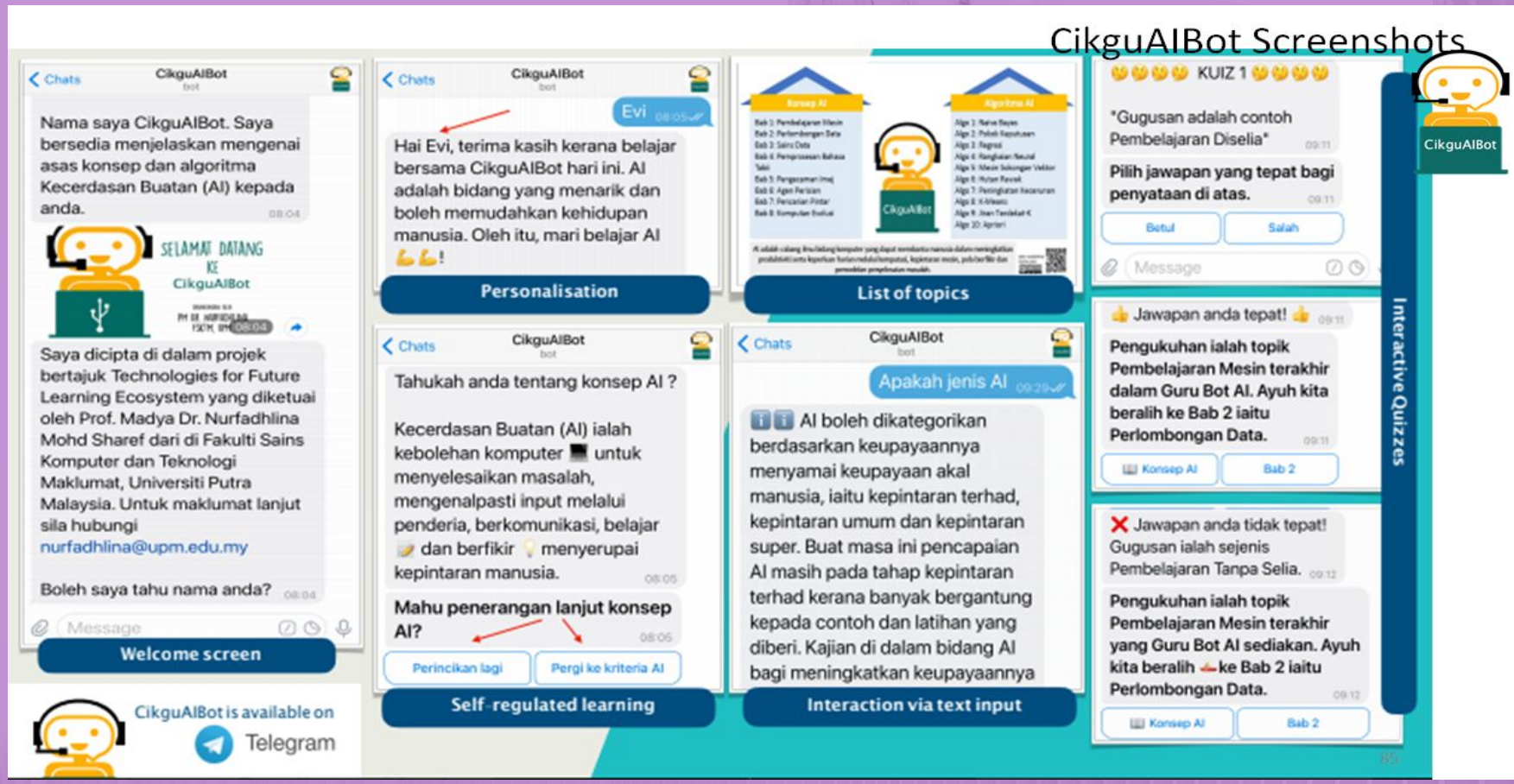
- Contents and media development;
- Chatbot development; and
- Deployment to the platform / encompassing system.

Step 4: Engagement Methods

- Notifications;
- User-led invocation; and
- Subscription.

TUTORING CHATBOT

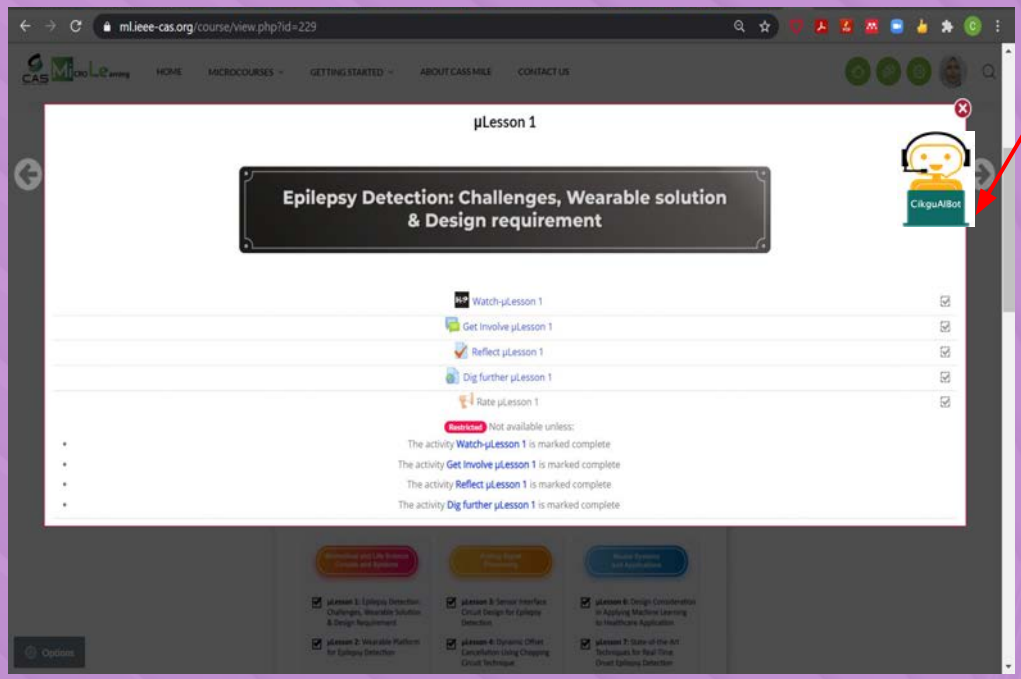
Telegram Dialogflow



Reference: Nasharuddin, N. A., Sharef, N. M., Mansor, E. I., Samian, N., Murad, M. A. A., Omar, M. K., Arshad, N. I., Shahbodin, F., Marhaban, M. H. (2021), *"Designing an Educational Chatbot: A Case Study of CikguAIBot,"* 2021 Fifth International Conference on Information Retrieval and Knowledge Management (CAMP), 2021, pp. 19-24, doi: 10.1109/CAMP51653.2021.9498011.

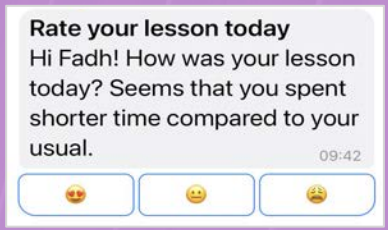
INTELLIGENT VIRTUAL ASSISTANT

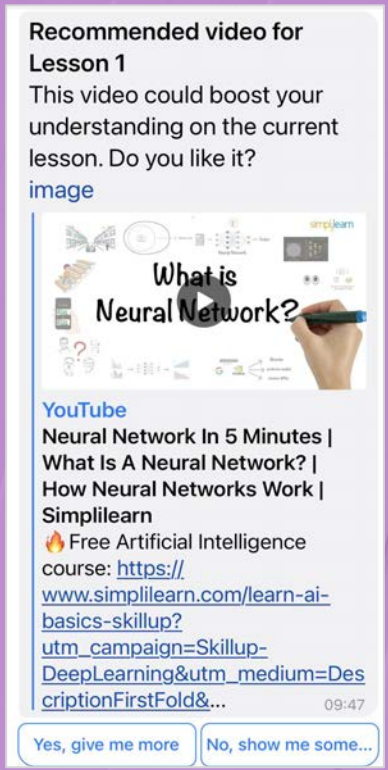
Engagement For Personalizing Learning Experience



Functions

1. Students get learning plan recommendations in the form of new learning materials
2. Students get alerts of upcoming lessons or any reminder
3. Students can access lessons of current week and past week
4. Students will get a warning if their participation is below average of the batch, and an alert when they are at risk



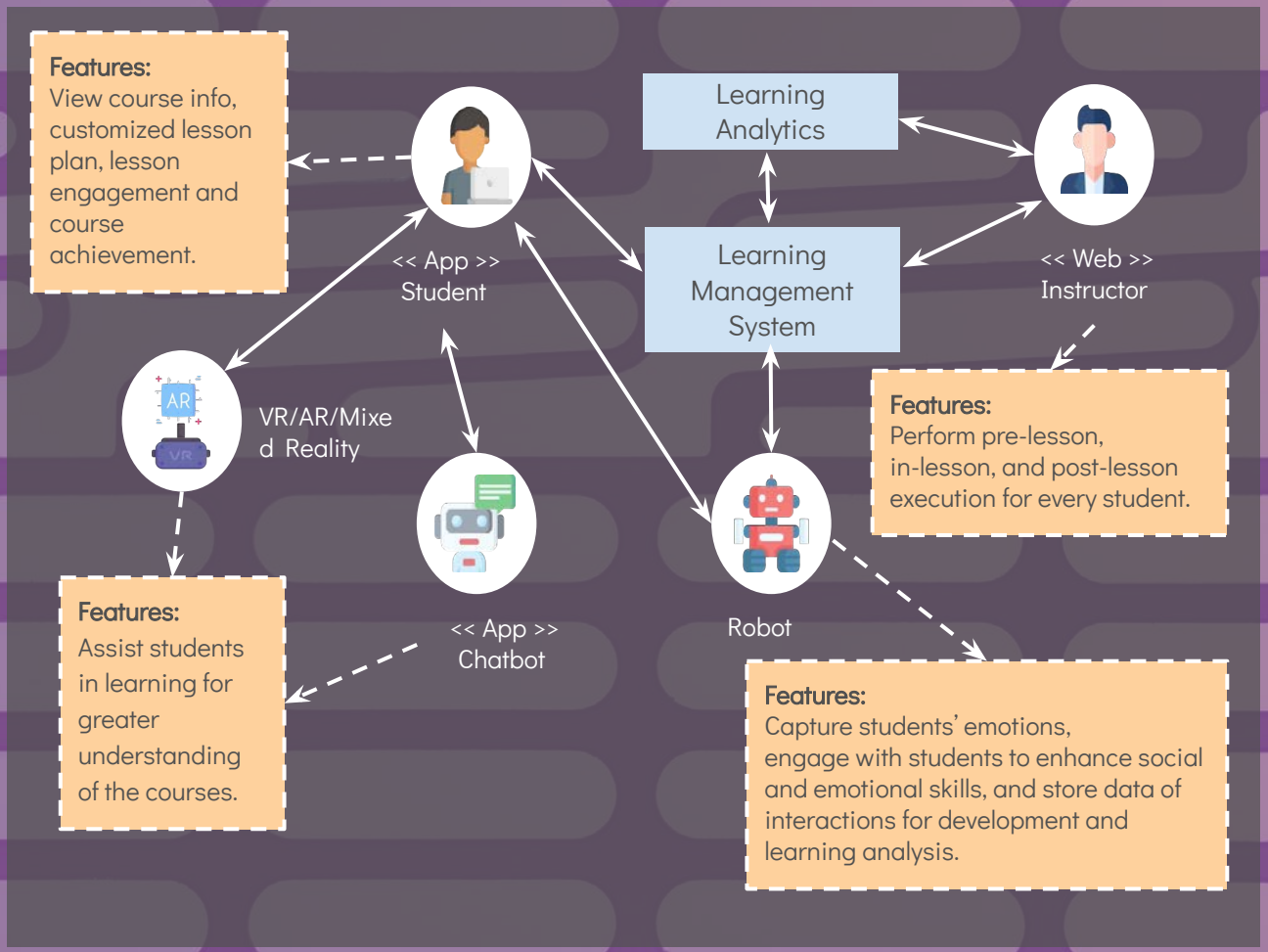


A virtual assistant is powered by AI through natural language processing and natural language generation to communicate in a human-like, two way conversation.

