



A Guideline Framework for Hybrid Education, Learning, and Assessment

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UNESCO International Bureau of Education
National Engineering Research Center of Cyberlearning and Intelligent Technology (China)
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Preface

The exponential acceleration in the development of new technologies such as artificial intelligence is driving profound changes in education globally. In the pre-pandemic era, a series of educational transformations had already emerged, including digitization, curriculum diversification, gamification, and digitalization of learning experiences. The global pandemic of the COVID-19 has accelerated these transformations, leading to the “new normal” of alternative and innovative models of education and teaching used in the era of the epidemic, and also brought many challenges to be addressed, for example, the inclusion of the diversity of learners’ characteristics, backgrounds, circumstances, and capacities into the mainstream of education policies, curricula, and pedagogies, as well as supporting teaching, learning, and assessment. To address these significant challenges while proactively considering education scenarios in the future, it is necessary to reimagine a new normal of education and teaching that is transformative, promising, and inspiring.

In this context, in March 2021, the UNESCO International Bureau of Education (UNESCO-IBE) released an initiative on the theme of Hybrid Education, Learning, and Assessment (HELA). Founded in 1925 in Geneva, Switzerland, IBE was led by the world-famous psychologist Jean Piaget and developed for nearly 40 years. In 1999, it joined UNESCO, focusing on educational content, methods, and teaching/learning strategies through curriculum development. Furthermore, IBE has now become a global center of excellence in curriculum and related matters, with a reputation for fostering a global consensus and expertise on innovative curricula among UN member states. UNESCO-IBE’s HELA initiative is to support countries around the world to identify, develop, experiment, assess, evidence, and scale up evidence-based modes in integrating and combining in-person and distance education. The aim is to help prepare learners for coping with the multiple challenges in life and seize the opportunities as persons, citizens, workers, entrepreneurs, and community members.

Responding to the above initiatives, UNESCO-IBE authorized Beijing Normal University in June 2021 to set up a joint executive working group involving the National Engineering Research Center for Cyberlearning and Intelligent Technology (CIT) and the China Education Innovation Institute of Beijing Normal University (The Innovation Institute) to develop a guideline framework for Hybrid Education, Learning, and Assessment. CIT was founded in 2017 with the approval of the National Development and Reform Commission of China. It is jointly established by Beijing Normal University as the executive institution, in conjunction with Tsinghua University, China Mobile, NetDragon Huayu, and iFlytek. The CIT team has laid the foundation for the content development of this report based on its long-term accumulation in the fields of smart education, application of artificial intelligence in education, and hybrid education. The Innovation Institute was established in 2014 and is a secondary institution of the Beijing Normal

University officially registered by the General Office of the Ministry of Education. The team of the Innovation Institute has a profound accumulation of the fundamental principles of education and youth development, which provides solid support for the development of this report. The joint working group has developed this guiding framework based on the theories of Hybrid Learning and Flexible Pedagogy, integrating the ideas of Hybrid Learning published by UNESCO-IBE in recent years, and also taking into account the role of new technologies such as artificial intelligence in innovating hybrid education. In this framework, key strategies for implementing hybrid education and assessment were proposed to provide guidelines for transforming practice in curriculum and teaching, thereby supporting the widespread use of technology to enable hybrid learning and flexible teaching. Overall, the purpose of this framework is to support teaching, learning, and assessment, promote human capacity development and education equity and contribute to the achievement of the United Nations Sustainable Development Goals.

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Abstract

Emerging technologies are transforming education in a systematic way. Along with this transformation, a series of challenges associated with teaching, learning, and assessment before, during and after the COVID-19 have been generated, calling for educational practitioners to address them. In this context, a variety of new approaches, including MOOCs, online synchronous instruction, and adaptive learning, have been adopted and combined in a flexible way to meet the local needs in the global wide. To integrate and share these experiences, UNESCO-IBE proposed the concept and initiative of Hybrid Education, Learning, and Assessment (HELA). In line with the initiative, a deeper understanding of HELA is discussed in this report. To help educational practitioners to implement HELA, we proposed some key elements for promoting HELA. We also identified the key stakeholders in HELA and described the roles and responsibilities of all relevant parties in this process. Furthermore, we provided an instructional model of hybrid education, learning, and assessment to demonstrate key phases of this hybrid instructional process to curriculum specialists, academic advisors, and teacher trainers. Considering the rising influence of artificial intelligence in education, we elaborated on the key AI applications that can be used to support hybrid education. Based on the potential benefits of HELA in further transforming education, we propose it as an innovative mode to promote the future of education. Therefore, it should be promoted and applied globally to help educate the new generation and accomplish the UN's sustainable development goals.

1. Introduction

In the pre-COVID-19 era, new digital technologies in education were already altering its modalities, contents, and meanings (Decuyper, 2019). These changes have already posed numerous and pending challenges. These challenges include genuinely mainstreaming the diversity of learners' profiles, contexts, circumstances, and capacities in the educational policies, curricula, and pedagogy and supporting the teaching, learning, and assessment processes.

Along with these challenges, there are numerous educational evolution and transformation. The traditional educational philosophies evolved, changing the role of teachers, the expectation of students, and the purpose of education. For instance, behaviorism learning theory considers students' interaction with the environment and their response to stimuli (Ertmer & Newby, 2013), while cognitivism learning theory emphasizes cognitive processes, such as critical thinking and problem-solving (Snelbecker, 1983). In addition, constructivism learning theory urged educators to place learners at the center of the educational process and identify how culture influences learners' beliefs and experiences.

Along with the above evolution in educational theories, transformation based on technologies also happened in educational practices. The exponential acceleration of technological platforms has penetrated the world of education and generated significant transformations: (1) digitization in which educational products are digitized, ubiquitous, immediate, portable, and distribution model has gone beyond the limitations of time and space; (2) curricular expansion and diversification, which favors the personalization of learning experiences and the sources of the truth of the education contents become diffuse; (3) gamification and intensification of learning experience open doors for the new paradigm, which seeks to engage and captivate students by entering the fantastic worlds of virtual experiences, playing, and immersion; (4) the datafication of learning experiences combined with digitalization lead to educational algorithms and analytics. These changes help form an ecosystem where the learning environment is different from traditional ones (UNESCO-IBE, 2021c). Huang et al. (2013) summarized the significant difference between a conventional digital learning environment and a smart learning environment (see Table 1.1).

Table 1.1 Differences between traditional digital learning environments and smart learning environments (Huang et al., 2013).

	Digital Learning Environment	Smart Learning Environment
Learning Resources	(1) Digital resources based on rich media; 2) Online access becomes the mainstream; 3) Users select resources.	1) Digital resources independent of the devices; 2) Seamless connection or automatic synchronization becomes fashionable; 3) Deliver on-demand resources.
Learning Tools	1) All-function in one tool, systematized tools; 2) Learners judge the technology environment; 3) Learners judge the learning scenarios.	1) Specialized tools and miniaturized tools; 2) Automatically sensing technology environment; 3) Learning scenarios are automatically recognized.
Learning Community	1) Virtual community focusing on online communication; 2) Self-selected community; 3) Restricted to information skills.	1) Combine with the mobile interconnected real community to communicate anytime and anywhere; 2) Automatically matched communities; 3) Depend on media literacy.
Teaching Community	1) Difficult to form a community, which is highly dependent on experience; 2) Make the regional community possible.	1) Automatically form a community which is highly concerned about the users' experience; 2) Make the cross-regional community fashionable.
Learning Methods	1) Focus on individual knowledge construction; 2) Focus on low-level cognitive objectives; 3) Unify evaluation requirements; 4) Interest becomes the key to the diversity of learning methods.	1) Highlight the knowledge construction of community collaboration; 2) Focus on high-level cognitive objectives; 3) Multiple evaluation requirements; 4) Thinking becomes the key to the diversity of learning methods.
Teaching Methods	1) Emphasize resource design and explanation; 2) Summative evaluation of the learning outcomes based on the learners' behaviors; 3) Observation of learning behaviors.	1) Emphasize activity design and guidance; 2) Adaptive evaluation of learning outcomes based on the cognitive characteristics of learners; 3) Intervention in learning activities.

The ongoing educational metamorphosis (Dhawan, 2020) was accelerated during the COVID-19 pandemic. Specifically, during the COVID-19 and post-COVID-19 era, countries are facing the challenges of responding effectively to the immediate and devastating effects of COVID-19, which calls for reflecting on the existing experiences to reimagine transformative and inspirational normality. Related policies and practices that promote alternative ways to maintain

and transform education have been carried out globally. The observed post-COVID-19 solutions emerged to further transform the ways of educating, learning and assessing to address global challenges in education. These post-COVID solutions include online learning, Massive Open Online Courses (MOOCs), and live streaming. A flexible combination of these solutions has been used to cope with these challenges.

Inspired by the global experiences, in this book, our purpose is to propose the concept of Hybrid Education, Learning and Assessment (HELA) and provide a guideline framework for the curriculum developers and specialists, pedagogical advisors, and teacher trainers in the global wide, including those in under-developed countries and regions. This framework aims at providing guidance on the adaptation of curriculum, pedagogy, and teaching to support hybrid learning and flexible pedagogy through the extensive and intentional use of technologies in teaching, learning, and assessment.

2. Understanding Hybrid Education, Learning, and Assessment (HELA)

2.1 The concept of HELA

Several countries have started transforming their education, learning, and assessments to cope with the needs of new generations. Along with these practices, it is urgent to rethink levels, provisions, and environments for educational development, which would lead to ideas of integrating in-person and online education. This mode is called Hybrid Education. It implies revisiting purposes, contents, and progression across educational levels, settings, and provisions (UNESCO-IBE, 2021a). HELA promotes the design, development, and assessment modes of sustainable education through the following (UNESCO-IBE, 2021a).

- 1) HELA combines and integrates in-person and online learning to provide learning opportunities for all learners in a way that is personalized.
- 2) HELA does not imply a one-size-fits-all model of organization and does not function equally and in a prescriptive manner for all educational centers.
- 3) HELA is characterized by the careful selection, prioritization, and sequencing of essential knowledge and core competencies.
- 4) HELA implies rethinking the organization and hierarchy of knowledge in the curriculum and revisiting instructional times.
- 5) HELA redefines the relationships between educators and students.
- 6) HELA entails a renewed dialogue and collective construction between education and social policies in general.
- 7) Proactive use of technologies can enhance the opportunities for the production, circulation, and dissemination of knowledge without obstacles.
- 8) HELA presents a unique opportunity to rethink the relationships between schools, learners, students, families, and communities.

Hybrid Learning

As one of the central elements of HELA, hybrid learning is defined by Staker and Horn (2012) as a formal education program in which a student learns at least in part through the online delivery of content. In this context, students can control time, place, path, and/or pace individually from home.

Term 1. Hybrid Learning

UNESCO (2020) defines HL in a universal sense as “a learning approach that combines both remote learning and in-person learning to improve the students’ experience and ensure learning continuity” (p. 11).

Hybrid learning is sometimes called blended learning. It is defined as having 30 - 79 % of the course content delivered online (Huang et al., 2020a). In contrast, “Face-to-face” instruction includes courses in which 0 - 29 % of the content is delivered online, including traditional and web-facilitated courses, while online courses are defined as having at least 80% of the course content provided online.

