

# 2020

## TEACH & LEARN THE UP WAY

LEARN

TEACH

**1 PREPARE**

BEFORE CLASS

**Provide activities & assess**

use clickUP & video

**2 ENGAGE**

IN CLASS

**Teach by questioning**

use clicker app

**3 CONSOLIDATE**

AFTER CLASS

**Let students**

revise & apply



UNIVERSITEIT VAN PRETORIA  
UNIVERSITY OF PRETORIA  
YUNIBESITHI YA PRETORIA



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# TEACH AND LEARN THE UP WAY

## Background

What knowledge and skills do our students need for the future, and particularly for the future workplace? Studies on the Fourth Industrial Revolution (4IR) identify the following skills and values as essential: adaptability career navigation, self-directed learning, lifelong learning, the ability to solve complex problems by taking a multi-disciplinary approach, critical thinking, innovation (creativity), teamwork (collaboration), environmental awareness, a productive work ethic, ethical reasoning, intercultural awareness, and digital fluency (see the UP Graduate Attributes).

The teaching and learning model of the University of Pretoria not only addresses the 4IR skills and optimal usage of the latest technology, but is also conducive to a deeper understanding of the characteristics and learning needs of our UP students. This generation is characterised by its ability to rapidly assimilate information and adapt to new technologies, eg in 2018, 96% of the students owned smartphones and 87,7% laptops. There were more than 40 000 logins to clickUP per day, and more than 5 000 tests were conducted online (with more than a million student logins). This generation of students works best by being made aware of pre-class work like videos, reading and research. Although the new generation of students seeks information independently and on-demand, they want human interaction and opportunities to discuss their views and concerns. Inquiry-led teaching and learning models work best for these students. If students come prepared to class, the class time can be used more effectively. During their engagement in class, students will thrive with more in-depth discussions, detailed explanations and robust debates on topics in the curriculum.

Educational research gives us a better understanding of how to develop the knowledge and skills our students need for their future. In 2000, the US National Research Council tasked a group of researchers to summarise key findings from research. These findings were documented in the book, *How People Learn: Brain, Mind, Experience, and School* (The National Academies Press). In 2018, the National Academies of Sciences, Engineering, and Medicine was tasked with reviewing the book and synthesising new research that has emerged in the study of learning. This resulted in the publication of *How People Learn II: Learners, Contexts, and Cultures* (The National Academies Press). From this and other research (see Appendix A), we know that transmitted information does not automatically transform itself into student understanding. Students make logical connections of new information based on their prior knowledge. The application of knowledge (problem-solving) and the effective retrieval of knowledge require a well-organised and connected knowledge structure. This entails a learning environment in which students actively participate to take control of (monitor and regulate) their learning. Effective teaching encourages students to construct a personal understanding and develop a critical attitude towards knowledge. Teaching is more than the transmission of information, and learning is more than memorising facts. We need to create opportunities for students to build on their prior knowledge and develop their thinking skills. Quality instruction requires students to come prepared to class, as this enables new teaching to build actively on their prior knowledge. Formative assessments make students' thinking visible. This enables students to monitor their progress and allows lecturers to meet students where they are.

Combining the latest technology and research creates new possibilities to develop scalable, flexible, interactive and active learning environments. Technology affects not only how we learn, but also what we learn. More time is available for focusing on more critical activities, such as developing ideas, exploring consequences, justifying solutions, understanding connections and solving problems. Technology also creates room for new activities. UP lecture halls with more than 150 seats are equipped with high-density Wi-Fi, and almost all large lecture halls are equipped with a visualizer (Aver document camera). By connecting their smartphones

via Wi-Fi to the internet in class, students can communicate, watch videos, use apps, and connect to clickUP (the Learning Management System). Some of these apps, such as the student response systems (ie Clickers), have the potential to monitor students' learning and improve their participation and engagement in large classes, which would otherwise be impossible. The use of videos and clickUP activities and assessments can help students to come prepared to class. Creating an environment for independent class preparation promotes and develops self-directed lifelong learners.