It can be integrated with other systems such as customer relationship management and email automation to provide context for the next round of communication.

It can also learn over time using the interaction history.

Conceptual Diagram and Examples
AI for Personalized LEARNING



Mindprint learning

https://mindprintlearning.com/

Cognitive screener that measures complex reasoning, executive functions and memory, and triangulates cognitive with academic and self-efficacy data.

Pandai

https://pandai.org/

Personalize learning content and assessment based on users profile to continuously identify improvements.

ACCENDO

https://accendotechnologies.com/

Talent intelligence to assess performance and recommend flexible learning pathways, connecting to career goals

Adaptive Technology

More info at http://squirrelai.com/

The Squirrel Ai Learning Intelligent Adaptive Learning System (IALS) provides student-centered intelligent and personalized education. It applies AI technology in the educational process of teaching, learning, evaluation, testing and training. Algorithms used are:

- Clustering algorithms such as k-means and EM are used to study how different types of students interact with systems;
- Logistic regression and EM to determine user ability;
- Item response theory, probabilistic theory, graph theory, Bayesian network for relationships between knowledge components and predicting the learning ability of learners when determining the time nodes for the next phase of learning; and
- Knowledge space theory, information entropy theory, Bayesian knowledge tracing technology together with logistic regression to diagnose knowledge state.

Modules in Squirrel IALS

User Persona Module

Provides fundamental support to other algorithms used in assessment and learning

Assessment Module

Infers learner knowledge mastery state and adjusts learner starting point on a knowledge graph

Learning Module

Shows learners where they are using the knowledge graph and pops up explanations automatically when the user gets a wrong response to the question

Reporting Module

Generates a report once learners complete a module, and offers the capability of comparing learners' learning results to others

Adaptive learning is an education technology that can respond to a student's interactions in real-time, by automatically providing the student with individual support

04

LEARNING ANALYTICS

Concept

Learning Analytics (LA) is defined as the measurement, collection, analysis and reporting of data about learners and their contexts, for the purposes of understanding and optimizing learning and the environments in which it occurs. It utilizes data analytics and studies how to employ data mining, machine learning, natural language processing, visualization, and human-computer interaction approaches, among others, to provide educators and learners with insights that might improve learning processes and teaching practice.

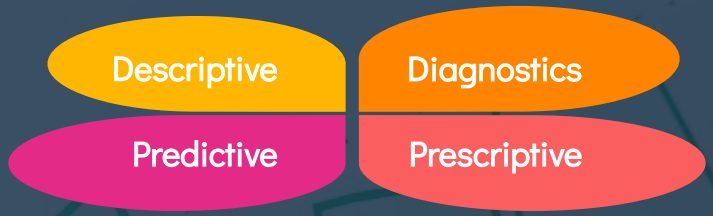
LA can be discussed as a tool, a process or an approach, depending on the perspectives and priority of the stakeholders. Deciphering learning trends and patterns from educational data requires techniques that combine pedagogical needs understanding, pedagogical design and instructional approaches, big data management, statistics analysis, machine learning algorithms and model developments and visualisation. The importance of measuring learning are as follows:

- To gauge whether your course/program is working as you intended it to work;
- To identify the top, active and passive learners;
- To chart a course of action to engage your passive (or other) learners;
- To make a comparative analysis of your courses and learners;
- To evaluate instructor/teacher/any other role performance; and
- To allocate your resources and strategize decision-making.

Types of LEARNING ANALYTICS

"What has already happened?"
Visualization of learning patterns

"Why something happen?"
Hypothesizing factors of performance and satisfaction



"Who could be at risk?"
Prediction of low achievement or engagement

"What should we do?"
Recommended action for further teaching and learning

Questions from analytics that can unleash insights:

- What is the learner engagement status compared to class average? Which learner needs attention?
- What is the relationship between learner progress and success? Does student learning and achievement patterns differ across courses?
- What is the pattern of time spending for each learning materials, activities and assessments?
- What are the important attributes to be used in predicting students' marks? Who is at risk?
- Does course design affects learning satisfaction, participation and achievement?

Learning analytics holds the potential to:

- Explain unexpected learning behaviors;
- Identify successful learning patterns;
- Detect misconceptions and misplaced effort;
- Adapt teaching approaches as interventions; and
- Increase users' awareness of their own actions and progress.

STEPS FOR LEARNING ANALYTICS DEVELOPMENT

1. Plan and gather data	Extract questions to be answered from key stakeholders, identify and collect data sources, set scope of analytics, prepare relevant tools and form execution team
2. Clean and explore data	Prepare a data lake and execute data pre-processing by integrate, filter, transform and standardize data
3. Analyse and visualize data	Apply statistics to perform descriptive and exploratory data analytics, build dashboard to visualize and identify trends, gaps and anomalies
4. Build analytics model	Mine data and apply machine learning algorithms for diagnostics and predictive analytics, perform testing and evaluations, identify rules and patterns for prescriptive analytics
5. Present insights	Report findings through dashboards, implement learned model through policy and execute awareness campaign to create culture, continue model improvement to support decision making

STEPS FOR LEARNING ANALYTICS IMPLEMENTATION

Define policy objectives

Develop strategy, plan for execution and aims from the insights brought by the learning analytics

Identify stakeholders

Determine the user of the learning analytics solutions, conduct training, form guidelines and procedures to support the aims

Identify the purposes

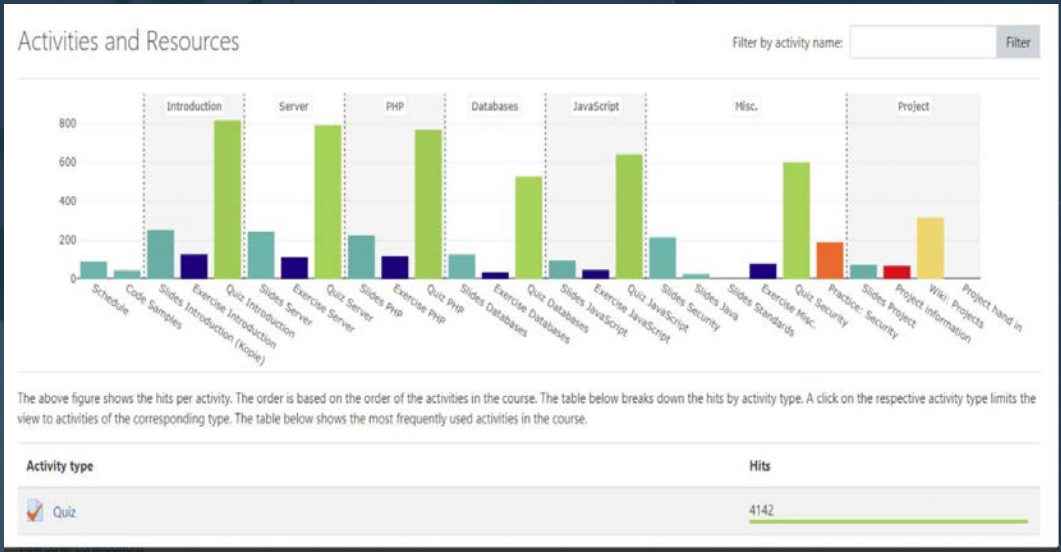
Set aim to achieve and the purpose from the insights brought by the learning analytics

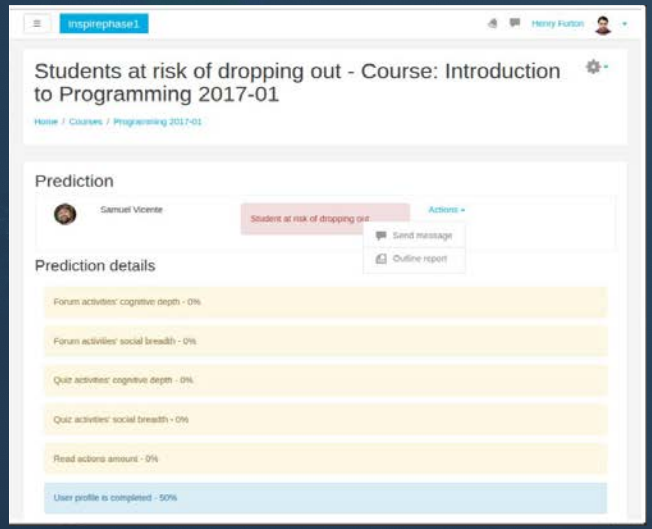
Build awareness and performance indicators

Continuously monitor, improve and take actions as intervention mechanism based on the insights

MOODLE PLUGIN FOR
LEARNING ANALYTICS

Explore Moodle learning analytics plugins at
https://moodle.org/plugins/index.php?q=analytics





While descriptive learning analytics informs about analysis based on existing data, diagnostics learning analytics focuses on understanding the factors contributing to certain happenings. The application of machine learning in predictive learning analytics allow instructors and students to get predictions such as grades and marks so they could perform suitable intervention mechanisms.

The prediction model could be developed based on features such as participation, student preferences and carrying marks. Machine learning can also be applied to personalise learning plans and learning contents by utilising the students' performance and preferences ratings. Student acceptance over the auto-generated recommendation can be further learned so the model will differentiate between and attend to individual learning needs.