Driven by the educational practice during COVID-19, Online-Merge-Offline (OMO) learning has become one of the new forms of Hybrid learning (Huang et al., 2021a). This mode relies on hybrid infrastructure and Open Educational Practices (OEP) to merge online and offline learning spaces together in real-time while simultaneously seamlessly teaching students in both the physical and online classrooms. The development of the OMO classroom framework is possible with the support of wireless devices, providing cloud-based services, including data analysis processes. This means that in the ideal context of OMO learning, technology, and open educational resources can foster communication and interaction among teachers and students, both online and offline, even though they are situated in different learning spaces. The goal of OMO learning is to provide authentic and innovative learning experiences, giving teachers more flexibility to teach both online and offline. For instance, in a case study of using OMO learning in English classes (Huang et al., 2021a), an interactive board with a smart pen was used in an OMO classroom, where students from the physical classroom and students from the online classroom simultaneously worked together to complete various English sentences (i.e., a fill-in-the-blank type of learning activity) under the guidance of the teacher. This OMO learning scenario can foster learning interactions between online and offline students at the same time, regardless of the learning space. Additionally, both online and offline students can see the learning interaction and receive oral feedback from their teacher as well as from their online and offline peers. Table 2.1 highlights the difference between traditional and new hybrid learning (OMO learning).

Table 2.1 Traditional vs new hybrid learning

Dimension	Traditional hybrid learning	New hybrid learning (OMO learning)
Environment	Online and offline	<ul style="list-style-type: none"> ● Immersive and merged online-offline environment; ● Smart offline environments (e.g., sensors, interactive board, etc.); ● Ergonomic offline environments (e.g., movable chairs and tables, etc.)
Resources	Printed and digital resources	<ul style="list-style-type: none"> ● Printed and digital open educational resources
Pedagogy	Digital pedagogy	<ul style="list-style-type: none"> ● Open educational practices (open pedagogy, open assessment; open collaboration)
Assessment	Online and offline assessment methods	<ul style="list-style-type: none"> ● Multi-modality learning assessment

2.2. Key elements to facilitate HELA

Hybrid Education, Learning, and Assessment (HELA), as a new trend in educational development (UNESCO-IBE, 2021a), deserves to be replicated in more countries and regions. To facilitate the implementation of HELA nationwide (see Figure 2.1), it is necessary to consider reliable infrastructures (Huang et al., 2020a), user-friendly technologies (Huang et al., 2020b), accessible digital resources (Camilleri & Camilleri, 2017), pedagogical strategies (Borich, 2014), continuous assessments (UNESCO-IBE, 2015), learning-teaching supports (Wang et al., 2021a), stakeholders collaborations (Huang et al., 2020a), and the building of an instructional organization of flexible-hybrid education (Huang et al., 2020a). National or regional education authorities can use the promotion of HELA development as an opportunity to facilitate the deep integration of ICT and education, advance the innovation of application and operation mechanisms, reasonably optimize the allocation of educational resources, and innovate the supplied form of educational services, and then enable the nationwide digital and intelligent transformation and upgrading of education.

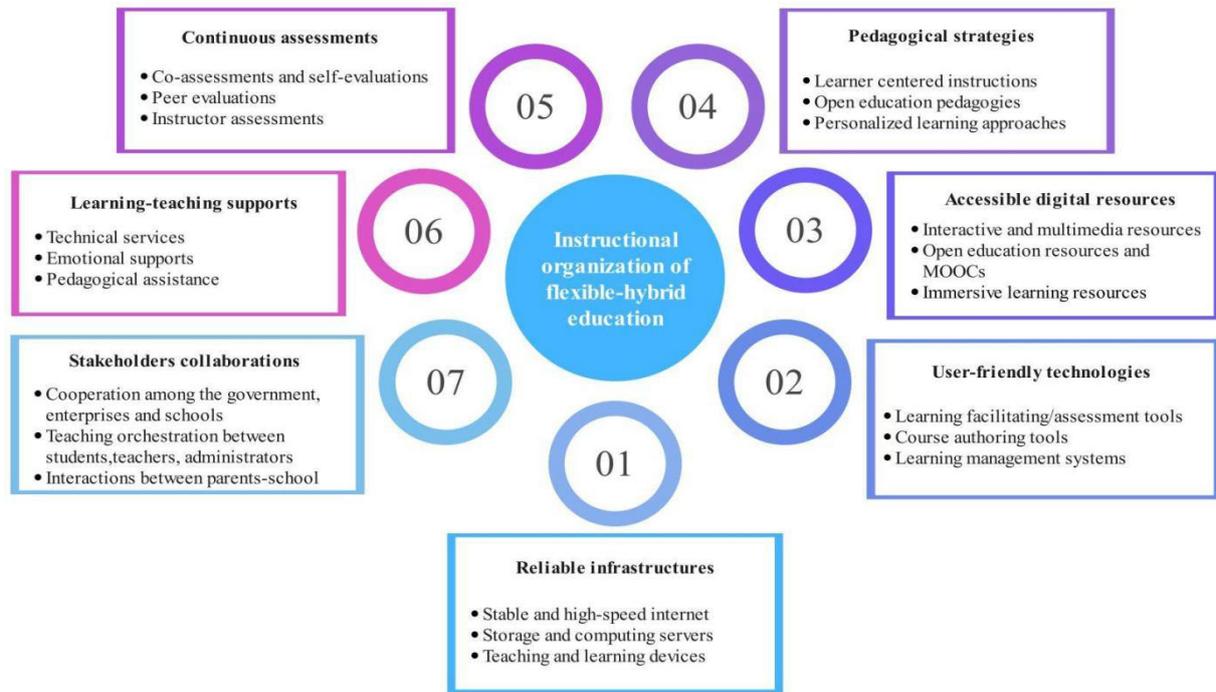


Figure 2.1. A framework of facilitating HELA nationwide

1) Reliable infrastructures

Improving the nationwide infrastructure is crucial for strengthening the implementation of HELA. The first key element for conducting HELA is to ensure reliable infrastructure, especially stable and high-speed internet, storage and computing servers, and teaching and learning devices (Huang et al., 2020a; UNESCO-IBE, 2021a; Wang et al., 2021a).

- **Stable and high-speed internet:** Network Environment is crucial to the support of different activities (Huang et al., 2020b), such as synchronous cyber-teaching using video conferencing and asynchronous cyberlearning by accessing or downloading digital learning resources (Huang et al., 2021a) and learning collaboration with peers via social software. Poor networks will make it difficult for students to participate in hybrid education (Al-Salman & Haider, 2020) and even cause negative perceptions. The government’s responsibilities involve providing high-speed and stable networks (Wang et al., 2021a), promoting new network technologies such as 5G, IPv6, and new generation WIFI to campus, as well as accelerating the iterative upgrading of network infrastructure.
- **Storage and computing servers:** Adequate data storage space and server computing power can sufficiently support the development of HELA. Data storage is the basis for data analysis, an essential foundation for enhancing hybrid education. In addition, HELA involves new intelligent devices and software. Running these devices and software generates massive data computing demands, challenging the current service computing capabilities. In addition, the

hybrid learning process will generate a large amount of data, which in turn requires a larger server storage capacity to save data files. Thus, it is particularly important for the related stakeholders to provide data storage services and computing services for HELA (Huang et al., 2020b).

- Teaching and learning devices: HELA involves using digital resources for online and face-to-face instruction, which also requires that teachers and students have reliable devices to participate in the learning process (UNESCO-IBE, 2021a). Teachers could use teaching devices to create course resources, use multimedia classrooms or online platforms to teach during the class, and use computers to conduct data analysis to assess teaching effectiveness. In addition, students need to use computers, smart tablets, or other devices to participate in hybrid learning. Interaction, online collaboration, and independent learning need learning devices (Huang et al., 2021a). In terms of optimization, the government may consider distributing personal learning terminals suitable for student use, promoting digital resources, and supporting face-to-face and remote personalized learning.

2) User-friendly technologies

With reliable infrastructure as the basis, the second key element is to provide students, teachers, and administrators with tools, software, and systems. To ensure a good experience for teachers and students, the technologies for HELA may be user-friendly, including learning facilitating/assessment tools, course authoring tools, and learning management systems (Huang et al., 2020b; UNESCO-IBE, 2021a).

- Learning facilitating/assessment tools: Learning tools with a good user experience are more likely to be favored and used by students, thereby developing the potential for active learning (UNESCO-IBE, 2021a). Easy-to-use assessment tools can be convenient for teachers to use and support students in self-assessment. Learning tools with personalized learning functions can support the whole process of learning intervention and help teachers and students master the current learning effects (Al-Salman & Haider, 2020). The online education platform provides an easy-to-use experience for teachers and students and supports online and face-to-face teaching (UNESCO-IBE, 2021a).
- Course authoring tools: Teachers need to create course materials suitable for online and face-to-face instruction, which requires them to have course creation tools with a good user experience. Teachers can create PowerPoint-based courseware with interactive features and accompanying multimedia materials to help students in independent learning (Huang et al., 2020b). To increase the supply and development of course authoring tools, the authorities can call for more social organizations and private sectors to participate, advocate sharing course materials, and encourage open-source sharing of educational software.
- Learning Management Systems (LMS): LMS could provide easy and effective functions for

teachers and students (Huang et al., 2020b). Strengthen the functions of the LMS in knowledge production, resource sharing, learning support, monitoring and evaluation, and management decision-making to realize the application service of the whole process of education and teaching, and finally optimize the efficiency and quality of teaching.

3) Accessible digital resources

Digital resources have become indispensable primary resources for the implementation of HELA. The development of a new generation of information technology has assisted in developing digital resources. Providing easy access to digital resources for teachers and students is the third key factor to consider, especially in interactive and multimedia resources, open education resources and MOOCs, and immersive learning resources (Camilleri & Camilleri, 2017).

- **Interactive and multimedia resources:** In hybrid education and learning, interactive resources can help students gain more learning experience (Liu, 2017). Course resources include videos, audio, text, pictures, and simulations, which can facilitate students' participation in a hybrid education and foster active learning (Huang et al., 2019). The government may provide funds to encourage educational resource production institutions to expand resource sharing and support schools, teachers, publishing units, and resource development companies to participate in digital education resource sharing. In libraries, museums, science and technology museums, and other spaces, digital resources can be shared with teachers and students. The digital education resource sharing plan may enrich the interactive and multimedia resources.
- **Open Education Resources (OER) and MOOCs:** OER was defined as: "learning, teaching, and research materials in any format and medium that reside in the public domain or are under the copyright that has been released under an open license that permits no-cost access, reuse, repurpose, adaptation, and redistribution by others" (UNESCO, 2019a, para.1). The already released resources of OER and MOOCs (Kaplan & Haenlein, 2016) provide students with opportunities to use and share the world's high-quality curriculum resources (Huang et al., 2020b; Masson, 2014). OER helps teachers save more time on course development and focuses more on the teaching process and results.
- **Immersive Learning (IL) resources:** practitioners in hybrid education could actively consider using Immersive Learning resources that can help stimulate students' desire to learn (Hergueux & Jacquemet, 2015). IL resources can also enhance the learning experience. For example, students can use VR to gain an immersive experience, and 3D projection can help students gain a more detailed view. The government could issue supportive policies to promote the development of IL resources based on new technologies such as artificial intelligence and virtual reality. Teachers can build a virtual laboratory based on the Internet, which can be used for technical training and exploratory learning.