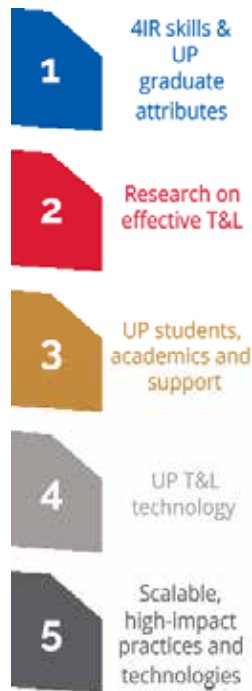


Figure 1: Factors informing a teaching and learning model

The assessment before class also provides valuable information for lecturers to shape more meaningful lectures that link up with students' prior knowledge and address misunderstandings.

In summary, a teaching and learning model needs to take into consideration the demands of the workplace, research on effective teaching and learning, the nature and needs of our current students, technological and

pedagogical innovations, and the current reality and facilities of the university (see Figure 1). In general, the University of Pretoria (UP) has large class sizes, with up to 600 students in a class. Any teaching and learning

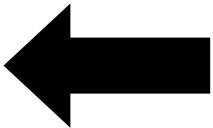
solutions must, therefore, make provision for this. The challenge is to develop a scalable, data-driven, research-based teaching and learning model that optimally uses technology to prepare our students for the 4IR.

## The teaching and learning model of the University of Pretoria

Its hybrid teaching model places the University of Pretoria in a perfect position to develop the skills that students need to function effectively in the 4IR. The University is currently using the Blackboard Learn LMS (clickUP), Blackboard Mobile, and Blackboard Collaborate technologies to support this hybrid learning. As illustrated in Figure 2 (below), the hybrid approach has the

potential to extend the classroom experience beyond the lecture period—before and after class. It provides the opportunity for lecturers to mix the best of contact and online delivery to create a new learning environment for students. Hybrid learning makes teaching and learning more effective by shifting the instructional sequence (see Table 1: Content presentation shift).

Table 1: Content presentation shift

	Before class	In class	After class
Traditional		Information: lecturer	Homework (simple to complex)
UP's hybrid model	Information: Video, textbook, other Formative assessment: simple homework questions	Engage: complex homework questions and discussions	

Quality instruction requires students to come to classes prepared, as this enables new teaching to build actively on existing knowledge. The latest technological developments allow students to go to class prepared and to make learning active and meaningful even in large classes.