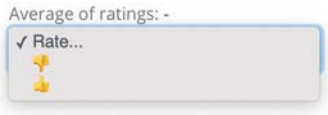
Analytics plugin available in Moodle

1. Grades Chart
2. Content Accesses Chart
3. Assignment Submissions Chart
4. Hits Distribution Chart
5. Engagement Analytics
6. Rubrics-enriched Grading
7. Behavior Analytics
8. Intelligent Content Recommendations (Adaptive Content)
9. Advanced Predictive Learning Analytics
10. Device Analytics

REPORTS & ANALYTICS

Learning Progress and Completion

Feedback '*get Involved*' in Micro Lesson : (Thumbs up/down)

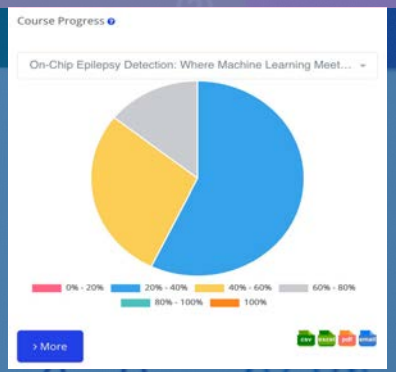


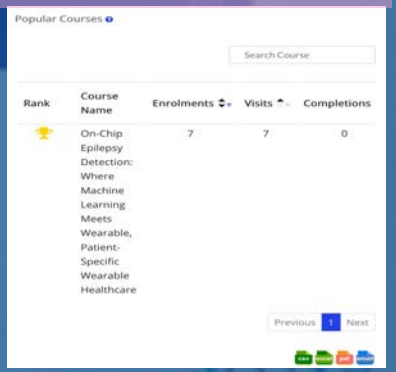
Completion of micro lesson (Rating 1-5 star)

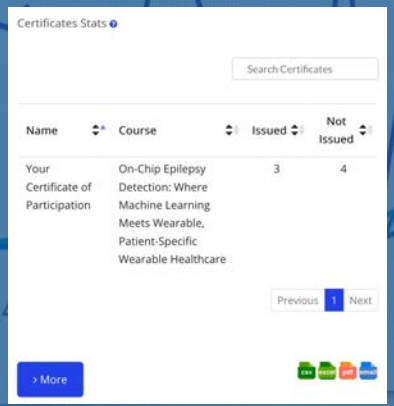
Completion of lesson/microcourse: (Short survey)

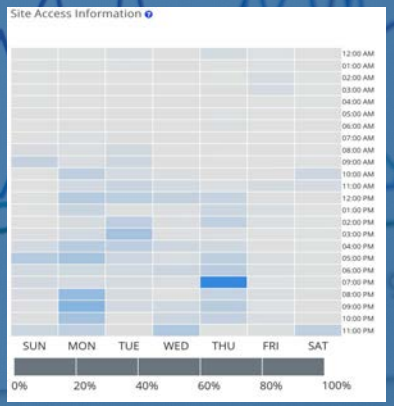
Besides using ready analytics from plugins, there are several features inside Moodle that can be utilised for analytics such as:

- Logs page – records individual interactions in table format;
- Activity reports – presents the popularity of resources and activities;
- Course participation – identifies whether students have engaged with content within a set timeframe; and
- Activity completion – shows if students have met the completion criteria that have been set.





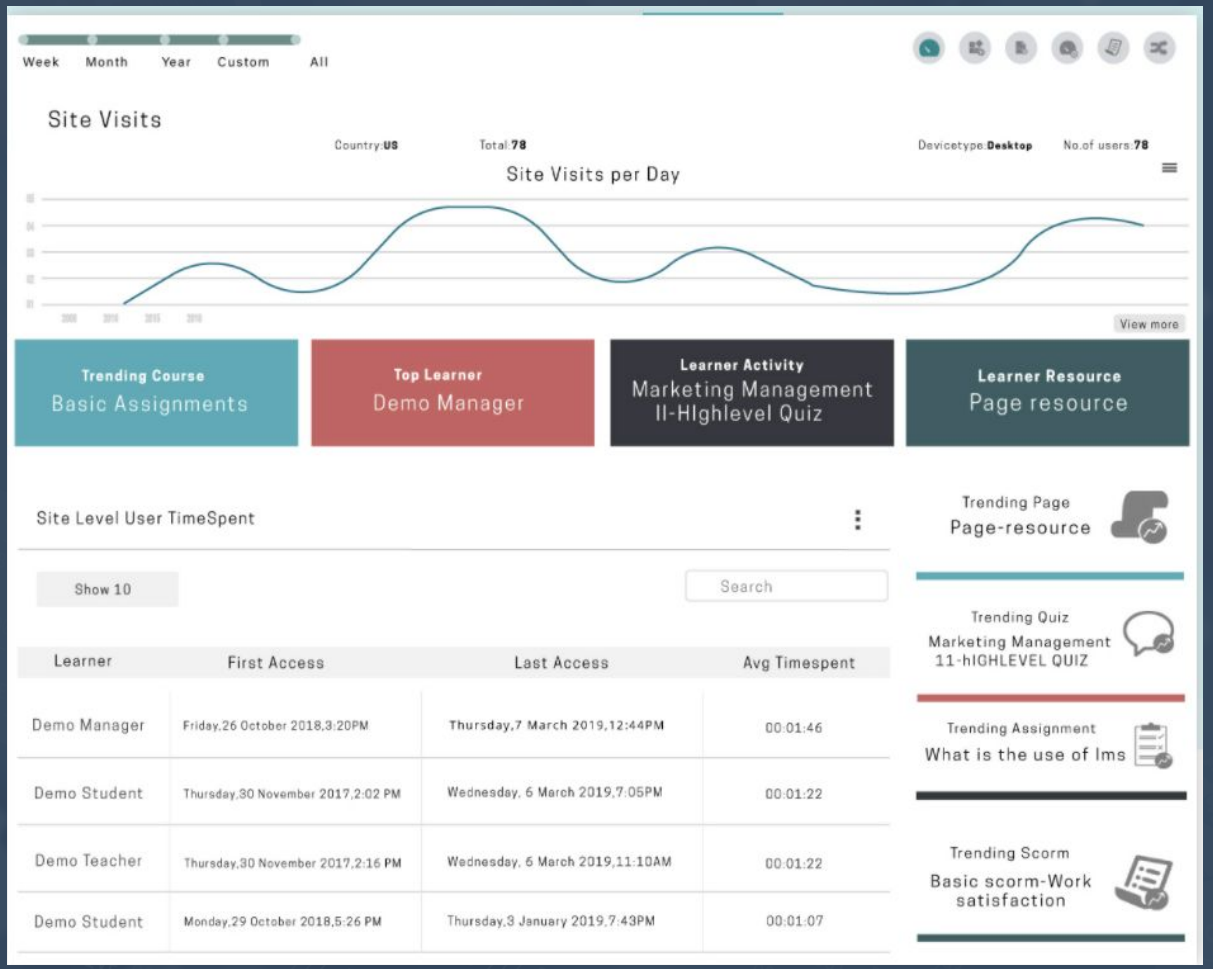




LMS Plugin for
LEARNING ANALYTICS

LearnerScript

Info sourced from https://learnerscript.com/



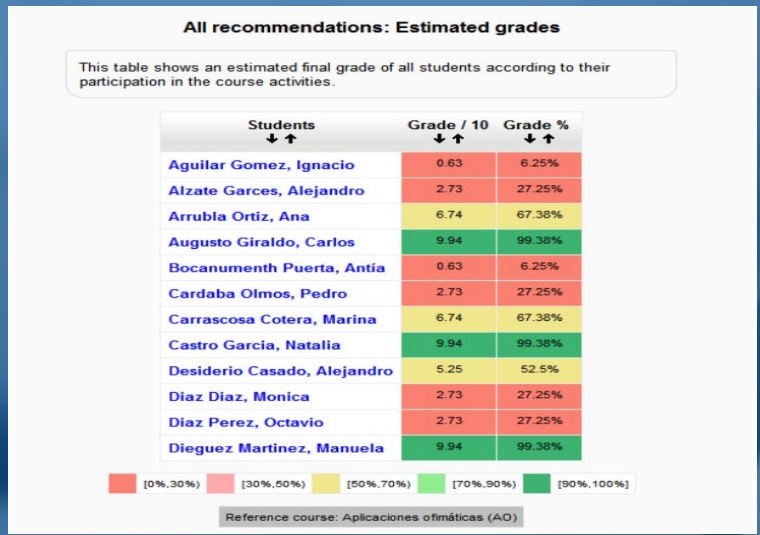
LearnerScript comes with readily available 80+ Canned Reports for users to analyze and visualize Moodle LMS data in the forms of various graphs, charts and tables, for actionable insights.

Features include:

1. Summarizes all course-related activities like – top trending courses, no. of course enrollments, course status, etc.;
2. Get a summary of learning activities like Enrolled, In-progress, Completed courses, etc. Drill-down for further insights and perform comparative analysis with peers to see who is good at what;
3. Use comparative analysis of courses to know which course is doing well;
4. Customize dashboards, or even add a custom Moodle reporting dashboard; and
5. Configure new reports, widgets and tiles.

MOODLE Plugin Example for
LEARNING ANALYTICS

Info sourced from https://moodle.org/plugins/block_analytics_recommendations



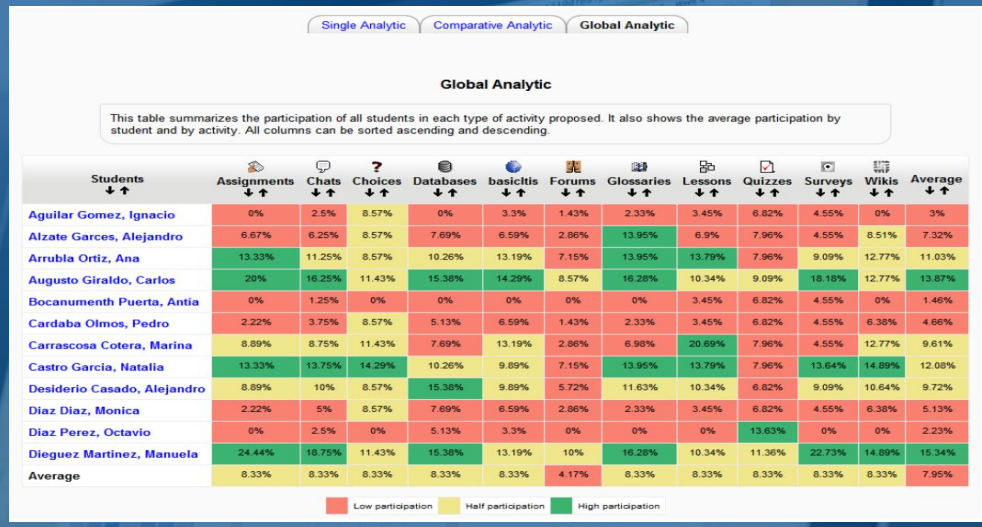
All recommendations: Estimated grades

This table shows an estimated final grade of all students according to their participation in the course activities.