4) Pedagogical strategies

Hybrid learning incorporates both online and face-to-face learning and requires a simultaneous updating of teaching and learning approaches to achieve optimal results. Therefore, choosing the appropriate pedagogical strategies is the fourth key element to consider. Hybrid education provides opportunities for the use of diversified teaching strategies (Borich, 2014; Gordon, 2014) and implies three perspectives to ensure the implementation of HELA: learner-centered instructions, open education pedagogies, and personalized learning approaches (Tlili et al., 2019; UNESCO-IBE, 2021a).

- **Learner-centered instructions:** Learners' perceptions and achievements are crucial for successful teaching and learning. Pedagogical strategies to conduct HELA with the learner at the center help bring out the learners' initiative, motivation, and creativity (UNESCO-IBE, 2021a). Teachers and administrators could engage learners in the entire learning process and support their acquisition of knowledge and skills (Borich, 2014). Teachers may consider learning contexts in course preparation and design learning materials that match learners' cognitive levels. In addition, teachers could communicate with learners frequently during teaching activities and help learners solve their difficulties. Some of the activities mentioned above and the entire instruction should be designed with a learner-centered approach (Huang et al., 2019).
- **Open Education:** With the internet, hybrid education is no longer limited to the traditional classroom and can incorporate more open educational strategies. Open Education allows students to acquire knowledge through hands-on exploration and stimulates students' interest to keep exploring. Furthermore, Open Education can increase access to quality educational content for learners, hence helping learners achieve self-learning and lifelong learning. Coupled with easily accessible digital resources, Open Education can help learners gain a deeper understanding of the subject content, all of which reflect a student-centered philosophy (Tlili et al., 2019).
- **Personalized learning approaches:** Personalized learning approach is a way of learning based on the different characteristics of learners to help students achieve their individual development goals (Wang et al., 2021b). Learners can carry out personalized learning to obtain exclusive learning strategies, whether in the classroom or through independent learning. The implementation of personalized learning respects learners' interests and preferences and helps students become self-motivated and active learners (Davidson & Major, 2014). A personalized learning approach also serves learners in a learner-centered environment, using information, content, skills, and support tools (UNESCO-IBE, 2021a). Schools may enhance the application of hybrid education from the above perspectives.

5) Continuous assessments

Assessments should not only be regarded as a method to measure what the student has learned but also as a means for students to develop and reinforce their competencies by providing multiple ways of demonstrating their learning (Casey & Wilson, 2005). Continuous assessments can help students and teachers identify areas of improvement. Co-assessments, self-evaluations, peer evaluations, and instructor assessments are also essential steps in testing the effectiveness of hybrid education (Huang et al., 2020a; UNESCO-IBE, 2015, 2021a, 2021b).

- Co-assessments and self-evaluations: Co-assessments are evaluation methods that teachers and learners use together (UNESCO-IBE, 2021b). Self-evaluations are methods used by learners to evaluate their own learning effectiveness (UNESCO-IBE, 2021b). Both evaluation methods can help learners understand their current learning progress to identify weaknesses. In addition, co-assessments can provide learners with opportunities to learn from each other and the work completed by other learners. The mixed use of the two evaluation methods helps learners understand their learning performance more objectively.
- Peer evaluations: Peer evaluations are often conducted by peer students in the same collaborative group to objectively assess the effectiveness of learners' progress (Huang et al., 2020a; UNESCO-IBE, 2021b). Peer evaluation helps identify learners' deficiencies and shortcomings and allows learners to get suggestions for improvement. Learners can know their learning status and learning effectiveness from peer evaluation. Peer evaluations can be conducted quickly through the E-learning system, and peers can comment and score directly in the system (Larmer et al., 2015).
- Instructor assessments: Instructors can also conduct evaluations in hybrid education, which is also more efficient and effective (UNESCO-IBE, 2021b). Because instructors are involved in the entire teaching process, instructor assessments help instructors examine the overall effectiveness of the whole teaching process to motivate them in teaching. With the help of the online learning system and AI, instructors can review the entire learning process, not just the evaluation of the final test (UNESCO-IBE, 2015).

6) Learning-teaching supports

The government can establish a coordination mechanism among multiple agencies to support the implementation of HELA and strengthen the support system for HELA development. Meanwhile, technical support/services, emotional support, and pedagogical assistance are still needed (Huang et al., 2020a; UNESCO-IBE, 2021a; UNESCO-IBE, 2021b; Wang et al., 2021a).

- Technical services: Technical services involve software and hardware-related support in the process of hybrid education (Huang et al., 2020a). Intelligent learning equipment, online

learning systems incorporating artificial intelligence technology, and smart classrooms all pose challenges to the information literacy of students and teachers (Aguilera-Hermida, 2020). Furthermore, hybrid learning combines online and face-to-face learning methods, which requires students and teachers to use various software and hardware.

- Emotional support: Teachers are suggested to pay more attention to students' negative emotions and motivate them to learn (UNESCO-IBE, 2021a). Emotional support can enhance students' emotional engagement in the hybrid learning process, and the emotional resonance between teachers and students is conducive to positively stimulating active learner behaviors (Wang & Huang, 2020). Students may feel isolated in the independent learning process, and teachers could provide emotional relief and reassurance to help students achieve their learning goals (Wang et al., 2021b).
- Pedagogical assistance: Providing learners with the necessary learning assistance is conducive for learners to have a better learning experience and achievement (Huang et al., 2020a). Thus, it is essential to provide students with learning guides and training on how to use the online learning system, hosting online discussions on hybrid learning methods (UNESCO-IBE, 2021a). In addition, teachers can give personalized guidance after receiving students' feedback (Ni & Ding, 2017). The government, enterprises, and social organizations should work together to provide quality pedagogical assistance to meet the diverse needs of students.

7) Stakeholder collaboration

Extensive collaborations among stakeholders are crucial for facilitating HELA. Such partnerships include but are not limited to: cooperation between the government, enterprises, and schools; collaboration between students, teachers, and administrators; interactions between parents-schools influence the implementation of HELA (Huang et al., 2020a; UNESCO-IBE, 2021a; Wang et al., 2021a).

- Cooperation between the government, enterprises, and schools: The government, companies, and schools can effectively promote hybrid learning quality by forming a consensus (Huang et al., 2020a). The government can support the implementation of HELA in terms of policy formulation and provide necessary funding. Companies play an essential role in supplying technology services, software development, and hardware products for hybrid learning. (Wang et al., 2021a).
- Collaboration between students, teachers, and administrators: Teachers, students, and administrators are the key stakeholders in implementing HELA (UNESCO-IBE, 2021a). In these three groups, poor coordination between any two parties may delay the implementation of hybrid education. Therefore, the three groups could actively interact and coordinate to solve the difficulties during the implementation process. Creating a friendly atmosphere of

mutual support and promotion has a positive effect on the implementation and improvement of HELA.

- Interactions between parents and schools: Hybrid learning encompasses both face-to-face and distance learning. Students studying remotely from home need parental support (UNESCO-IBE, 2021a). Schools could establish communication channels for parents, actively understand their demands, and promote the goals and benefits of HELA implementation. Parents' thoughts and perceptions will inevitably influence learners' behavior, so parents may interact with the school to provide a positive environment and support learners in implementing hybrid learning. Schools and parents should work together to create a positive hybrid learning environment for learners.

8) Instructional organization of flexible-hybrid education

The shift from Traditional Instruction models to Hybrid Education inevitably requires flexible teaching and learning (Huang et al., 2020a). The government plays a pivotal role in promoting cooperation supported by new technologies to promote the reform of teaching methods to adapt HELA for higher teaching quality. The organization of teaching and learning can become more flexible in the arrangement of teaching time, the application of teaching methods, the use of supporting technologies, and the evaluation of learning effects (Casey & Wilson, 2005; Huang et al., 2021). In terms of teaching space, it is not limited to traditional classroom learning but also includes students' independent learning space outside the school. The teaching format can consist of both distance learning and face-to-face learning. The learning time also becomes flexible: students can schedule their learning activities, make use of their own free time, and join face-to-face and live teaching based on their needs. In short, HELA implementation requires more flexible organizational support.

2.3 The roles of key stakeholders in HELA

Based on early works by UNESCO (UNESCO-IBE, 2017) and others (e.g., Huang et al., 2020a) who studied the roles of stakeholders in educational settings, we created a figure demonstrating and clarifying the key stakeholders involved in HELA and their responsibilities. As indicated in figure 2.2, we propose eight key stakeholders involved in hybrid education, which are assembled as a four-layer onion model (see Figure 2.2). Stakeholders such as students, teachers, and parents are at the very core base of this model. Parents or guardians play an essential role, as they are deeply involved in the hybrid education process, especially when students study remotely. Then comes schools, whose primary responsibility is to organize and plan hybrid learning under the guidance of government and local educational authorities. The next layer is government, which

plays an important role in launching policies and allocating funds for effective hybrid education. On the top of the onion model, three key stakeholders, namely NGOs, enterprises, technicians, and administrators, were listed. They support and facilitate hybrid teaching and learning in multiple ways and, for instance, by providing learning support services (technicians), offering tools and digital/AI solutions (enterprises, NGOs), and managing and coordinating resources (administrators). Detailed responsibilities are described below in a one-by-one fashion.

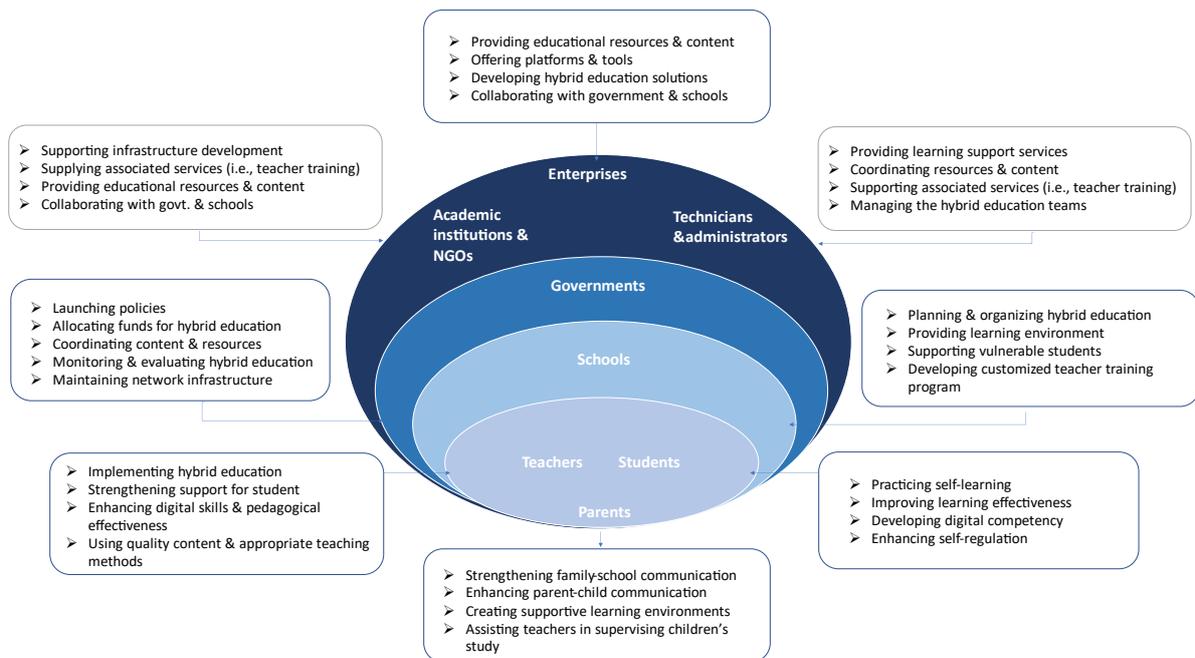


Figure 2.2. Stakeholders involved in HELA

1) Government as the public service provider

- Launching policies on hybrid education

With the authority of governing, the government and educational authorities have the responsibility to formulate relevant policies for hybrid education (Lee et al., 2017). Within the policies, clauses like the roles of stakeholders, the funding allocation, implementation strategies should be specified. In addition, together with national educational authorities, the government should also set up a special work panel to formulate plans for hybrid education. Importantly, flexibility should be given to local schools/educational institutions in setting their own concrete hybrid education plans. Moreover, the policies and guidelines should specify the development of a hybrid learning curriculum. The policies should also take the time of crisis (i.e., the COVID-19 pandemic) into consideration. For example, policies on how to respond to national and global pandemics should be specified (Huang et al., 2020). To wrap it up, the government plays a leading role in hybrid education by issuing policies to ensure the responsibilities of different stakeholders.