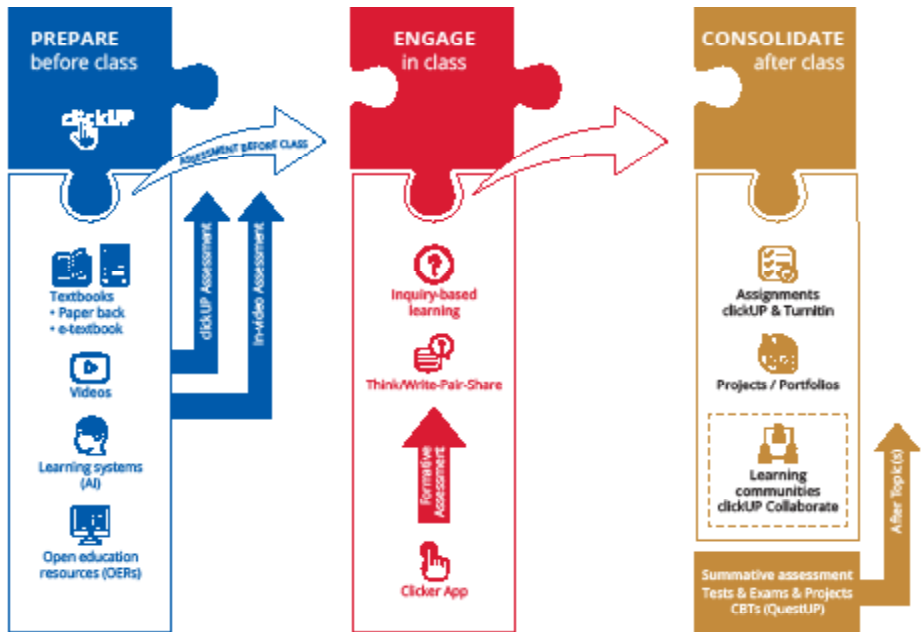


Figure 2: UP teaching and learning model

The UP hybrid model assumes three phases in teaching and learning, namely (a) preparation before class, (b) engagement in class and (c) consolidation after class.

## Stage 1: PREPARE before class

Students can prepare for the class using traditional textbooks, eTextbooks, videos or personalised learning environments. The research<sup>1</sup> (see Appendix A) about effective teaching and learning highlights the advantages of preparing for class: 'Prior knowledge can reduce the attentional demands associated with engaging in well-learned activities, and it can facilitate new learning'. Independent preparation also prepares students for *life-long learning*: 'People continue to learn and grow throughout the lifespan, and their choices, motivation, and capacity for self-regulation, as well as their circumstances, influence how much and how well they learn and transfer their learning to new situations'.



**Textbooks:** The majority of students prefer physical textbooks. In some disciplines, the need may arise for notes, highlights and annotations for later reference and clarification. However, advantages of e-books include customisability, hyperlinks to other resources, the ability to search for keywords, using bookmarks, easy access to a built-in dictionary, copy-and-paste functionality, and the option to have the device read the text aloud. From 2020, the university uses the VitalSource platform to give students instant access to eTextbooks on any device (first 14 days free access)—both online and offline. These eTextbooks integrate into clickUP (Blackboard) and allows

<sup>1</sup> National Academies of Sciences, Engineering, and Medicine. 2018. *How people learn II: Learners, contexts, and cultures*. Washington, DC: The National Academies Press. <https://doi.org/10.17226/24783>.

for the tracking of students' interactions with the textbooks, which gathers user information and student engagement.



### Open educational resources

**(OER):** Academics do not have to prescribe publishers' textbooks.

Where possible, students should be provided with free open educational resources (OER). The SASSE survey indicated that only 48% of first-year students and 33% of senior students bought textbooks in 2018. Academics can adapt and enrich open educational resources (OER), or work in teams to create new open-source textbooks. OpenStax provides high-quality open-source courseware at no costs. There are OER materials available for almost all the foundation courses:

- OpenStax: <https://openstax.org/>
- OpenSUNY textbooks: <https://textbooks.opensuny.org/>
- Open Textbook Library: <https://open.umn.edu/opentextbooks/>
- OER Commons: <https://www.oercommons.org/>
- Lumen Learning: <https://lumenlearning.com/courses/>



### Personalised adaptive learning systems:

Artificial Intelligence (AI) driven adaptive learning systems create a personalised learning experience by adapting the content according to students' individual learning needs based on data from their responses to questions, tasks and experiences. The embedded assignment marks could be automatically recorded in the Grade Centre in clickUP. Publishers are at the forefront and have developed adaptive learning environments, eg MyLab (Pearson), ALEKS & Connect2 (McGraw Hill), etc.

## Assessment before class

The *formative assessment* before class makes students' thinking visible to both teachers and students. This enables students to monitor their progress and permit the teacher to grasp the students' preconceptions, understand where the students are, and design instruction accordingly. In the assessment-centred classroom environment, formative assessments help both teachers and students monitor progress<sup>2</sup>. This *metacognitive* approach to teaching can help students learn to take control of their learning and also prepares them for life-long learning. In terms of preparing students for the 4IR, the preparation and assessment before class will prepare them for self-directed learning and thinking (life-long learning).