Students	Grade / 10	Grade %
Aguilar Gomez, Ignacio	0.63	6.25%
Alzate Garces, Alejandro	2.73	27.25%
Arrubla Ortiz, Ana	6.74	67.38%
Augusto Giraldo, Carlos	9.94	99.38%
Bocanumenth Puerta, Antía	0.63	6.25%
Cardaba Olmos, Pedro	2.73	27.25%
Carrascosa Cotera, Marina	6.74	67.38%
Castro Garcia, Natalia	9.94	99.38%
Desiderio Casado, Alejandro	5.25	52.5%
Diaz Diaz, Monica	2.73	27.25%
Diaz Perez, Octavio	2.73	27.25%
Dieguez Martinez, Manuela	9.94	99.38%

[0%,30%) [30%,50%) [50%,70%) [70%,90%) [90%,100%]

Reference course: Aplicaciones ofimáticas (AO)



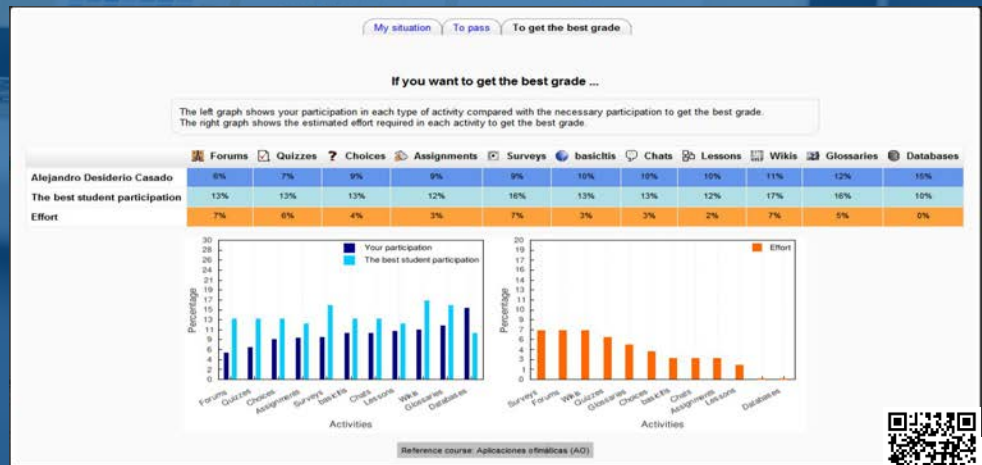
Single Analytic | Comparative Analytic | Global Analytic

Global Analytic

This table summarizes the participation of all students in each type of activity proposed. It also shows the average participation by student and by activity. All columns can be sorted ascending and descending.

Students	Assignments	Chats	Choices	Databases	basicltis	Forums	Glossaries	Lessons	Quizzes	Surveys	Wikis	Average
Aguilar Gomez, Ignacio	0%	2.5%	8.57%	0%	3.3%	1.43%	2.33%	3.45%	6.82%	4.55%	0%	3%
Alzate Garces, Alejandro	6.67%	6.25%	8.57%	7.69%	6.59%	2.86%	13.95%	6.9%	7.96%	4.55%	8.51%	7.32%
Arrubla Ortiz, Ana	13.33%	11.25%	8.57%	10.26%	13.19%	7.15%	13.95%	13.79%	7.96%	9.09%	12.77%	11.03%
Augusto Giraldo, Carlos	20%	16.25%	11.43%	15.38%	14.29%	8.57%	16.28%	10.34%	9.09%	18.18%	12.77%	13.87%
Bocanumenth Puerta, Antía	0%	1.25%	0%	0%	0%	0%	0%	3.45%	6.82%	4.55%	0%	1.46%
Cardaba Olmos, Pedro	2.22%	3.75%	8.57%	5.13%	6.59%	1.43%	2.33%	3.45%	6.82%	4.55%	6.38%	4.66%
Carrascosa Cotera, Marina	8.89%	8.75%	11.43%	7.69%	13.19%	2.86%	6.98%	20.69%	7.96%	4.55%	12.77%	9.61%
Castro Garcia, Natalia	13.33%	13.75%	14.29%	10.26%	9.89%	7.15%	13.95%	13.79%	7.96%	13.64%	14.89%	12.08%
Desiderio Casado, Alejandro	8.89%	10%	8.57%	15.38%	9.89%	5.72%	11.63%	10.34%	6.82%	9.09%	10.64%	9.72%
Diaz Diaz, Monica	2.22%	5%	8.57%	7.69%	6.59%	2.86%	2.33%	3.45%	6.82%	4.55%	6.38%	5.13%
Diaz Perez, Octavio	0%	2.5%	0%	5.13%	3.3%	0%	0%	0%	13.63%	0%	0%	2.23%
Dieguez Martinez, Manuela	24.44%	18.75%	11.43%	15.38%	13.19%	10%	16.28%	10.34%	11.36%	22.73%	14.89%	15.34%
Average	8.33%	8.33%	8.33%	8.33%	8.33%	4.17%	8.33%	8.33%	8.33%	8.33%	8.33%	7.95%

Low participation | Half participation | High participation



My situation | To pass | To get the best grade

If you want to get the best grade ...

The left graph shows your participation in each type of activity compared with the necessary participation to get the best grade.
The right graph shows the estimated effort required in each activity to get the best grade.

	Forums	Quizzes	Choices	Assignments	Surveys	basicltis	Chats	Lessons	Wikis	Glossaries	Databases
Alejandro Desiderio Casado	6%	7%	9%	9%	9%	10%	10%	10%	11%	12%	15%
The best student participation	13%	13%	13%	12%	16%	13%	13%	12%	17%	16%	10%
Effort	7%	6%	4%	3%	7%	3%	3%	2%	7%	5%	0%

Your participation
The best student participation
Percentage
Activities

Effort
Percentage
Activities

Reference course: Aplicaciones ofimáticas (AO)

1. Analytics and Recommendations is a Moodle plugin. It uses charts and tables that are color coded so students can quickly see their participation.
2. Students can see single analytics about their participation in the course. Teachers can see single, comparative analytics and global analytics (all students together).
3. Moreover, the block shows recommendations for students about what activities they should do to improve their final grade. It shows a estimated final grade with a reference course.

AT-RISK PREDICTION

Early alert indicator dashboard

OU Analyse

Info sourced from
https://analyse.kmi.open.ac.uk/

Predictions

25 | Export | Select columns

Student Information				Next TMA predictions Generated: 10/03/21 (today) Week: 5		Long term predictions Generated: 25/02/21 (13 days ago) Week: 3	
	Student PI	Name	TMA	Submission	Risk of NS	Completion	Passing
–	AXXXXXXX	Cynthia Reinger		Submit		51-60%	51-60%
⚑	AXXXXXXX	Noah Kreiger		Not Submit		41-50%	41-50%
–	AXXXXXXX	Antwan Murray		Submit		51-60%	51-60%
–	AXXXXXXX	Santos Gorczany		Submit		51-60%	51-60%
–	AXXXXXXX	Rowan Goodwin		Submit		41-50%	41-50%
▼	AXXXXXXX	Rashawn Stark		Not Submit		71-80%	71-80%
▼	AXXXXXXX	Marjorie MacGyver		Not Submit		N/A	N/A
⚑	AXXXXXXX	Lexie Kozey		Not Submit		41-50%	41-50%
⚑	AXXXXXXX	Luis Dicki		Not Submit		31-40%	31-40%
–	AXXXXXXX	Domingo Sauer		Submit		61-70%	61-70%
–	AXXXXXXX	Cary Rohan		Submit		71-80%	51-60%
	AXXXXXXX	Willard Sanford	S	N/A	N/A	41-50%	41-50%

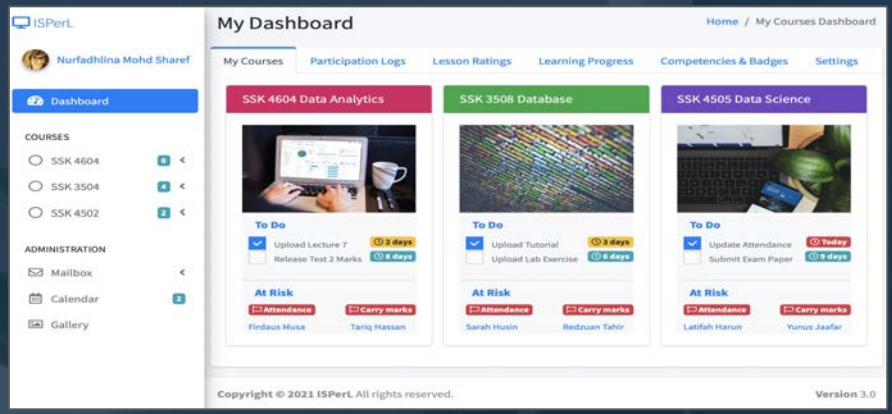
Figure: Example screenshot of the Early Alert Indicators dashboard showing (a) short term predictions i.e., the probability a student will submit their next assignment (see Teacher-Marked Assessment - TMA) and (b) long term predictions i.e. the probability of completing and passing the course (Note: student names are not real)

Survivability prediction is one of the main factors contributing to the popularity of learning analytics, as users could gain insight on student retention.

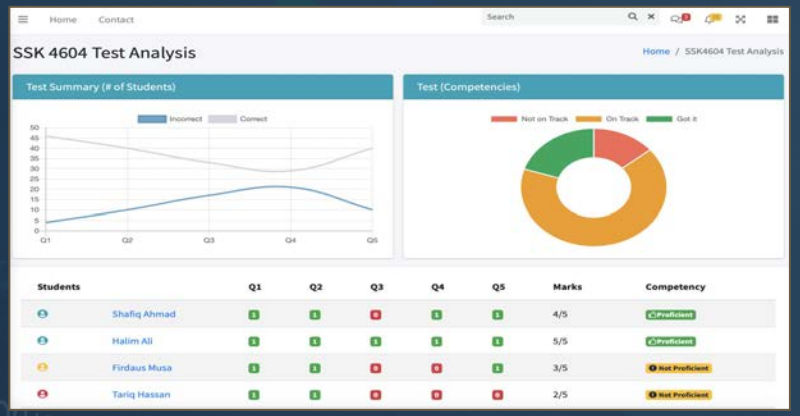
Besides, learners-at-risk also allows curricular intervention while understanding the relationship between learning behavior and student performance.

Source: Herodotou, C., Maguire, C., McDowell, N., Hlosta, M., & Boroowa, A. (2021). The engagement of university teachers with predictive learning analytics. *Computers and Education*, *173*(June), 104285.

Concepts of Analytics for PERSONALIZING LEARNING



Example interface of LMS with learning analytics personalized learning

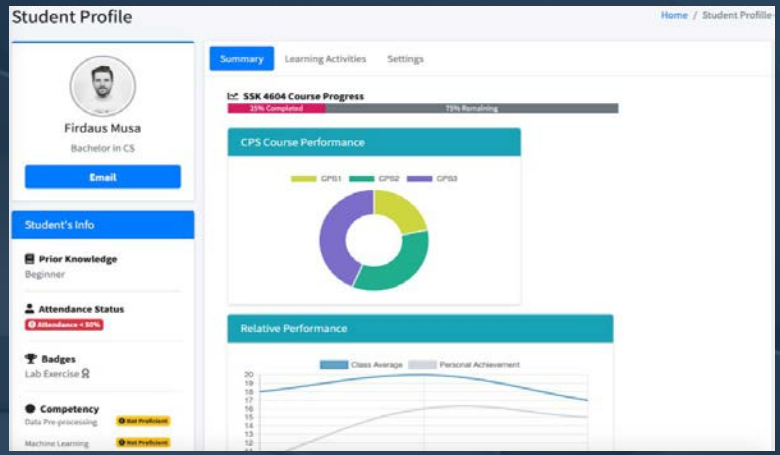


Example interface of LMS with learning analytics personalized learning

Talaqqi based pedagogical approach emphasizes on the human as the learning facilitator is substantial in a personalized learning implementation.