- Allocating funds for hybrid education

Aside from launching policies, allocating funds is also crucial. Authorities such as national departments of finance and education should guide local departments to formulate guidelines for school funds. Funding for hybrid education is suggested to focus on both macro and micro levels. Firstly, at a macro level, there should be general funding for schools at different levels. Local financial departments should pay closer attention to the influences of the COVID-19 pandemic on education and living costs. They are also required to formulate policies and measures to support school funds with overall arrangements for educational budgets to promote the allocation and use of financial funds for hybrid education. Secondly, at a micro-level, the government is suggested to allocate funds for special student groups. For instance, to prevent digital exclusion, the government should distribute funds to local governments to purchase ICT equipment for disadvantaged students, especially children from low-income families with learning disabilities and lacking essential hybrid learning equipment. Moreover, national departments of finance and education can also allocate funds for infrastructure development (Castells & Solé-Ollé, 2005), especially for building reliable and stable networks.

- Coordinating content & resources

The government also needs to coordinate resources, tools, and educational content for hybrid education. Government should closely cooperate with institutions such as None Government Organizations (NGOs), enterprises, and others that can assemble various platforms, tools, quality content, and resources for school teaching (Miller-Grandvaux et al., 2002). National educational authorities should coordinate the compilation and publication of learning materials in primary and secondary schools to provide high-quality, harm-free electronic materials for hybrid learning. Government and educational authorities also need to securitize the content and platforms that students will use, protect children from potentially violent and harmful content, as well the risk of exposure to online sexual exploitation and, cyberbullying. The download links and instructions of electronic materials need to be collected and tested to avoid potential risks (Huang et al., 2020a). When in times of crisis (i.e., COVID-19), they may also need to keep up with the newest situations and updates to meet the needs of teachers and students.

- Monitoring & evaluating hybrid education

Monitoring and evaluation can serve as a driver of continuous improvement (Sanderson, 2001). The government should monitor and evaluate the hybrid education process. When practicing hybrid education, local governments can develop critical evaluation indicators to assess and monitor the quality of hybrid teaching and learning, track learning outcomes, and analyze relevant factors influencing hybrid teaching and learning quality (Tabor, 2007). In addition, the government needs to specify the persons responsible for monitoring efforts in the school, the

target issues to be monitored, the data collection methods, and the monitoring schedule. Specifically, the government needs to ensure that all the monitoring data is processed and utilized to develop and improve hybrid learning without bringing risks. That being said, the guardians and the necessary partners are informed of the monitoring process and critical results. As hybrid education cannot completely replace classroom learning, local education authorities should guide the schools to make accurate and comprehensive assessments of students' learning quality and set individualized education plans accordingly.

- Maintaining network infrastructure

A coordination mechanism could be established to guide major telecommunication and network operations and maintenance service providers to provide powerful network support while increasing the construction of the broadband network and base stations (Huang et al., 2020b). Infrastructure development in economically disadvantaged areas should be emphasized, especially for those lacking internet access or suffering from a slow internet connection. Education authorities need to guarantee the learning terminals for students with financial difficulties. All regions are suggested to conduct analysis and prediction in advance according to local network conditions, server capability, and student distribution, to make complete preparations for hybrid education.

2) Academic institutions and NGOs as assistants

- Collaborating with the government & schools

Partnerships for development are one of the Millennium Development Goals (MDGs), now absorbed into the Sustainable Development Goals (SDGs) (UN General Assembly, 2015). Collaborations between government, NGOs, and academic institutions can improve service delivery. NGOs and educational institutions communicate and collaborate closely with both government and schools. The previous study has proved that embedded partnerships between government and other academic institutions can bring about positive changes in government working practices on a sustainable basis (Bano, 2019). In hybrid education, NGOs act as helpful assistants for the government, sharing responsibilities such as allocating resources and contributing to teacher training programs.

- Supporting infrastructure development

By collaborating with government, policymakers, and enterprises, the NGOs can establish a range of facilities and investment mechanisms that provide varying types of financial, practical, and strategic support to develop the infrastructure required for hybrid education, such as school, network infrastructure building of both government and community schools (Miller-Grandvaux & Yoder, 2002). Such collaboration between NGOs and government makes the role of non-

Government social organizations even more critical as they seek to supplement, complement, or substitute the formal education system in the country and reach out to the excluded, underprivileged, and challenged sections of society. Therefore, they have an irreplaceable role in supporting infrastructure development.

- Supplying associated services (i.e., teacher training)

Academic institutions and NGOs can also supply associated services for hybrid education. For instance, some regions do not have access to hybrid education, and NGOs help them set up classrooms for daily instruction and learning. Teachers who participate in hybrid learning programs for the first time may encounter either pedagogical or technical issues. Academic institutions and NGOs can help them by organizing tailor-up hybrid education training sessions, allowing the government to ensure that teachers have a smooth transformation from traditional classroom teaching to a hybrid teaching model. By supplying services from academic institutions and NGOs, it is possible to improve development effectiveness and sustainability and hold governments and policymakers publicly accountable.

- Providing resources & content

Academic institutions and NGOs can also help by providing resources and content needed for hybrid education. Two parts are explained: firstly, academic institutions and NGOs allocate their resources and educational content for general school groups; secondly, they may help the disadvantaged student group, providing customized materials and content based on students' individual needs. In addition, academic institutions and NGOs also play various roles in supporting education service delivery (Rose, 2009). For example, they can help provide extra support in delivering courses to unserved children and communities, and building e-classroom for vulnerable student groups.

3) Role of technicians & administrators

- Providing learning support services

Technicians' responsibilities include training students and teachers using tools, fixing technical problems, and teaching students to search for information on the internet. They manage and maintain the learning management system to ensure reliable delivery of online content, provide quality professional development opportunities to prepare faculty to develop academically rigorous, accessible, and enriching educational experiences for all learners, and provide technical support services in using hybrid learning technologies to students and faculty (Markova et al., 2017). In addition to technicians, some administrators can provide counseling services regarding the practice of hybrid learning and offer academic support whenever needed. They may also

support the hybrid education teams, manage the process, and follow the updates closely. Most importantly, it is suggested that both technicians and administrators work together to assist teachers and students in successfully implementing the hybrid education model. Moreover, administrators and technicians should act as the bridge between teachers and industries and investigate the needs of schools and teachers while asking for individualized solutions and products from educational service providers.

- Coordinating resources & content

Administrators contribute to hybrid education via extending communication and locating necessary resources (Porter et al., 2014). Faculty and support staff (such as IT staff) provide cooperation and firm support that may facilitate the implementation of hybrid education (Moskal et al., 2013). It is crucial to have all the required resources and content ready for hybrid education. The administrators are responsible for organizing, negotiating, and purchasing all the products, services, and solutions from businesses, industries, and other participating institutions. They need to evaluate the quality of courses to ensure that all the materials are suitable and safe for students. In addition, they need to monitor the whole process of hybrid education and provide quick feedback for teachers and industries regarding the usage of resources and materials for improvement.

- Supporting associated services

If associated services, for example, tailor-up hybrid teacher training programs, are needed, administrators and technicians need to organize professional development programs. Administrators should coordinate the best available training resources, arrange suitable spaces, and hire the right mentors for the teachers who have the related needs. Technicians can demonstrate to teachers the proper way to use technology in hybrid learning and when is the best time to use it. Technicians also need to investigate and understand what teachers and students prefer techniques and tools, analyze the current situation, and offer customized services through constant communication with IT industries and businesses.

- Managing hybrid education teams

The most salient role of school administrators may be managing the whole team. First, they need to set communication guidelines, clearly indicating different stakeholders' responsibilities and roles to facilitate smooth communication between various parties. Secondly, they need to embrace cultural diversity and viewpoints while setting guidelines and rules. Besides, administrators are suggested to establish the workflow to manage hybrid learning projects, and provide teachers and students in-time support when needed. At times of crisis (i.e., COVID-19 pandemic), they may also need to organize activities that connect remote learners, teachers, and other staff, foster communications and interactions, and promote the well-being of employees

and students during hard times.

4) Enterprises as providers

- Providing educational resources & content

Students need many kinds of digital resources and content for hybrid learning. To address these needs, enterprises, especially educational technology companies, play an essential role in hybrid education, as they provide schools with digital resources and teaching content. Government or educational authorities either purchase products or provide services for schools. Those resources should be of high quality, safe, and user-friendly. Enterprises should work closely with school teachers to select quality teaching content and extra-curriculum materials. Importantly, they should investigate what resources and tools students will be using and provide customized hybrid learning solutions accordingly.

- Offering quality platforms & tools

Enterprises also provide quality platforms and tools, such as learning management systems (LMS), and tools for instant messaging, social networking, blogs and forums, course recording tools, and educational games (Okaz, 2015). In hybrid education, schools realize that they rely on educational technology that provides a maximum amount of flexibility and integration. Teachers learned that they could teach remotely with tools such as tools for recording lessons and delivering content to students, as well as online polls to assess whether they understood the content. Enterprises recognized that they need to provide suitable platforms and tools according to the local conditions and avoid unnecessarily increasing teachers' workloads. EdTech tools and platforms should make it easier for teachers to create individualized lesson plans and learning experiences that foster inclusion and boost the learning capabilities of all students.

- Developing solutions for hybrid education

Integrating quality content and platforms into individualized yet effective solutions is of great significance for educational technology enterprises. By utilizing the newest educational technology development, students may extend their full potential in learning in a hybrid model. Technologies such as speech-to-text, artificial intelligence (AI), hybrid cloud computing, data management, and augmented reality (AR) enhance learning environments by developing learning potential and improving outcomes, and improving engagement. For example, IBM Education solutions help create cognitive campuses, which help educators and students improve the learning process for better results from kindergarten through higher education¹.

- Collaborating with governments & schools

¹ Source: <https://www.ibm.com/industries/education>

Enterprises need to have close collaboration and constant communication with local and national governments to provide services and educational products. Moreover, they need to establish smooth communication with schools at different levels, hear schools and teachers out, and investigate their needs in delivering hybrid education. They should also obey the policies and guidelines set by the government and policymakers. Thus, it is essential to maintain constant dialogue and collaboration between enterprises, government, and schools.