Students must be held accountable for class preparation. Students' preparedness for each class should be assessed before the class. There are different ways to do this, and technology now enables us to do it in many powerful ways:

- **Video assessment and tools (H5P software):** From 2020, all academics and students have access to new interactive video and content in clickUP. The tools are available in clickUP in any Content Area under Build Content, Interactive videos and tools. A lecturer can embed interactive quizzes into videos and track student results in the Grade Centre. The integration of in-video assessments, games and questions allows seamless integration of marks to the Grade Center. There are many benefits to using videos for the preparation for class. Although it is possible to produce videos using your mobile phone, it is easier to search for an appropriate video from EdX, MITx, YouTube, Khan, or any other educational video site.

<sup>2</sup> National Academies of Sciences, Engineering, and Medicine. 2018. *How people learn II: Learners, contexts, and cultures*. Washington, DC: The National Academies Press. <https://doi.org/10.17226/24783>.

- **clickUP assessment:** Students can complete a clickUP assessment before class (textbook preparation).
- **Ticket to enter:** Some lecturers also use the 'ticket to enter' concept<sup>3</sup> to ensure that students come prepared to class:
  - A completed assignment is used as a 'ticket' to join the class.
  - Students are allowed to come to class with a one-page 'cheat sheet' which they can use to solve a problem.
  - Students are allowed to come to class with a mind map which they can use to write a class test.

## Stage 2: ENGAGE in class



Inquiry-based learning (ie teaching by questioning, not by telling)<sup>4</sup> enables students to think, communicate and justify their ideas. The information that was gathered as a result of the assessment before class should be used to formulate a few challenging questions/class assignments that could lead to in-depth discussion. Abla<sup>5</sup> suggests the following hints to spark student engagement: craft fewer (but more profound questions), introduce controversy, mine the knowledge gap, ask the students why they should know this, and encourage dynamic collaboration. Eric Mazur suggests that after posing a question, a student needs to think/write/work individually. Ask students to respond (use The Clicker App in large classes). Ask students to find peers with a different answer and to convince them of their response. Ask the students to respond again and explain the correct answer (lecturer's or students'). When students explain the work to their peers, it enhances their own understanding and retention<sup>6</sup>.

Research shows that inquiry-based learning motivates students, stimulates critical

thinking and creates opportunities to develop a deeper understanding of concepts. The research also emphasises the importance of student explanations: 'The learning strategies for which there is evidence of effectiveness include ways to help students retrieve information and encourage them to summarize and explain material they are learning'<sup>7</sup>. In terms of preparing students for the 4IR, this inquiry-based learning has the potential to improve students' critical thinking, problem-solving skills, creativity, teamwork, intercultural communication and collaboration.



The use of a student response system to capture responses will avoid useless choral responses. From 2020, the university has an institutional license for a Clicker Mobile App (TurningPoint Mobile Clicker Solution). This enables all lecturers and students to use the mobile version of clickers at no additional costs. The clicker responses (marks) are automatically captured in the clickUP grade centre. A recently added feature of this App includes class attendance feature with built-in geolocation. The TurningPoint Mobile App

<sup>3</sup> <https://www.facultyfocus.com/articles/blended-flipped-learning/ready-to-flip-three-ways-to-keep-students-accountable-for-pre-class-work/>

<sup>4</sup> About 2 400 years ago Socrates explained that teaching by questioning, not by telling, enables students to think, communicate, and justify their ideas.

<sup>5</sup> <http://www.eaicy.eu/post/7-ways-spark-engagement/>

<sup>6</sup> [https://www.edutopia.org/article/why-students-forget-and-what-you-can-do-about-it?utm\\_source=facebook&utm\\_medium=socialflow](https://www.edutopia.org/article/why-students-forget-and-what-you-can-do-about-it?utm_source=facebook&utm_medium=socialflow)

<sup>7</sup> National Academies of Sciences, Engineering, and Medicine. 2018. *How people learn II: Learners, contexts, and cultures*. Washington, DC: The National Academies Press. <https://doi.org/10.17226/24783>.



allows students to respond to multiple question types, such as multiple-choice, alphanumeric, multiple responses and essay questions. Questions and answer choices are displayed on the web-enabled device while polling is open. This provides lecturers with data not only about class attendance and engagement but also about student understanding (formative assessment). The feedback from the system will also provide students with instant feedback about their understanding. To download the latest version of TurningPoint Instructional Software go to [TurningPoint v 8.7.3 for PC](#) or [TurningPoint v8.7.2 for MAC](#). Watch this video on how to enable Mobile Clickers using TurningPoint: <http://bit.ly/2Plttpw>.