The automation from the recommended learning materials, adapted activities and differentiated assessments are reported as an assistive mechanism for the instructors and administrators to perform course and program intervention.

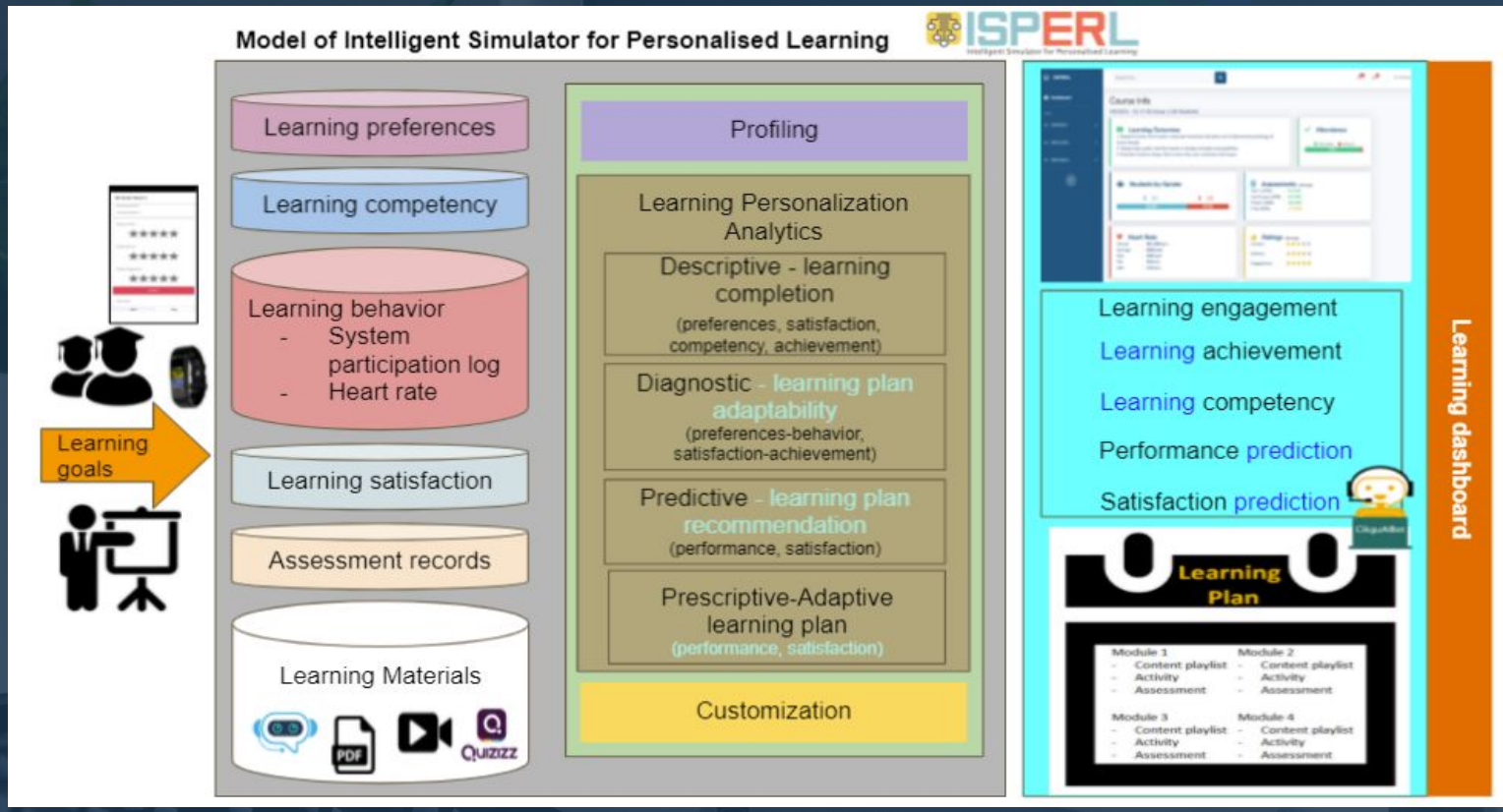
This integration of human-machine interaction improves the efficiency of humans, as well as optimizes learning experience and competency-building achievements.



Example interface of LMS with learning analytics personalized learning

Reference: Sharef, N. M., et. al (2020), "Learning-Analytics based Intelligent Simulator for personalized Learning", International Conference of Advancements in Data Science, e-Learning and Information Systems https://ieeexplore.ieee.org/document/9276858

Concepts of Analytics for PERSONALIZING LEARNING



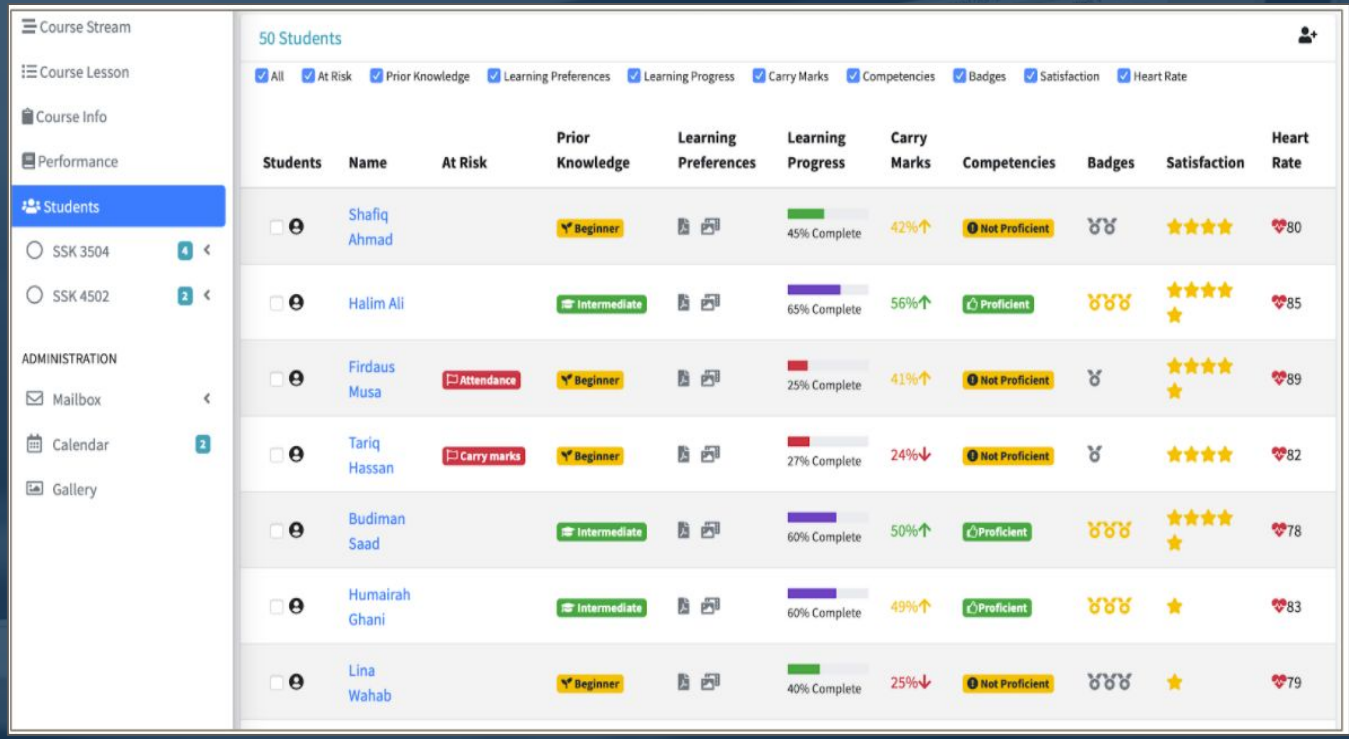
Learning analytics model for personalized learning

Reference: Sharef, N. M., et. al (2020), "Learning-Analytics based Intelligent Simulator for personalized Learning", International Conference of Advancements in Data Science, e-Learning and Information Systems
https://ieeexplore.ieee.org/document/9276858

Concepts on Analytics for
PERSONALIZING LEARNING

Learning analytics can be harnessed as an educational recommender system to support the implementation of personalized learning by:

1. Producing reports of achievement, participation and engagement to instructors;
2. Predicting students at-risk;
3. Automating notification and feedback to learners; and
4. Recommending materials, activities and assessments that could optimize learning experience and performance.



Potential and at-risk students could be identified, and comparison between expected and real results could also take place.

By analysing each student's progress and marks distribution, instructors could analyse the strengths and weaknesses, as each assessment typically measures certain competencies.

LMS Plugin Example for PERSONALIZED LEARNING

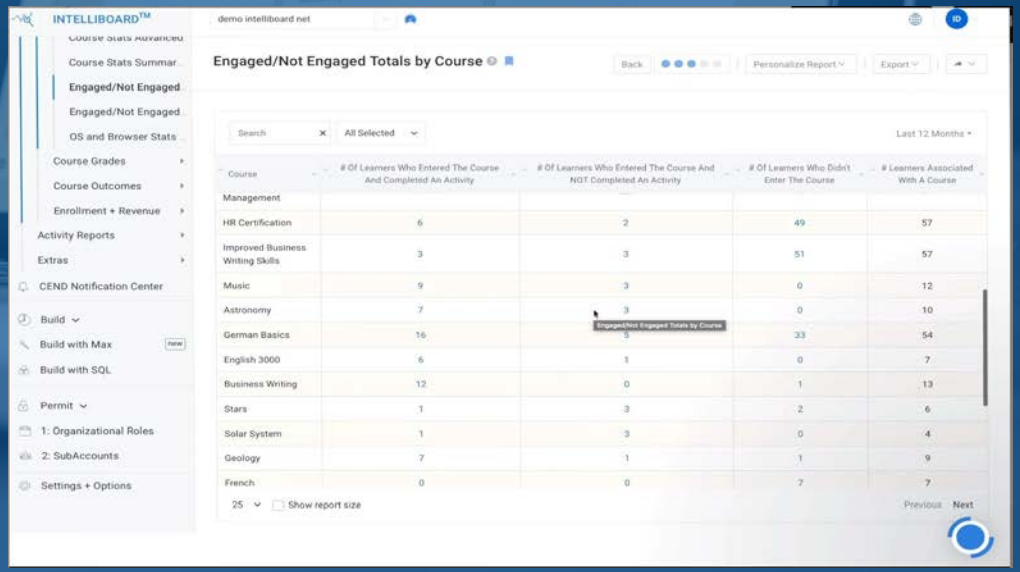
IntelliBoard™

Info sourced from https://intelliboard.net/

Real-time customizable reports with automated notifications and dashboards for learners and instructors

FEATURES

1. Identify patterns of learner behavior and create appropriate interventions to keep learners focused.
2. Use multiple reports that identify at-risk learners using institutional parameters.
3. Compare course performance across time, learner and instructor.
4. Get to know learners and compare individual learners: high achieving, at-risk, and under-engaged; in real-time.
5. Schedule reports for when you need them. Create event notifications based upon defined triggers.