5) Schools as organizers

The role of the school matters for student engagement. Schools providing support for academic learning, meaningful pedagogy and curriculum, and personalized learning environments are more likely to have their students engaged and achieve success (Klem & Connell, 2004). In this report, “schools” refer to both public and private schools. Whatever the type, they should cooperate with educational authorities, families, and students in co-designing, co-developing, and co-implementing hybrid education.

- Planning & organizing hybrid education

School administrators should formulate a hybrid education implementation plan in which detailed instructional arrangements, teacher training plans, learning support, and funds allocation are specified. All schools, including public schools, private schools, semi-publicly funded schools, and international schools, should have hybrid learning plans. In addition, schools should develop emergency plans to respond to national disasters, global pandemics, and extreme weather. Besides, it is essential to include plans to mitigate the risks of harmful, violent content, cyberbullying, or children’s exposure to sexual content to promote positive experiences for children when learning online. Moreover, schools could also set their safeguarding policies to protect children while learning in a hybrid model, provide resources and information on digital safety to support parents and caregivers in creating a positive hybrid learning experience, and, more importantly, promote and monitor good online etiquette.

- Providing a learning environment

The learning environment is crucial for successful hybrid teaching delivery. Hybrid learning needs an innovative learning environment that intentionally utilizes information and communication technology (ICT). This learning environment should have the necessary technological, social, and educational affordances to provide students opportunities to learn (Beers et al., 2005). In addition, the learning environment should be comfortable and safe and can encourage interaction between peers, teachers, and even parents. Schools can conduct a survey, investigate teachers’ needs, and test the functions of software and hardware. Based on the

investigation, they can rebuild or improve the current environment to facilitate hybrid teaching and learning.

- Supporting vulnerable students

Schools and teachers play a vital role in supporting vulnerable children (Masters et al., 2020). Schools should consider the needs of special students when planning hybrid education. Vulnerable students refer to groups of students with learning disabilities (i.e., attention-deficit/hyperactivity disorder, anxiety, Dyslexia.), as well as students who came from disadvantaged groups (i.e., children from less developed regions, rural areas, or those whose families, social, or economic circumstances hinder their ability to learn at school). Special arrangements could be made when schools plan and deliver hybrid education. First, for students with learning disabilities, social workers or special teachers should work with course teachers to conduct distance learning. They should monitor those students closely and adjust the teaching schedule accordingly. Second, for students from disadvantaged groups, allocate extra funds to support their ICT equipment purchasing, travel subsidies, etc. Emotional support is crucial when teaching online. Thus, teachers and teaching assistants play a role in monitoring vulnerable students, giving feedback on time, and offering counseling services when needed.

- Developing customized teacher training programs

Since not every teacher is familiar with pedagogy, technological applications, and common practices of hybrid teaching, special training sessions may be needed for successful implementation. First, school administrators are suggested to set evaluation criteria and develop training programs for teachers' teaching readiness in hybrid education. Teachers could be evaluated in terms of their ICT competence and organization ability of online teaching. Secondly, schools can develop detailed plans for teachers' professional development programs and emphasize aspects like hybrid teaching pedagogy and techniques such as AI for better interaction. Moreover, schools should also take advantage of various national platforms for teaching and learning, keeping them accessible for teachers. For example, in China, the National Public Service Platform for Educational Resources² provides access to excellent courses, teaching and training resources, and expert teams for teachers.

6) Teachers as the curriculum co-developer and co-implementor

Teacher support has proved to be a significant predictor of students' learning engagement (Strati et al., 2017). In hybrid education, sometimes teachers and students are separated. Thus, relatedness is salient, and students need to feel that teachers are involved with them. Students

² <http://www.eduyun.cn>

also need to feel they can make critical decisions for themselves (that is, autonomy) (Deci & Ryan, 2008; Klem & Connell, 2004). Moreover, in hybrid education, teachers should work closely with students, investigate students' needs and preferences, and co-design and co-develop curriculum along with students.

- Strengthening support for students

In hybrid education, when teaching is conducted online or at a distance, students need more support from teachers (Jokinen & Mikkonen, 2013). First, teachers need to support students on relatedness and autonomy; each teacher needs to monitor students' learning and growth as well as signs of any need for support. Remedial teaching should be provided in mutual understanding between the school, the pupil, and the guardian. A thorough investigation should be conducted for those students with poor academic performance, and additional assistance is recommended to improve their grades. Teachers should pay close attention to the learning and living conditions of students with disabilities and take effective measures to ensure their learning opportunities and psychosocial well-being. Teachers should also understand the technology that students will be using when delivering class in a hybrid model, learning to support students technically, emotionally, and cognitively.

- Building digital skills & pedagogical effectiveness

In hybrid learning, teachers' roles, teaching methods, and teaching environment differ from traditional classroom teaching. Thus, it is necessary to receive teacher training to meet the new teaching normal. Teachers should work actively and regularly participate in teacher training programs. Teachers' digital competency is an essential part of teaching skills. They can hone their skills using the TPACK model, understanding the role of technology and the interaction between technology and pedagogy, and how to make teaching more effective and engaging (Papanikolaou et al., 2017). At times of crisis, such as during the outbreak of COVID-19, teachers have to shift classrooms from offline to online by way of live streaming, and recorded broadcasting. Teachers will have to switch from being a leader in classroom teaching to being a tutor.

- Using quality content & appropriate teaching methods

Quality teaching methods and content produce learning (Fenstermacher & Richardson, 2005). To make the course engaging, teachers should learn how to select and use quality content and instructional skills to engage students. The teaching and learning content should be appropriate and aimed at some worthy purpose. They should also avoid overloading learners by asking them to use too many tools and doing too much homework. In addition, the content of teaching should be free of harm and from responsible publishers/contributors with proper copyrights. Teachers should combine the network conditions and their capabilities to consider appropriate instructional approaches. When choosing the instructional methods, teachers need to consider the instructional

modes as well as other curricular elements. The applied teaching methods have to be morally defensible and grounded in shared conceptions of rationality (Fenstermacher & Richardson, 2005).

- Implementing hybrid education

To successfully deliver the hybrid course, teachers should conduct a pre-course analysis and understand the technologies and tools students will be using, the teaching styles students prefer, and the level of students' current knowledge and skills. Teachers also need to pay attention to vulnerable student groups, making individualized learning plans (ILPs) accordingly. Based on actual conditions and resources, teachers could appropriately select and organize instructional content to ensure the effectiveness of the teaching process. Moreover, teachers should combine the network conditions and their capabilities to consider appropriate instructional modes and approaches. Design is very crucial in implementing hybrid education. Teachers should carefully choose the proper instructional mode, including synchronous online learning, asynchronous online learning, and open learning. When designing learning activities, they can apply self-regulated learning, explorative, collaborative learning, and other learning activities in online scenarios.

7) Parents/guardians as homeschooling supporters

In hybrid education, parents/guardians are eager for more online interaction to facilitate children's learning and desire better learning support from schools, flexible work arrangements, and government subsidies (Lau & Lee, 2021). However, they also acted as a salient role in promoting children's learning. They need to know that sometimes parents may live separately with children due to situations such as immigration, disasters, and pandemics. In such cases, other available family members or legal institutions could step out and offer help for that student-in-need and share the role of guardians. There are several responsibilities that parents share in this hybrid education: parents/guardians perform as an organizer, instructor, manager, and importantly, a motivator.

- Strengthening family-school communication

In the online part of hybrid education, teachers usually communicate regularly with students and families through online platforms and virtual learning environments. It is worth noting that parents/guardians and caregivers can step in and help strengthen such connections. They should stay in contact with the classroom and support teachers, school leaders, and counselors. Parents/guardians can also share their concerns with students and offer suggestions for improvement. In addition, parents should communicate with schools to jointly guarantee the

quality and effectiveness of distance learning.

- Enhancing parent-child communication

The hybrid model of education may bring more time for parents to communicate with their children. Effective communication can help build a parent-child relationship of mutual trust and respect, through which parents can set role models for children. Parents'/guardians' role as motivators and organizers is of great importance in this communication process, which means they need to provide increased levels of support in terms of motivation and organization. They should hear children out and discuss daily schedules, lesson plans, activities, or even how to gather and collect materials. In addition, parents or caregivers should motivate students to progress and work through problems, as it may be challenging to get desired help when learning distantly.

- Creating supportive learning environments

Generally, parents/guardians should help children create a favorable learning environment equipped with necessary hardware and software that enable students to focus on their studies. Parents should help set up a physical space dedicated to school-focused activities, establish a quiet and comfortable environment free from distractions, and maintain a good internet connection. Parents/guardians also need to make sure that an adult is always there to supervise students' learning. Creating a quiet environment is important for families with children of different ages and parents who may often work from home for a variety of reasons. Siblings may need to work in different rooms to avoid distraction. Many families will need to negotiate access to devices, priorities for WIFI bandwidth, and daily schedules. To sum up, parents/guardians should provide a quiet and comfortable learning environment for students, guarantee learning equipment, and ensure network support.

- Assisting teachers in supervising children's study

Children usually spend a lot of time in a classroom where teachers are available to support them. However, in a hybrid system, teachers may not have the same time or resources to support students as fully as they had before. Thus, the role of parents/guardians in assisting teachers becomes crucial. They should take the initiative to seek all kinds of resources to assume the role of a "temporary head teacher" during students' remote study. They will supervise children to attend classes on time, form good online learning habits, and balance study and physical activities. Parents/guardians should communicate with teachers regularly and oversee children's homework to help them safely identify and use online learning resources. Most importantly, they should provide support and encouragement and expect children to do their part.

8) Students as the self-learners

Even with support and assistance from multiple stakeholders, students remain primarily responsible for quality hybrid learning. They are required to engage in and contribute to the whole teaching, learning, and assessment processes (Stabback, 2016). In hybrid education, students should practice self-learning and self-regulation, improve learning effectiveness, and develop digital competency.

- Practicing self-learning

Self-learning is the key to successful hybrid education. Students need to be well-prepared before class. In the morning, students should ask themselves what classes or subjects will be taught today, what assessment will be taken, how to arrange the time and what kind of resources are needed. If needed, they should discuss with parents, peers, or teachers and seek suggestions from them. At the end of the day, students can reflect on what has been learned, which part is easy/hard, and what could be done to improve it. Simple self-checking-in should help both plan well beforehand and reflect on the day afterward. It helps students organize themselves and set priorities for learning tasks.

- Improving learning effectiveness

Not all students thrive in hybrid learning. Some students struggle with too much independence or lack of motivation. Students should improve learning effectiveness since sometimes the course is conducted remotely. Building a sense of connection and community is crucial, which facilitates learning engagement (Young & Bruce, 2011). They should be well-prepared for the incoming course, cooperating closely with parents or peer learning partners. Upon finishing a class, students can reflect on what has been learned and is yet to be. Such daily check-in routines can help avoid later challenges and disappointments. They help students develop self-management and executive functioning, which are essential skills for life. Moreover, students can also utilize learning approaches such as team-based learning or collaborative learning, learning from peers, and collaboration.

- Developing digital competency

Digital literacy is a mindset and attitude, not just a skill set. Students should improve their digital capabilities in hybrid learning. They should have skills and capabilities in many aspects, including the ability to use technology, search, use, and critically evaluate information. This is vital since, in hybrid learning, students need to identify critical resources from the internet to support self-learning. Meanwhile, they should learn to communicate, collaborate, and participate in online environments, know how to manage online identities, as well as personal security and privacy. Digital competency development is best

achieved in this context.