### Stage 3: CONSOLIDATE after class



Almost all lecture halls are equipped with a Visualizer (Aver document camera) with the capability to record classes. These videos could be made available to students in clickUP and used for remedial and revision purposes. Assignments after class provide further opportunities for students to consolidate their knowledge and organise it into meaningful hierarchical patterns. Plagiarism detection software (Turnitin – available in clickUP) can identify unoriginal content. It allows individual student assignments to be uploaded to clickUP and then to match the content with other students' assignments as well as web material.



**Project-based learning** is another form of inquiry-based learning where students work together on a complicated inter-disciplinary problem – inside or outside the classroom, over a more extended period and in diverse groups – on a relevant topic (eg sustainability). In terms of preparing students for the 4IR, this has the potential to improve their teamwork (human connection, social skills

and community), critical thinking, problem-solving, collaboration skills, intercultural awareness, and digital fluency.



### **Collaborative small-group work**

not only helps students to gain and consolidate their knowledge but also improves their social skills. It provides the opportunity to explain and refine their understanding by sharing their ideas and filling in each other's knowledge gaps. ClickUP makes it possible to create groups and to manage group work. Peer assessment is also a collaborative learning technique where students evaluate each other's work. There is software that offers students the opportunity to assess group members based on specific criteria.



**Community engagement:** Given its unique base of knowledge and skills, the University of Pretoria is in an ideal position to apply that expertise to solving problems identified by communities. Most of the community engagement at the University is curricular – that is, students earn credits towards their degrees while applying their knowledge in the service of the community. Each academic programme includes at least one community engagement component. These community engagement opportunities provide an in-depth learning experience for students, fostering development of skills for managing relationships, problem-solving and civic responsibility, which offers a competitive edge for students entering the world of work.

**Summative assessment** evaluates student learning at the end of an instructional unit. Students must also be able to function and develop as individuals. Some competencies could be measured effectively with technology. This becomes even more important at a university that has large class sizes like the University of Pretoria. Authentic assessment will be necessary; whichever format is chosen

for evaluation. The problems posed will have to address the creative problem-solving skills students will need to thrive in the future. QuestUP computer-based tests (CBTs) create a secure environment for completing online testing. Computer-based testing (CBT) is used extensively for both formative and summative assessment at the University of Pretoria as an integral part of the assessment strategies of many academic departments.

## Critical success factors for implementing this model

Beyond the professional development of academic staff, other factors that can affect the successful implementation of the new T&L model are:

- Study guide information:
  - How to prepare for each class
  - Assessments before each class
- Adjusting the weights of assessments:
  - Student preparation: adjust the value of the weight of assessments by giving more weight to the pre-class assessments
  - Lecturers refraining from repeating the basic knowledge in class

## Professional development of UP academic staff

A crucial success factor for the implementation of UP's hybrid model is knowledge and skills about assessment, teaching and learning, curriculum and e-learning. The Hybrid Learning Self-Evaluation App on the [clickUP Helpsite](#) allows the lecturers to improve their teaching by identifying possible areas for improvement. The system generated private report provides a snapshot of a lecturer's current teaching and could be used to guide their own teaching development. The Department for Education Innovation also offers professional development courses and e-learning workshops for lecturers. The e-education group supports technology-enhanced teaching and learning through staff training sessions, consultation on the use of clickUP and other technologies, instructional design and an e-support office. The Educational Consultants (ECs) provides initial and continuing professional development for curriculum development, teaching, assessment and tutoring.