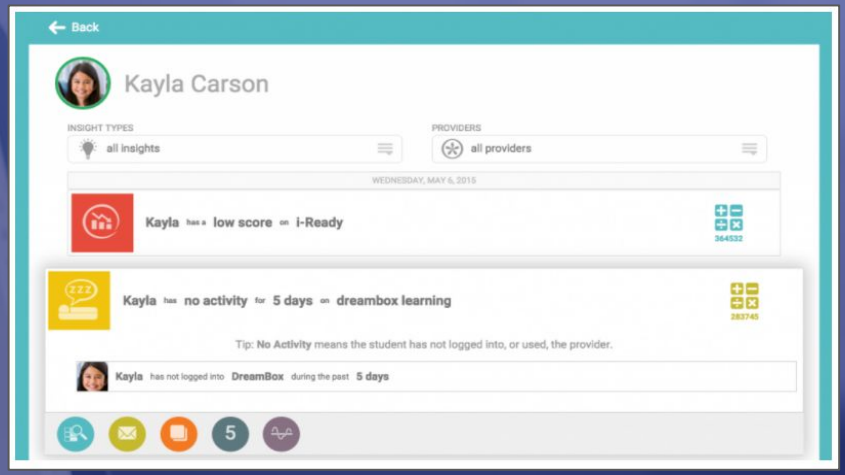
Application Example for
PERSONALIZED LEARNING

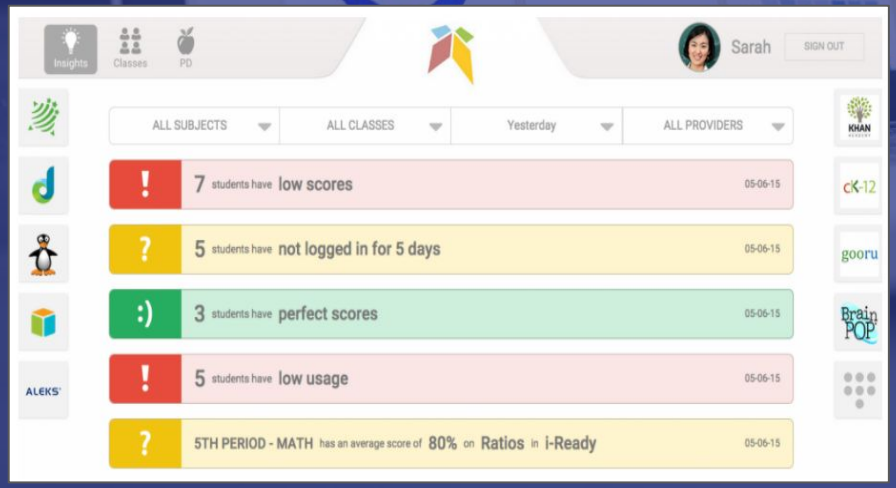
Highlight Personalized by Education Elements

Info sourced from https://www.edelements.com/personalized-learning

Highlight from Education Elements is a cloud-based personalized learning platform (PLP) being used in over 100 schools across the United States.

1. Student LaunchPad - Students can access digital content, tools and web resources from one place conveniently.
2. Insights for Teachers - Automatically recognizes patterns in student performance, saving teacher time and making it easier to adjust the learning experience.
3. Activity and Usage Reports - Teachers can review class progress toward goals and see trends in performance over time.
4. School and District Leader Dashboard - Leaders can view digital content data across all schools and classrooms. This data can help to maximize product usage and minimize wasted licenses.





LMS Plugin Example for
PERSONALIZED LEARNING

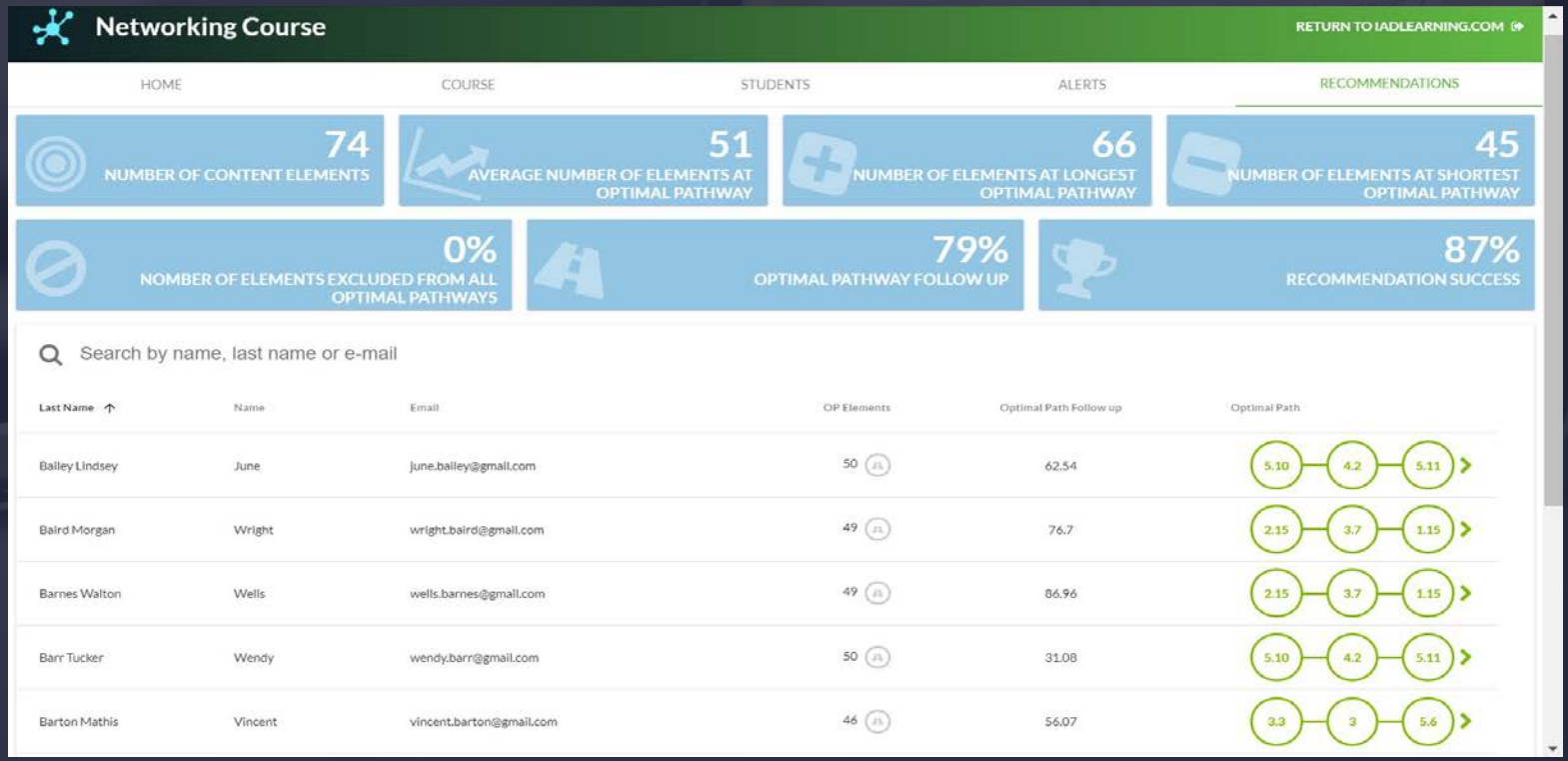
IADLearning

Demo and info sourced from :
https://dashboard.elearningcloud.net/students

Students acquire personalized content recommendations based on their profiles and on the cumulative experience of other students that already went through the same materials.

Teachers and institutions get predictive learning analytics, content and navigation alerts based on the students' interaction with the course content and their progress.

Proactive follow-up actions are taken based on the analytics generated and displayed by IADLearning.



LMS Plugin Example For
PERSONALIZED LEARNING

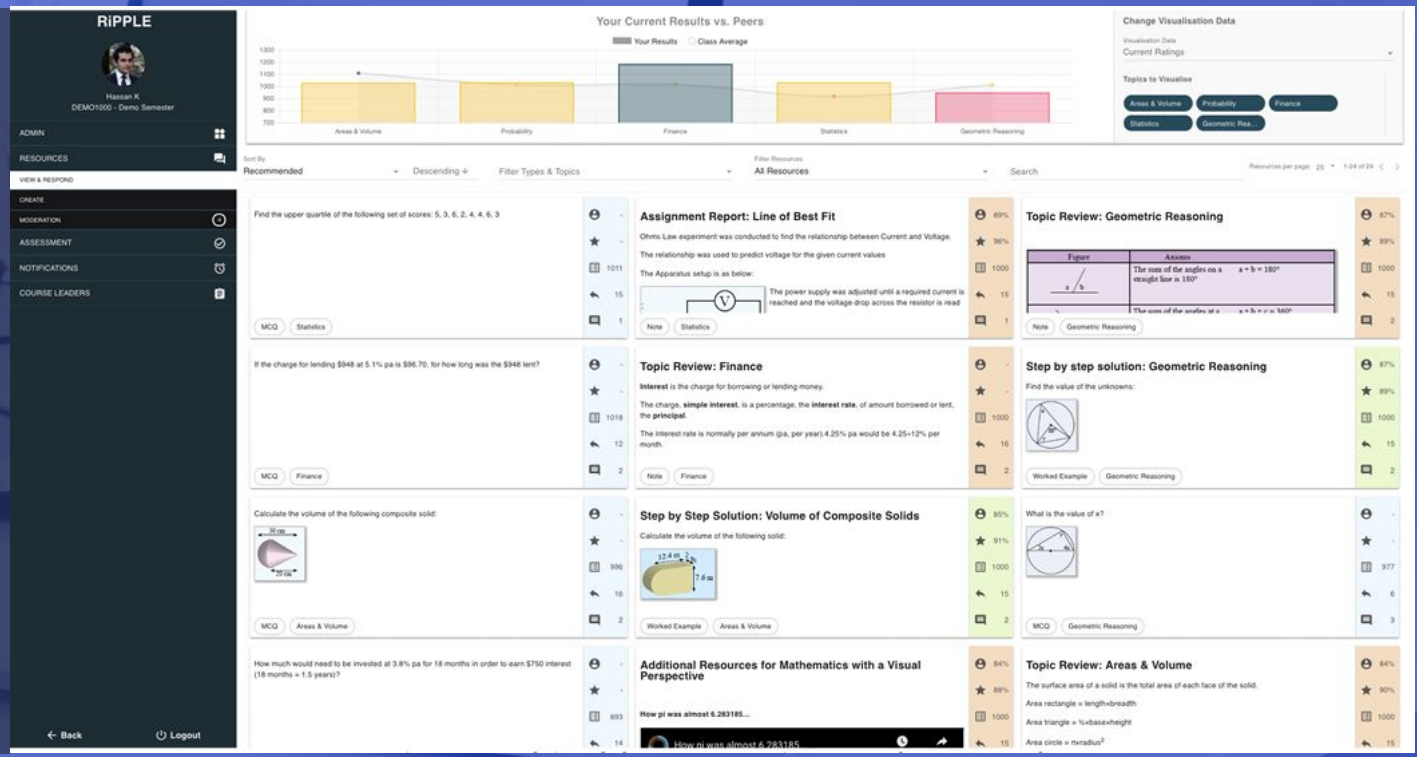
RIPPLE

Info sourced from http://ripplelearning.org/

Recommendation in personalized Peer-Learning Environments (RIPPLE) is developed by the University of Queensland. RiPPLE leverages the science of learning, crowdsourcing, and AI to improve students' active engagement, satisfaction, and learning.