- Enhancing self-regulation

Becoming a sophisticated learner (especially in hybrid learning situations) involves learning to manage the conditions of one's own learning (Bjork et al., 2013). Students need to develop good self-regulation skills from the start. Students need to hone their abilities to understand the course and control the learning environment for hybrid learning. Before the class, proper goal setting should help identify what is to be achieved and how much effort is required. Students also need to conduct self-monitoring, track learning pace regularly, and use proper strategies for self-reinforcement. In addition, students can conduct self-evaluations based on learning objectives, personal learning status, and peers learning status. They can also run a self-analysis of their homework. These strategies mentioned above can help students better understand their learning process and improve their plans to maximize the initiative of self-evaluation. Besides, parents' companionship and support are also needed to ensure students' effective learning and self-discipline.

3. The Guidelines for Advancing HELA

In this section, to promote HELA globally and achieve success in educational practice, we propose the guidelines for advancing HELA. This section contains three parts. The first part states the fundamental principles to follow when promoting hybrid education. Examples are accessibility, inclusivity, and contextual grounding. The second part briefly describes the employing strategies, and the third part presents the instructional model of HELA, from pre-analysis to final assessment. A detailed description is presented below.

3.1 The fundamental principles underpin HELA

- Accessibility & Inclusivity

In hybrid education, course design needs to account for accessibility and inclusivity (Andujar & Nadif, 2020). When designing a hybrid education curriculum and delivering courses, it is salient to recognize that students have various levels of competencies and ensure that meaningful learning is available and accessible to all students. Thus, it is of great importance to pay attention to vulnerable student groups, including students from disadvantaged groups (i.e., children refugees, displaced persons, children living with difficulties), students with learning difficulties, and highly gifted learners. Appropriate provisions must be provided to students who face physical, psychological, and emotional challenges (UNESCO-IBE, 2017). Designing an inclusive

curriculum is significant. Principles include establishing and supporting a class climate that fosters belonging for all students; creating multiple, low-stakes opportunities for students to demonstrate their learning; providing timely feedback on student work; selecting course content that recognizes the diversity and acknowledges barriers to inclusion; and making appropriate provision for students who have physical, psychological and emotional difficulties should be followed.

- Contextual grounding

Researchers have often argued that issues of context and culture are consistently ignored when devising development policy (Crossley, 2009; Heyneman, 2009). Contextual grounding means context matters should consider regional, national, and global differences when implementing hybrid education. Technology, such as ICT, can be helpful but needs to be appropriately used. In addition to technology, instructors and other educational stakeholders also need to analyze the resources available and students' family economic status. For example, in less-developed rural areas, many families may not afford a laptop or even no stable network connection across the region. Hence, planning a hybrid education that requires each student to study at home seems impossible. In this case, government and relevant educational authorities need to allocate extra funds to build an efficient network and support families with essential equipment. Cultural issues are another factor that deserves attention. Specifically, cultural diversities should be respected and weighted when planning content and interactive activities of hybrid education. Moreover, paying attention to vulnerable student groups is also important when planning hybrid education. For example, hybrid learning can be challenging for students with learning difficulties. Instructors are required to set frequent communication and dialogues with parents and figure out solutions to help students.

- Equity

Equity in education means that every student, regardless of their own personal and socio-economic status, ethnicity, or family background, should have access to the resources to acquire reading, writing, and simple numeracy skills. There are huge differences in financial conditions, religious beliefs, and cultural backgrounds throughout the world. Governments and other stakeholders need to prioritize education for all children. Practicing hybrid education means that we also need to ensure that all school-age children, regardless of individual circumstances, can access the curriculum equitably (Gülbahar & Madran, 2009). Therefore, the curriculum itself must be designed in ways that consider and make provision for this wide range of cultural, social, financial, and geographic circumstances (UNESCO-IBE, 2017).

In hybrid education, essential ICT equipment and network infrastructure are necessary when courses are delivered on a remote base. Many low-income families do not have the WiFi

connections or computer equipment needed for hybrid learning in many areas. Building reliable network connections and ensuring that every student has essential ICT equipment (i.e., computers, laptops) should be on the top mission to complete and priority of the government and relevant stakeholders. Educational stakeholders need to dedicate themselves to analyzing the situations and designing a hybrid learning curriculum to make sure that all students receive comparable learning experiences regardless of location (Butz et al., 2016).

- Flexibility

The principle of flexibility will ensure that a range of opportunities and pathways are provided to students through the hybrid education curriculum. Through flexibility within the curriculum, we genuinely acknowledge and provide help for our students' wide and ever-changing range of needs, interests, and aspirations (UNESCO-IBE, 2017). The flexibility in hybrid learning can be reflected in five aspects: time and location of learning, learning content and sequence, delivery mechanism, instructional methods, and assessment methods. For example, there are different ways to assess a student's performance, which can be either a short-filmed presentation, a research paper, team projects, peer assessments, parent-assisted assessments, or standardized tests. Another example can be the use of an E-portfolio, which is a method that can offer more flexibility for students to update the evidence of their development and achievement (Gordon, 2014). The timing and delivery channel of assessment can also be flexible. Flexible learning can be provided by applying learning analytics approaches.

- Intentional technologies use

Intentional technology use means that when using different tools and technologies in hybrid education, it is better to have a particular end in mind and understand the benefit of technology use and the potential risk it may bring to students (Lubin, 2016). Students' safety should be the prior consideration while using technology or a tool. Teachers should be prepared and understand what technologies, tools, or apps students will be using and like to use in the classroom. They should also have a clear knowledge of how to use the technology and what to offer from using those technologies. Thus, to speak of intentional use of technology, means the motivation or desire to use technology, with a particular end in mind, conscious knowledge, and understanding of the consequence of such use. It is important to consider all these implications. Except for readiness and aims, a teacher should also show commitment to using technology, recognizing the educational value, and believing in the transformative potential of the technology (Hennessy et al., 2005).

3.2 Employing strategies of hybrid learning

When employing hybrid learning, curriculum experts and instructors are suggested to consider and understand some generic strategies in advance.

- First, work backward from the course goal to avoid a counterproductive focus on technology (Sands, 2002).
- Second, focus on interaction (student to student and student to teacher) rather than the delivery model.
- Third, redesign the learning activities that carry over to the classroom and back online.
- Fourth, consider the problems in the traditional classroom and integrate technology to solve the problem online.
- Fifth, remember to start with simple technologies and tools.

3.3 The instructional model of hybrid learning and assessment

The specific approach to implementing hybrid instruction depends on the local context where the instruction is executed. Generally, it is recommended that institutions prepare for HL implementation by setting curriculum goals and conducting pre-analysis to clarify learners' features, environment, and learning content. Then, learning objectives should be clarified, and the associated learning outcomes can be defined. These learning outcomes will guide hybrid teaching and learning, including designing and implementing learning activities and materials, providing customized learning supports and services, and preparing learning environments and tools. Next, a unique step is constraints analysis because of diverse students, dynamic process and environment, and uncertainty in the learning environment and process in hybrid learning. When the results of a constraints analysis are propitious to the goal, a learning assessment will be conducted in the next step. However, when strong constraints for achieving the goal emerge, the process will be redirected to clarify learning objectives and define learning outcomes. It is an interactive process, which will be completed until the hybrid teaching and learning is optimal for achieving the pre-set goals. This instructional process is summarized in figure 3.1, and the details for each step are presented in the following sections 4-8.

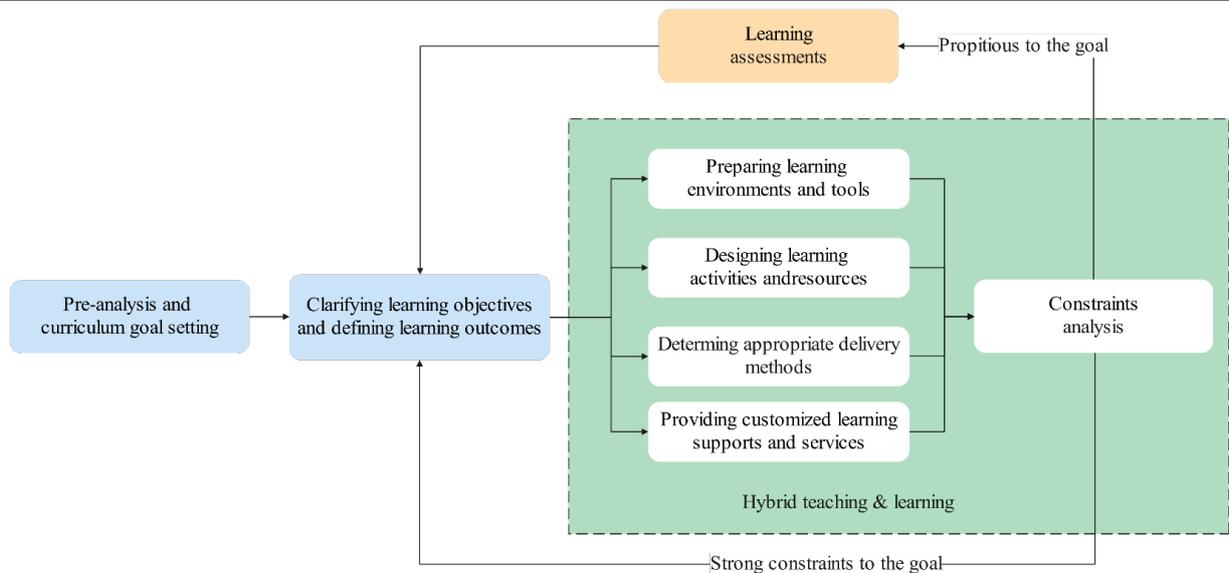


Figure 3.1. The instructional model of hybrid learning and assessment

4. Pre-analysis and Clarifying Curriculum Goals

4.1 Clarifying curriculum goals adapted to HELA

The curriculum goal is the purposes or ends stated in general terms. It usually does not have criteria of achievement or mastery. Curriculum goals are related to educational aims and philosophy. These goals typically do not delineate the specific items of content. Typically, they refer to the accomplishment at the group level rather than the individual learner level. They should be broad enough so that they can lead to specific curriculum objectives (UNESCO-IBE glossary)³. Typical examples of curriculum goals can be “students will learn to respect and get along with people of different cultures” and “students will attain an appreciation for literature, art, music.”

For setting curriculum goals, a variety of references can be used by teachers or curriculum developers. Curriculum standards are one kind of reference, which are guidelines that can reflect the purpose of the curriculum. Curriculum standards are often created at the institutional, national, and regional levels to indicate what students should know and be able to do within a particular content area. Standards are valuable references for aiding teachers and curriculum developers in designing an aligned curriculum that represents what students need to know, understand, and do in each grade level or course. To determine the standards, teachers need to reflect their purpose and target audience (UNESCO-IBE glossary). In the USA and China, standards are also broadly used. For example, Common Core State Standards are state-led efforts in the USA which define

³ Source: <http://www.ibe.unesco.org/en/glossary-curriculum-terminology/c/curriculum-aims-goals>

the knowledge and skills students should have in their K-12 careers. New Course Standards are proposed for multiple subjects by the Ministry of Education in China. 21st-century skills are also good references popular in the USA, Canada, UK, New Zealand, AEPC, and OECD members, which can give teachers and curriculum experts some ideas for goal setting since it points out key personal skills and competencies needed for the current and next generation. These 21st-century skills include learning and innovation skills, digital literacy skills, and career and life skills. In addition, OECD also proposed “The OECD Learning Compass 2030,” which lists important competencies aligned with SDGs that learners need to thrive in the digital society⁴.