The University is using the QuestionMark Perception product, known as QuestUP within the institution. The Department for Education Innovation provides assistance and training about the use of this technology, creating relevant questions and interpreting the statistical analysis. In 2018, a total of 1 070 tests were conducted with 121 752 student logins.

As part of the teaching and learning requirements, newly appointed staff are required to complete the UP Teaching and Learning Induction process. The induction process consists of the following:

- Attending the Induction Introduction for one-and-a-half days.
- Completion of all the foundational professional development courses (included clickUP courses) as identified by the Department for Education Innovation.
- Receiving peer-evaluated (class visits) at least twice by a peer or Educational Consultant.

After completing the induction process, a certificate will be issued, which should be used by HR as probational evidence of successful completion of the induction process. From January 2020, the educational consultants and the instructional designers will also offer several institutional courses:

### Teaching and learning courses

- T1: Learning Theories in the Digital Age
- T2: Inquiry-based Learning (IBL)
- T3: Video as a Tool for Student Engagement
- T4: Open Educational Resources (OER)

### Curriculum development courses

- C1: Curriculum Transformation
- C2: Developing Study Guides

### Assessment courses

- A1: Designing Accountable Assessment
- A2: Design Rubrics
- A3: Design Objective Assessments

### E-learning courses

- E1: Creating Digital Lectures
- E2: Trendy Tools for Cool Lectures

- E3: E-learning for Academics
- E4: Peer assessment

### clickUP workshops

- L1: Overview
- L2: Content
- L3: Assessment
- L4: Collaboration
- L5: Grades
- L6: Assist
- L7: Data and Student Success

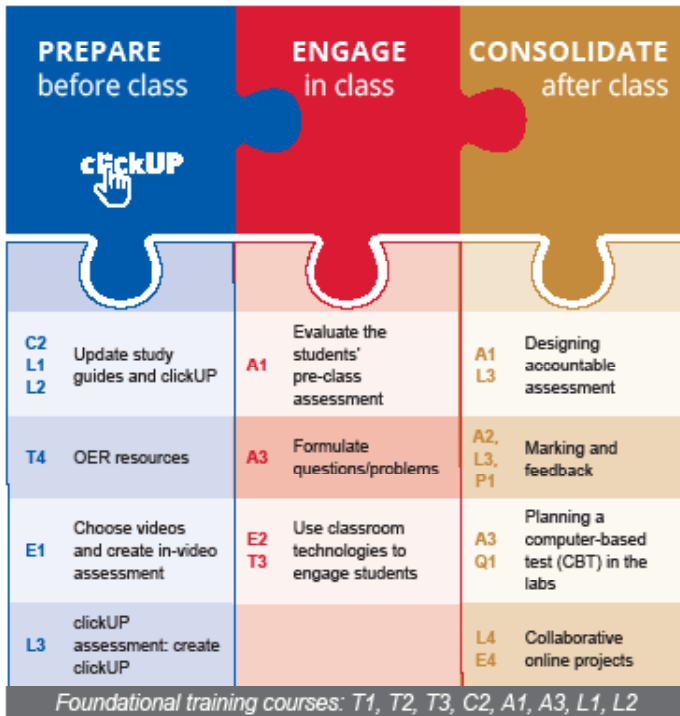
### Computer-based testing (CBT) workshops

- Q1: QuestUP (computer-based testing)

### Turnitin (plagiarism)

- P1: Turnitin: Grading and Feedback
- P2: Turnitin Similarity

These courses will prepare the staff to implement the revised teaching and learning model:



The Department for Education Innovation (EI) provides support for optimising student learning. The Education Consultancy (EC) provides strategic leadership and change management for

curriculum, teaching, learning and assessment innovation, as well as continuing opportunities for teaching development to build capacity to implement an inquiry-based approach. The e-Education unit provides strategic leadership, support and training opportunities for staff development to build capacity to implement a hybrid approach. Both subject-specific teaching innovation and pedagogical innovation are promoted and supported to enhance student learning. The available Scholarship of Teaching and Learning (SoTL) grants and the Flexible Futures Conferences stimulate such innovation.