Features:

1. Engages students in creating, evaluating and analysing knowledge.
2. Employs crowdsourcing to provide rich and timely feedback to students.
3. Provides a tailored learning path for each student based on their academic abilities.



05

WAY FORWARD

HOW TO TRANSFORM?
BLENDING RESEARCH, INNOVATION, AND ENTERPRISE-LEVEL SERVICE DELIVERY

Higher education institutions are transforming towards higher embracement of an "anyone anywhere anytime" model of education, opening up great access for more people to pursue degrees and credentials through learning technology, fluid curriculum design, and free tuition programs. Meanwhile, Artificial Intelligence (AI) and Learning Analytics (LA) are the key technologies that have growing importance on the future of postsecondary teaching and learning along several dimensions of significance: equity and inclusion, learning outcomes, risks, learner and instructor receptiveness, cost, and importance for more flexible approaches to teaching and learning.

The challenges to follow in detail how students behave while learning in Learning Management Systems may have rather crucial consequences, especially for evaluating students' online learning activities and behaviors. Investigating learners' interaction with a course by means of learning analytics can provide useful information about their learning experience and behavior. Various approaches and tools have been made available, but the implementation of personalized learning at scale requires a holistic strategy. This involves competencies of the instructors, dedication of the learners, evidence-based learning with data and analytics as the core of governance. Code of practice and ethics of the infusion of humanoid and increased automation should also be in place.

This section concludes by discussing the **way forward**, options and strategies to be undertaken to ensure that technologies for future learning could be harnessed to increase productivity, and overall quality of learning experience. Learners' and instructors' mental health would also improve as institutions implement more humanized and relational forms of learning. It is expected that enrollment rates would increase, while ensuring that resilient learners are produced. Implications should be observed such as the risks of collecting and analyzing student data, especially for learners from peripheries and with barriers to learning, to avoid them being vulnerable to exploitation. Data practices in higher education should also be carried out in a manner that pays back to the communities from which data is extracted.

PERSONALIZED LEARNING
NEEDS OF IMPLEMENTATION FRAMEWORK

Personalized learning can be implemented in an institution based on the following phases:

PHASE 1 – Plan & Align

PHASE 2 – Foundations: Assess your resources

PHASE 3 – Design: Defining your audience, the messages, and messengers

PHASE 4 – Reflect and Iterate: Define your measures of success

For personalized learning to reach its true potential, the community must work together on multiple fronts:

1. **Educators** must know how to use technology to engage, motivate, and personalize learning with their students;
2. **Researchers** must evolve new methodologies that embrace the diversity of learners for testing the effectiveness of products, programs, and interventions;
3. **Developers** must create tools that are more precisely and intentionally tuned to the specific aspects of learning for individuals across all content areas and developmental stages; and
4. **Collegial leadership** must be in place to strategize, administer, enforce, support and facilitate educators and program providers for implementation, complemented with suitable technologies.

PERSONALIZED LEARNING WITH ANALYTICS
IMPLEMENTATION AT-SCALE

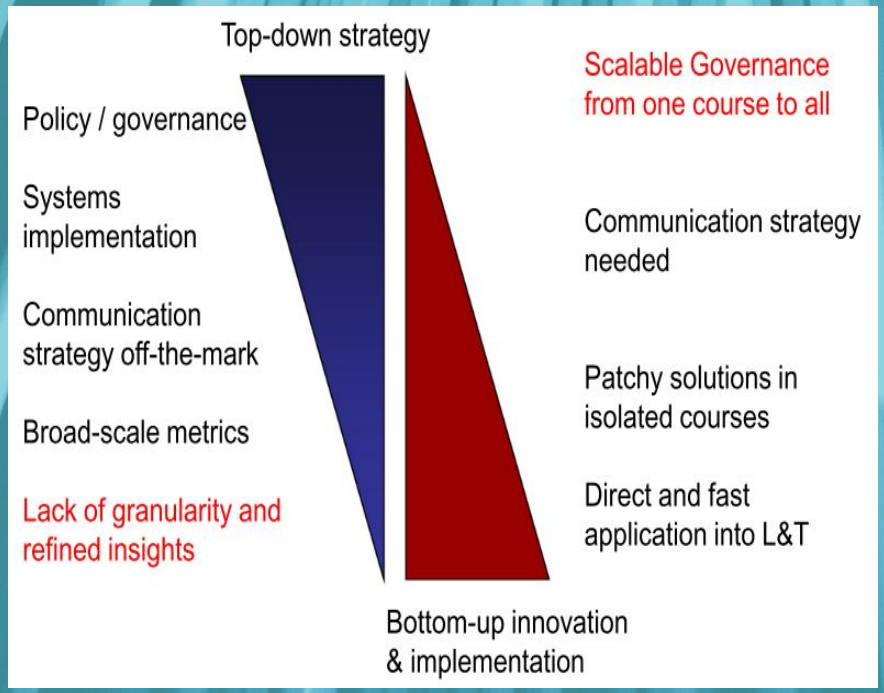


Figure: Top-down vs. bottom-up approaches in designing and delivering learning analytics solutions at university level

Source: Munguia et. al (2020), "A learning analytics journey: Bridging the gap between technology services and the academic need", The Internet and Higher Education 46 (2020) 100744

Scaling Nationally: 7 Lessons Learned

Lesson 1: The team needs a number of core roles in order to succeed

Lesson 2: Do not expect process change to occur quickly

Lesson 3: The tools should be developed with users and match their terminology and processes

Lesson 4: Applying standards to data really does work

Lesson 5: Do not underestimate legal and contractual complexity

Lesson 6: Users want to understand predictive models (and that is hard)

Lesson 7: Consider the innovation chasm

Info sourced from: https://www.slideshare.net/mwebbjisc/lak2018-scaling-nationally-seven-lesson-learned

TAKING LEARNING ANALYTICS TO PRACTICE
BRIDGING THE GAP BETWEEN TECHNOLOGY SERVICES AND THE ACADEMIC NEED

Research in learning analytics has studied various aspects encompassing visualization, interaction, machine learning and pedagogical effectiveness; but technology readiness to support real-world education challenges are still limited.

Governance that embraces the usage of learning analytics covering ethics, infrastructure, expectations and competencies to empower and improve students, lecturers and institutions should also be given more attention.