Specifically, hybrid learning has unique features which should be considered in goal setting. For example, in the online session, teachers and students may be separated from each other, which puts the virtual participants at a disadvantage. In addition, managing devices can be a laborious task for teachers or IT staff. The use of multiple devices and apps can bring distractions to students for their learning. Based on these features, there are a lot of factors that might affect reaching goals in a hybrid mode. For example, limited internet access, overwhelmed technology or device use, poor quality of the utilities, distractions, and little communication and collaboration opportunities. It has been reported that under the condition of such challenges, teachers and students may feel insecure about the demanding course goals (Dyment & Downing, 2018) and thus become demotivated. Course planning, including goal setting, for hybrid learning, is more complex than traditional face-to-face learning (Mossavar-Rahmani & Larson-Daugherty, 2007), and we must consider how various challenges and constraints that affect learning (Haron et al., 2021). Thus, we suggest curriculum specialists and instructors comprehensively analyze and consider those constraint factors related to risks for goal achievement, learning conditions, and scenarios specific to hybrid learning. Based on such analysis and considerations, they can carefully think about how the determined goals and objectives can be achieved in hybrid contexts. As a result, they should carefully set adapted and achievable goals for the curriculum to determine the appropriate scope and the level of difficulty for achieving the goals.

4.2. Conducting comprehensive analysis at the very beginning

To determine how hybrid learning could be designed, crucial observations and analyses at the front end need to be conducted. The purpose is to identify learners’ prior knowledge and proficiency level, the level of their ICT skills, specify learning tasks to build a sound foundation for the organization of learning activities in the hybrid contexts, and recognize the features of the hybrid context that may influence hybrid learning. The outcome of this pre-analysis is an analysis

⁴ https://www.oecd.org/education/2030-project/teaching-and-learning/learning/learning-compass-2030/OECD_Learning_Compass_2030_concept_note.pdf

report, which is a summary of the starting point of instruction based on these analyses.

Pre-analyses can chiefly be conducted from three aspects: (1) analysis of learner characteristics, in terms of regular assessment of learners' prior knowledge, learning styles, learning preferences, motivational status, necessary ICT skills for participating in hybrid learning, online communication skills, etc.; (2) analysis of learning objects (knowledge taxonomy), in terms of defining what should be taught based on knowledge taxonomy and the relationships among them; and (3) analysis of hybrid learning environments, in terms of finding out the environmental features (Huang et al., 2008).

5. Stating Learning Objectives and Defining Outcomes

5.1 Stating learning objectives

Learning objectives describe the intended educational activity's expected goal(s). Learning objectives can guide the organization of specific topics or activities to achieve the desired outcomes. They can also be used to structure the content of educational activities. Traditionally, the "ABCD" method for writing learning objectives can be used as an example⁵. As the dominating educational philosophy shifts toward constructivism and the features of hybrid learning environments become different from the traditional classroom teaching, there should be more elements to be considered in the written objectives. Huang et al. (2021b) believe the nature of online learning, which is one portion of hybrid learning, is one type of technology-enhanced learning. They highlighted the importance of several aspects of this type of learning. These aspects include but are not limited to thinking carefully about how learning activities (learning tasks, methods, and assessments), resources (e.g., books, videos, audios), services (e.g., feedback, supervision, and support), and scenarios (e.g., time, location, other participants in learning) will be and how they can affect achieving objectives. Thus, curriculum experts and instructors should carefully understand and consider learning objectives in hybrid contexts, activities, services, and scenarios.

⁵ UCLA course planning Tip Sheet

<https://www.uclahealth.org/nursing/workfiles/Education%20Courses/ContinuingEducation/ce-LearningOutcome-v-LearningObjective-052016.pdf#:~:text=not%20present%20%20%20Learning%20Outcome%20%20,State%20normal%20range%20for%20blood%20pressure.%20%20>

5.2 Defining learning outcomes

A learning outcome is a statement of what a learner is expected to do, know about, and value after a unit of study and how well they should be expected to achieve as a result of completing the course. Thus, it states both the substance of learning and how its attainment will be demonstrated.

Term 2. Learning Outcomes

Learning outcomes are the statements of the knowledge, skills, and abilities individual students should possess and can demonstrate upon completion of a learning experience or sequence of learning experiences (Allan, 1996).

Behavioral verbs are often used when describing the learning outcomes. Thus, outcomes are SMART: specific, measurable, achievable, relevant, and time-bounded. Based on these features, there can be some similarities between learning objectives and outcomes. Table 5.1 shows some examples to explain the difference between the two.

Table 5.1. Examples of learning objectives and corresponding outcomes⁶

Learning Outcome	Learning Objective
Knowledge: At the conclusion of the educational activity, participants will self-report knowledge gain of effective communication styles using a 5-point Likert scale.	Describe characteristics of effective communication styles.
Competence/Skill: At the conclusion of the educational activity, participants will self-report an intent to change practice by applying evidence-based communication strategies.	List 5 methods of creating a safe environment for holding a confidential conversation.
Competence/Skill: At the conclusion of the educational activity, participants will self-report an intent to change practice by applying evidence-based communication strategies	Define the components of the SBAR patient handoff tool.

⁶ Reference: UCLA course planning Tip Sheet

<https://www.uclahealth.org/nursing/workfiles/Education%20Courses/ContinuingEducation/ce-LearningOutcome-v-LearningObjective-052016.pdf#:~:text=not%20present%20%20%20Learning%20Outcome%20%20,State%20normal%20range%20for%20blood%20pressure.%20%20>

Clearly stated outcomes allow students to know in advance the knowledge and skills they need to master. It can guide students' learning process, keep students engaged in the learning process and improve learning effectiveness and efficiency. Learning outcomes are also helpful for keeping the entire teaching process goal-oriented. It can help teachers choose content and materials which are supportive of the goals. With outcomes, teachers can better focus on the teaching process, evaluate teaching effectiveness, and adjust teaching contents and methods based on the obtained feedback. There are a few steps for writing learning outcomes statements.

- Clarify what students should know and what they can do at the end of the course.
- Use measurable and uncovered verbs and avoid covered words such as “know.”
- Try to keep one clear learning outcome per statement.
- The statement should reflect the abilities, skills, attitudes, and values teachers want students to develop.
- Generally, 4-6 outcome statements are enough for one learning unit.

1) Identifying the focused knowledge and cognitive skills in the unit

There are different types of knowledge (Biggs, 1999) that can be the focus of learning outcomes:

- Declarative knowledge: knowing what, or knowing about – the “content” of knowledge
- Procedural knowledge: knowing how to do things
- Conditional knowledge: knowing when to do things
- Functional knowledge: knowing how to employ the first three types of knowledge to solve problems.

In addition to acquiring knowledge, students are also expected to apply what they have learned in authentic situations and solve complex problems. The following figure provides a quick reference to Bloom's Taxonomy (Revised) about the type of outcomes. When students engage in learning, the cognitive, affective, and psychomotor aspects of their learning are usually interwoven with each other.

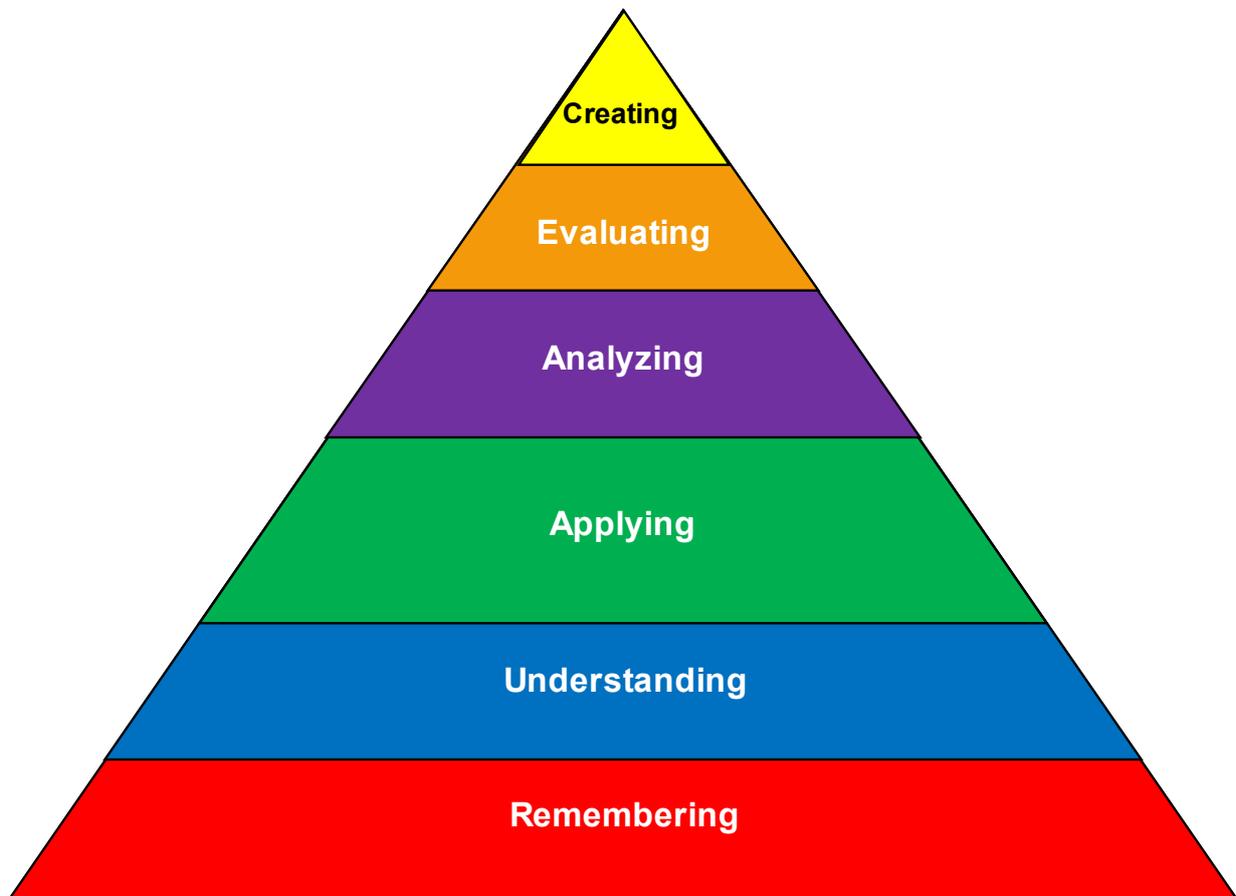


Figure 5.2. Bloom Taxonomy (Revised)

Different types of learning outcomes have different features. For example, some of them may be more conceptual, while some of them are more hands-on. When designing curriculum and instruction in the hybrid mode, we suggest curriculum experts and instructors align the features of learning outcomes with the features of the hybrid learning context (i.e., online or offline portion). The part of in-person sessions of hybrid learning can provide more hands-on experiences and face-to-face interactions⁷. Boyarsky (2020) suggested that specific outcomes can be best served as in-person activities, such as synchronous group brainstorming sessions, communicating class expectations and outlining individual responsibilities, call and response presentations, etc. In contrast, the part of the online session is more flexible, less expensive, and offers more variety. As Boyarsky (2020) suggested, self-paced learning and activity completion, automatic grading programs such as multiple choice of True/False quizzes, asynchronous group discussions, written critical analysis and thoughtful discourse, etc., can be best served in online portion activities.