## Concluding remarks

The Internet sparked one of the recent moves in higher education, namely the move towards online learning. As with all new technological developments (eg e-books, radio, television and satellite TV), the expectation was that massive online open courses (MOOCs) would displace traditional in-person higher education. Cheaper online learning models can easily replace poor-quality teaching (information transfer). However, the role of the lecturer is critical in good-quality teaching that prepares students for the 4IR. Penprase<sup>8</sup> explains that: 'Blended instruction and optimization of flipped and online courses will [produce] more efficient learning environments ... and "high-touch" components of the educational experience will become of increasing value and will not be easily replaced by technology'. Although we all agree that technology on its own does not guarantee good education, we also know that the lack of technology will hinder progress in education.

In an article in *The Chronicle of Higher Education*, Supiano explains how traditional teaching deepens inequality (disadvantaging black and Latino students). He suggests a way to address it: 'Inclusive teaching has two main components: putting more structure into a course, giving clear instructions so that all students know what to do before, during, and

after class; and thoughtfully facilitating class discussion so that everyone can participate'<sup>9</sup>. The University of Pretoria attracts many high-ability students. Inclusive education is meant to address the needs of all students, including high-ability students. It often happens that these high-ability students are not optimally challenged and developed. This teaching and learning model (see Figure 2: UP teaching and learning model) does not only provide better opportunities for the struggling students who enter the University with content gaps, but it also offers better opportunities for the high-ability students:

- A personalised, adaptive learning environment enhances student learning through individually tailored instruction, their readiness and abilities notwithstanding.
- Collaborative learning allows high-ability students to work together and to challenge each other<sup>10</sup>.
- 'Self-directed learning is an effective tool for student engagement that supports higher-level thinking'<sup>11</sup>.
- Project-based learning works exceptionally well for high-ability students<sup>12</sup>.
- The model ensures that some of the assessment tasks are content-rich and challenging.

<sup>8</sup> Penprase, BE. 2018. The Fourth Industrial Revolution and higher education, in *Higher education in the era of the Fourth Industrial Revolution*, edited by NW Gleason. pp 207–229.

<sup>9</sup> [https://www.chronicle.com/article/Traditional-Teaching-May/243339?key=17K21y7n\\_SJUZ04t4-9d7lOkgeOIOadPliV9KXWx066EvvWTSLX9pc7NmdtyoL...](https://www.chronicle.com/article/Traditional-Teaching-May/243339?key=17K21y7n_SJUZ04t4-9d7lOkgeOIOadPliV9KXWx066EvvWTSLX9pc7NmdtyoL...)

<sup>10</sup> <https://www.edutopia.org/blog/gifted-students-general-ed-classrooms-elissa-brown>

<sup>11</sup> <https://www.edutopia.org/article/identifying-and-supporting-gifted-ells>

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## Appendix A: Research on effective teaching and learning

In 2000, the National Research Council tasked a group of researchers to summarise key findings from research. These findings were documented in the book, *How people learn: Brain, mind, experience, and school*<sup>13</sup>. In 2018, the National Academies of Sciences, Engineering, and Medicine was asked to review and synthesise new research that has emerged in the study of learning. This resulted in the publication, *How people learn II: Learners, contexts, and cultures*<sup>14</sup>. From this and other research, we know that transmitted information does not automatically transform itself into student understanding<sup>15</sup>. Students construct their understanding of the information based on their prior knowledge. They make logical connections between pieces of information to generalise, categorise and solve problems. The application of knowledge (problem-solving) and the effective retrieval of knowledge requires a well-organised and connected knowledge structure: 'knowledge of a large set of disconnected facts is not sufficient'.