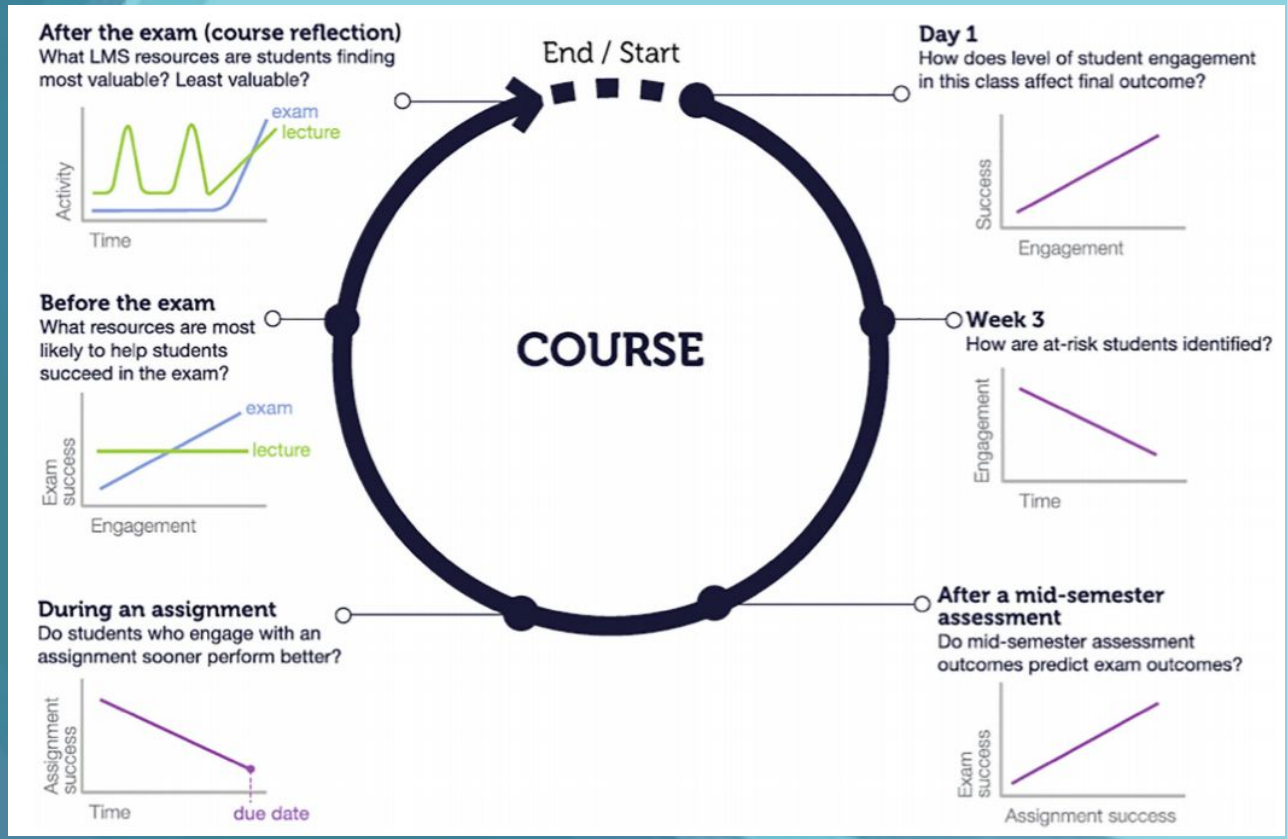


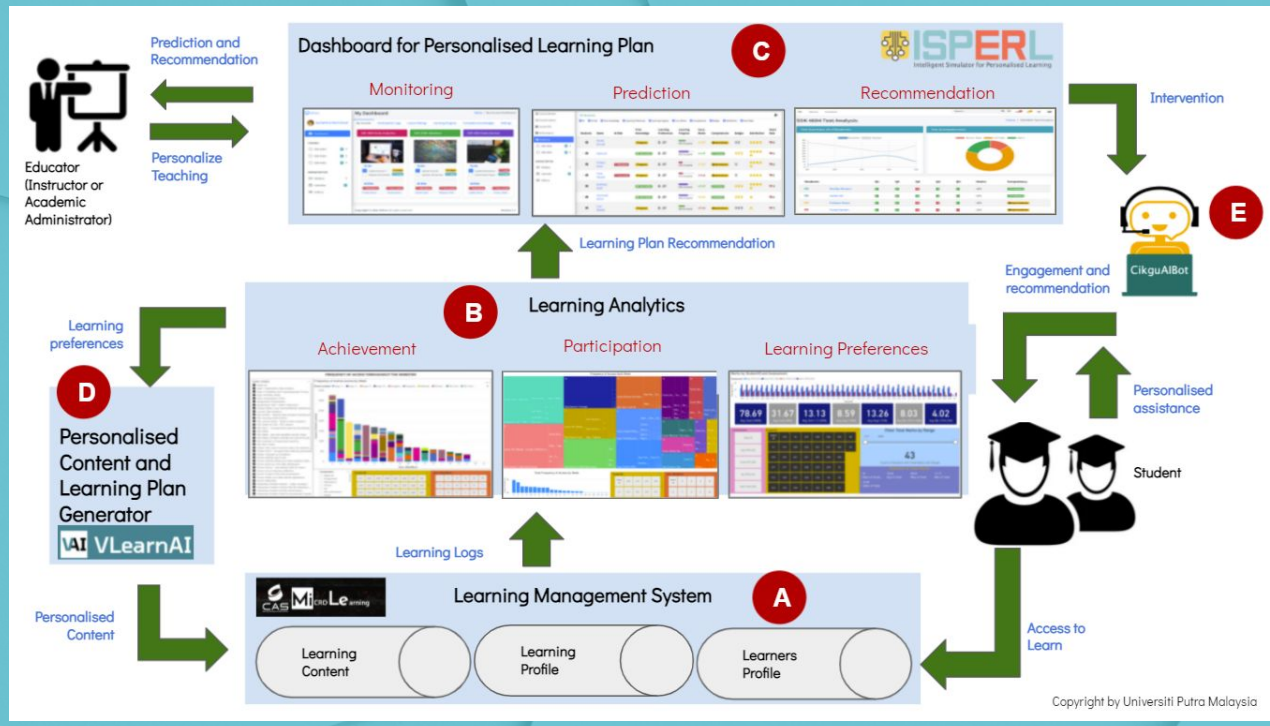
Figure: Example on set of guidelines to help academics interpret LMS data at different points in a semester

Info sourced from: Munguia et. al (2020), "A learning analytics journey: Bridging the gap between technology services and the academic need", The Internet and Higher Education 46 (2020) 100744.

INTERACTIVE INTELLIGENCE
FOR ASSISTIVE PERSONALIZED LEARNING

Adaptive learning uses data to adjust the path, pace, and content of a learning program, according to the learner's needs. This adaptation occurs while the learner is completing the learning, rather than at the start.

Adaptive learning can harness data from learning activity as well as behaviors, interactions, and external activities that may take place outside of it. Instructors and administrators could gain a detailed understanding of learner performance and in turn deliver highly-personalized learning that targets individual strengths and weaknesses.



Framework for Interactive Intelligence for Assistive Personalized Learning

We recommend that an assimilative ecosystem for personalized learning can be achieved by converging technology and humans through **FIVE** elements, as shown in the framework: LMS (**A**), Learning Analytics for achievement (**B**), participation and learning preferences, dashboard for Personalized Learning implementation setup via monitoring, prediction and recommendation functions (**C**), personalized learning plan generators that can enrich learning experiences and optimize performance (**D**), and chatbot to engage learners based on adaptive rules and interactive machine learning (**E**).

HUMAN-IN-THE-LOOP MACHINE LEARNING CONVERGING HUMAN WITH AI

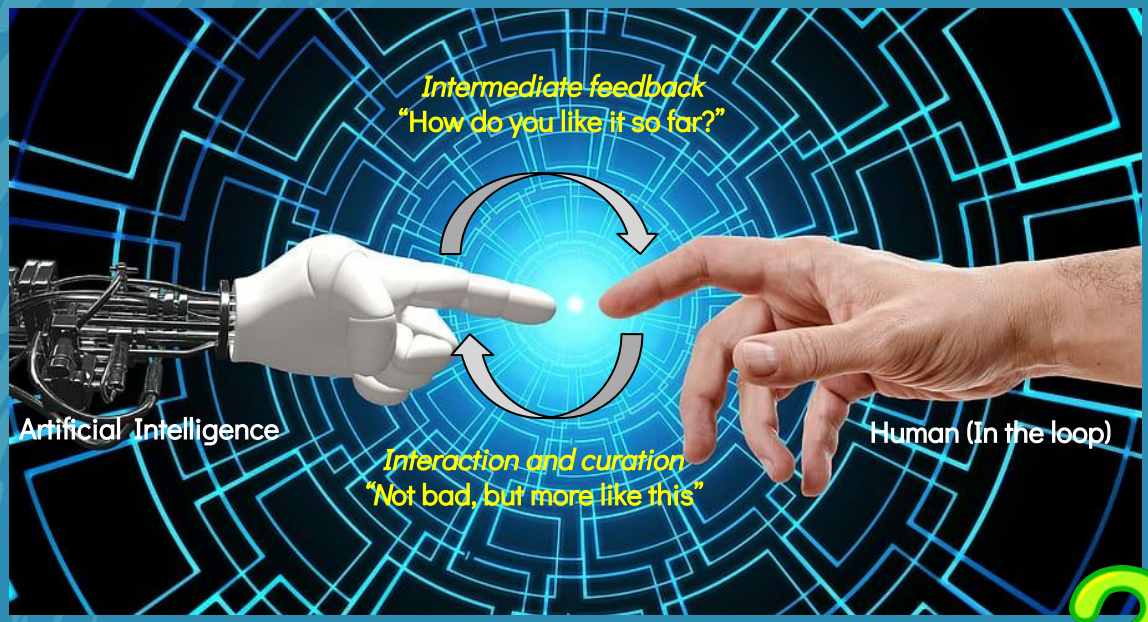
Watch conceptual video by Stanford Uni

Making a Machine Learning application more accurate with human input, and improving a human task with the aid of Machine Learning

First, humans label data. This gives a model high quality (and high quantities of) training data. A machine learning algorithm learns to make decisions from this data.

Next, humans fine-tune the model. This can take place in several different ways, but commonly, humans will score data to account for overfitting, to teach a classifier about edge cases, or to add new classes in the model's purview.

Lastly, people can test and validate a model by scoring its outputs, especially in places where an algorithm is unconfident about a judgment or overly confident about an false positives.



How do you combine people and machines to create AI?

The human-in-the-loop approach combines the best of human intelligence with the best of machine intelligence. Machines are great at making smart decisions from vast datasets, whereas people are much better at making decisions with less information.

GUIDELINE FOR ACHIEVING
Sustainable Future Learning Ecosystem

ENTITY

Ministry
Institution
Governance
Financial
Human resource
Infrastructure
Industry
Society

ACTOR

Academic leaders
Academic administrators
Educators
Education technologist
Educational analyst
Instructional designers
Researchers
Professional practitioners
Learners
Industry

ENABLER FOR FUTURE LEARNING ECOSYSTEM

- Shift of mindset and shared vision
- Agile governance with strategic implementation plan
- Monitoring of implementation and scaffolding for refinement
- Training and development of competencies
- Integrated and well-concerted initiatives to avoid silos and internal competition
- Sustainable financial support
- Continuous quality improvements
- Innovative educators
- Aspired academic leaders
- Proactive academic administrators
- Resilient learners
- Updated technology
- Prominence and referred as benchmarks

PERSONALIZED LEARNING AIDED BY ARTIFICIAL INTELLIGENCE AND LEARNING ANALYTICS

QUOTES

"Technology will not replace great teachers but technology in the hands of great teachers can be transformational." - George Couros

"Technology in the classroom is NOT the end goal. Enabling learning everywhere is the goal." - Andrew Barras

"Education is the most powerful weapon that we can use to change the world." – Nelson Mandela

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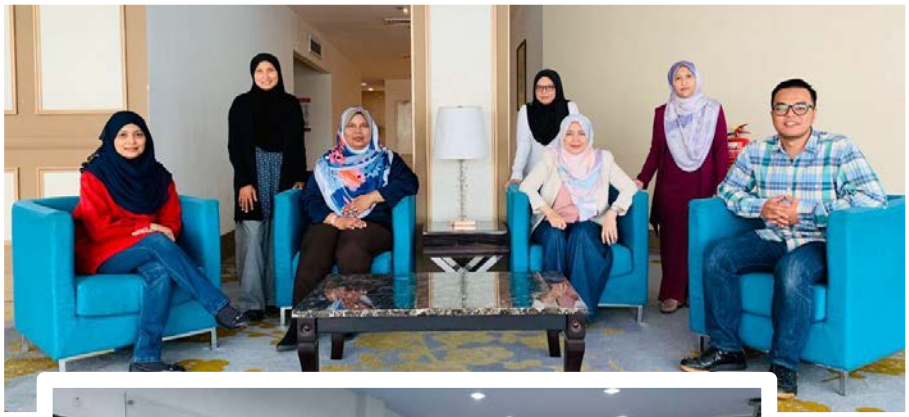
AUTHORS GALLERY



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Check out for more at our website https://sites.google.com/upm.edu.my/technology4futurelearning/

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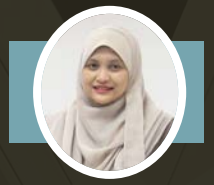

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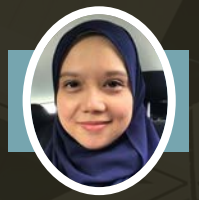

Future learning ecosystem is characterized by an environment where the learners' needs are addressed by precision learning-based services empowered by technologies and supported by talaqqi. This playbook presents the concept, state of the art and guide for the implementation of learning analytics, artificial intelligence and internet of things as the core technologies for future learning ecosystem.

Reviews for Playbook Technology Future Learning Ecosystem

This Playbook is well illustrated and provides comprehensive references to the target readers. It also covers the next generation pedagogy in facilitating personalization, inclusivity and flexibility of learning pathways.
I believe the Playbook will be useful in leapfrogging the learning transformation through personalized learning required to address the gravity of the current crisis. We hope that this Playbook will spark discussion amongst educators, departments and institutions about their future learning ecosystem.
(Associate Professor Dr. Wan Zuhainis Saad, Director, Academic Excellence Division, Ministry of Higher Education, December 2021)

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George Couros, educator and author of The Innovator's Mindset, says, "Technology will never replace great teachers, but technology in the hands of great teachers is transformational."
I couldn't agree with him more! However, I have always maintained that technology in education and learning is not a panacea. Its effectiveness would be contingent upon its seamless integration into the curriculum and effective implementation. This playbook—a valiant effort by a group of committed educators—is an attempt to provide guidance for the emerging culture of learning in the digital age.
This timely Playbook provides an overview of the processes involved in developing, adopting, adapting, and deploying emerging and future technologies within the context of the digital learning ecosystem. It incorporates cutting-edge educational technology advancements such as virtual reality, augmented reality, adaptive and assistive technology, and others, and conceptualises them as a model for a personalised learning ecosystem.
I believe the Playbook will provide a framework for educators to develop their digital competence in light of the rapidly changing skill sets and competencies required to succeed in today's fast-paced digital world. This aligns with the national agenda for globally connected online education.
(Prof. Dr. Abd Karim Alias, Universiti Sains Malaysia, Winner of many Educator Awards, December 2021)

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