Some other conclusions from these two publications are:

- **Prior knowledge facilitates new learning:** 'Prior knowledge can reduce the attentional demands associated with engaging in well-learned activities, and it can facilitate new learning.'
- **Connected knowledge needed for problem-solving:** 'Learners routinely generate their own novel understanding of the information they are accumulating and productively extend their knowledge by making logical connections between pieces of information. This capacity to generate novel understanding allows learners to use their knowledge to generalize, categorize, and solve problems.'
- **Organised knowledge structure:** 'To develop competence in an area of inquiry, students must: (a) have a deep foundation of factual knowledge, (b) understand facts and ideas in the context of a conceptual framework, and (c) organize knowledge in ways that facilitate retrieval and application' and '[t]he conceptual framework allows experts to organize information into meaningful patterns and store it

<sup>13</sup> Bransford, J; Brown, AL; Cocking, RR & National Research Council (US). 1999. *How people learn: Brain, mind, experience, and school*. Washington, DC: National Academy Press.

<sup>14</sup> National Academies of Sciences, Engineering, and Medicine. 2018. *How people learn II: Learners, contexts, and cultures*. Washington, DC: The National Academies Press. <https://doi.org/10.17226/24783>.

<sup>15</sup> Penprase (2018): 'Such educational programs will need to shift emphasis away from routine tasks and, like the more academic curriculum, develop habits of mind and capacity for creativity within workers at all levels.'

hierarchically in memory to facilitate retrieval for problem-solving. And unlike pure acquisition of factual knowledge, the mastery of concepts facilitates the transfer of learning to new problems.'

- **Active learning and metacognition:** 'Successful learning requires coordination of multiple cognitive processes that involve different networks in the brain. In order to coordinate these processes, an individual needs to be able to monitor and regulate his own learning' and '[a] metacognitive approach to instruction can help students learn to take control of their own learning.'
- **Growth mindset:** 'The brain develops throughout life, following a trajectory that is broadly consistent for humans but is also individualized by every learner's environment and experiences ... The relationship between brain development and learning is reciprocal: learning occurs through interdependent neural networks, and at the same time learning and development involves the continuous shaping and reshaping of neural connections in response to stimuli and demands. Development of the brain influences behaviour and learning, and in turn, learning influences brain development and brain health.'
- **Formative assessment:** 'Formative assessments – ongoing assessments designed to make students' thinking visible to both teachers and students – are essential. They permit the teacher to grasp the students' preconceptions, understand where the students are in the "developmental corridor" from informal to formal thinking, and design instruction accordingly. In the assessment-centred classroom environment, formative assessments help both teachers and students monitor progress.'
- **Summarise and explain information:** 'The learning strategies for which there

is evidence of effectiveness include ways to help students retrieve information and encourage them to summarize and explain material they are learning.'

- **Motivation:** 'Motivation to learn is influenced by the multiple goals that individuals construct for themselves as a result of their life and school experiences and the sociocultural context in which learning takes place. Motivation to learn is fostered for learners of all ages when they perceive the school or learning environment is a place where they "belong" and when the environment promotes their sense of agency and purpose.'
- **Technology:** 'The decision to use technology for learning should be based on evidence indicating that technology has a positive impact on learning ... Effective use of technologies in formal education and training requires careful planning for implementation that addresses factors known to affect learning. These factors include alignment of the technology with learning goals, provision of professional development and other supports for instructors and learners, and equitable access to the technology. Ongoing assessment of student learning and evaluation of implementation are critical to ensuring that a particular choice of technology is optimal and to identifying needed improvements.'
- **Lifelong learning:** 'People continue to learn and grow throughout their lifespan, and their choices, motivation, and capacity for self-regulation, as well as their circumstances, influence how much and how well they learn and transfer their learning to new situations ... Engagement with work (especially complex work that involves both intellectual and social demands), social engagement, physical exercise, and adequate sleep are all associated with lifelong learning and health ageing.'