Following this principle, we can assign the most appropriate outcomes to the online or offline

⁷ <https://projectionsinc.com/abetterleader/in-person-training-vs-online-learning/>

portions of hybrid learning. For example, if the expected outcome is to apply the learned principles from a physical class and make a STEM-related product, hands-on activities can be assigned to the in-person sessions. The outcomes related to the self-study session focusing on conceptual learning can be done flexibly, particularly in the online sessions.

2) Multiple types of tasks reflecting learning outcomes

Learning outcomes can be reflected in learning tasks. There are many types of learning tasks that can be completed either online or offline, such as reading, discussions, case studies, quizzes, report presentations, practice exercises, virtual labs, essays, simulations, roleplay, games, and design projects. Learning tasks should be aligned with learning outcomes. The figure below provides a method to help curriculum designers or instructors identify the missing or underestimated tasks and highlight where they may over-evaluate a learning outcome.

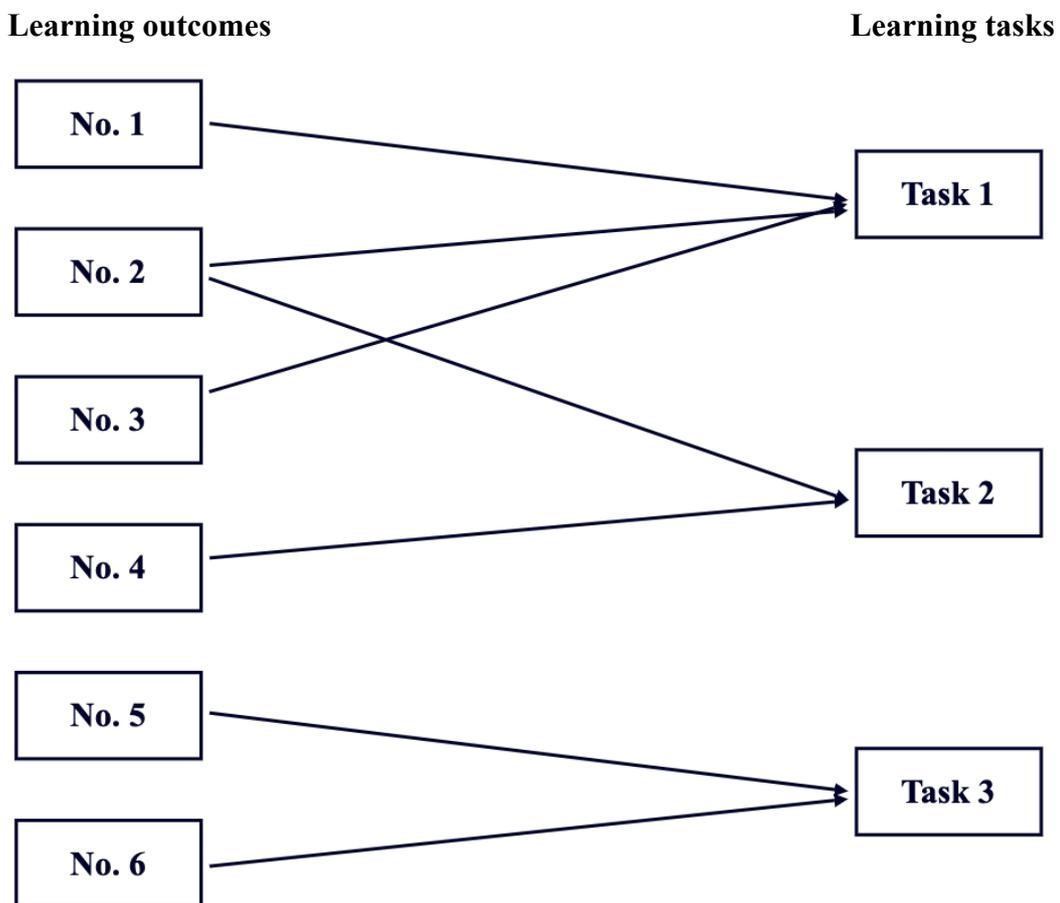


Figure 5.3. The possible relationship between learning outcomes and learning tasks

6. Hybrid Teaching and Learning

6.1. First thing first: understanding learning

To provide effective hybrid teaching, the first step is to understand the nature of learning. From the perspective of constructivism, learning is the process of constructing mental representations of the world by interacting with the environment. It can be further understood in the following ways (Huang et al., 2019).

- Learning should be learner-centered and activity-focused.
- The learning process consists of the re-organization and re-construction of the knowledge they have already acquired and the meaningful construction of new knowledge.
- Learning is a social and language-centered behavior.
- Constructivism emphasizes the contexts of learning and the value of creating meaningful learning contexts.
- Effective learning needs appropriate resources to support meaning construction.

Term 3. Constructivism is a theory in education that recognizes learners construct new understandings and knowledge, integrating with what they already know. This includes knowledge gained prior to entering school.

Source: Nola, R., & Irzik, G. (2005). *Philosophy, Science, Education and Culture*. Springer Science & Business Media.

Once we understand the nature of learning, we can clarify the implications of constructivism toward curriculum and instruction. Here, according to Jonassen (1991), the work of curriculum devolvement mainly includes curriculum analysis, design, and evaluation. The specific implications of constructivism are listed below for curriculum experts and teachers.

- Teachers and curriculum experts can define the major content domain but should not limit curriculum scope with arbitrary boundaries (Seyyedrezaie & Barani, 2017).
- Pay attention to the learning context. Teachers or curriculum developers are suggested to carefully consider the context of learning since both context and content are crucial in a constructivist approach degerming the instructional methods and strategies (Strommen, 1992). From this perspective, curriculum specialists and teachers should design various learning scenarios to support learners in understanding concepts and principles from different perspectives. In this way, students can develop higher-order skills, such as problem-solving, decision-making, and creativity.

Term 4. Learning scenario

A learning scenario is an outline of a learning activity, a postulated sequence of events for learning, or a learning setting for a group of learners working together. See Figure 6.1.



Figure 6.1. The elements of the learning scenario

- The emphasis of curriculum and instruction is not only on the learner’s prior knowledge but also on his/her cognitive processes, self-reflective skills, and the learning process itself. The goal is to cultivate the learners’ thinking and knowledge construction skills (Strommen, 1992).
- Emphasize learners’ active role and the use of active learning methods, which can help students develop self-meaning and self-regulation to maintain a good learning status.
- When misconceptions emerge, teachers can use them as “targets” of corrections to help students understand the content correctly.
- Learners will be one of the evaluators who can realize the meaningful aspects of what they have done through the evaluation process.

Term 5. Emergent Curriculum

An emergent curriculum is a specific type of constructivist curriculum that focuses on the conversation and cooperation based on emergentism. It can represent the basic features of the curriculum development and major direction in the future.

Source: Yu-le, Z. (2004). Some thoughts on emergent curriculum. The Forum for Integrated Education and Educational Reform sponsored by the Council for Global Integrative Education, Santa Cruz, CA. <http://chiron.valdosta.edu/whuitt/CGIE/yule.pdf>.

Seyyedrezaie and Barani (2017) recommended a set of critical tips for implementing an “Emergent curriculum” from a constructivist perspective.

- Based on the features of the specific context and the characteristics of different learners, the

curriculum goal, content, and teaching methods should vary accordingly.

- The role of the teacher is not a passive knowledge transmitter but an active curriculum researcher and creator.
- No longer the passive recipients of knowledge, the role of a student is also the subject, creator, and constructor in the curriculum.
- Teachers should listen attentively. This “Listening” requires the teacher to commit himself to education wholeheartedly and immerses himself in the sea of student soul to fully comprehend its beating and flopping. By listening to each other and communicating at an equal status, the teacher and the student actively think and express themselves freely and finally produce innovative outcomes.

How to teach effectively? Here are some general suggestions for teachers:

- Encourage learners to make contributions and share ideas. Then, use learners’ responses to help achieve the learning goals and let students enhance and extend learning based on their own experiences and knowledge.
- Provide the content structure in advance and cognitive or mental strategies at the beginning of a lesson and offer activity structures.
- Ask content and process-related questions to promote inquiry and problem-solving.
- Guide students to generate solutions, search for information, and make adjustments when needed.
- Exhibit teachers’ energy, passion, and interest using differing tones, gestures, eye contact, etc.
- Develop a harmonious relationship with learners.

One necessary foundation of effective curriculum development and teaching is lesson planning, which describes the instruction for an individual lesson within a course. Each lesson plan should include some or all these elements: (1) learning objectives/outcomes (should be SMART), (2) the content and the structure of each lesson, which should be clear. (3) learning materials, including handouts, textbooks, visual aids, grading rubrics, activity packets, etc. (4) an introduction section, focusing on concepts or skills to be learned. (5) elaborated teaching behaviors and steps. (6) learning activities, allowing learners to practice what they have learned or extend knowledge. (7) a summary for teachers to wrap up the lesson. (8) assessment to measure whether students have learned.

In hybrid learning, students mainly learn in a model combining online and offline contexts. Thus, curriculum developers and teachers must design and implement the lesson plan according to the characteristics of hybrid learning. The following sections will describe the essential parts of

planning hybrid teaching and learning.

Term 5. Online learning

Online learning is defined as learning experiences in synchronous or asynchronous environments using different devices with internet access. Students can be anywhere to learn and interact with instructors and other students (Singh & Thurman, 2019).

6.2 Preparing hybrid learning environments

A hybrid learning environment consists of the physical (offline) and digital (online) setting where learners carry out their work, including all the tools, documents, and other artifacts found in that setting. Besides, it includes the socio-cultural contexts for learning activities (Goodyear, 2001). Van den Akker (1999) distinguished the physical and digital setting from its tools, documents, and artifacts and the socio-cultural background where learners carry out their activities which emerges from this intentionally planned and designed hybrid environment.

There are several ways of engaging learners in a hybrid environment⁸.

- 1) Know the target learners, including their age, degree of experience, how that experience relates to the teaching content, their comfort level, ICT skills, and previous experiences with the technologies used.
- 2) Introduce the daily plan as the lesson begins. Start with a clear visual structure, demonstrate to the target learners what have prepared and let them know what will come next.
- 3) Provide real-world context for the learning content. Clearly outline how learners can apply key concepts and skills they learned to their daily life. Have the plan ready ahead of time for getting back on track if anything goes off track. Be prepared to reel things back in promptly and respect everyone involved.
- 4) Confirming students' success and recognizing their efforts can often motivate students. Provide rewards for learner involvement and participation.
- 5) Exploring information beyond the provided course materials is an excellent way to keep the target learners engaged. It is also good to demonstrate the real-world applications of the course.

⁸ Source: <https://trainingindustry.com/articles/strategy-alignment-and-planning/5-best-practices-for-engaging-learners-in-a-hybrid-environment-spon-allencomm/>

6.3. Leveraging technologies intentionally

1) Planning technology-enhanced lessons

Advanced technologies should be integrated with instructional methods to offer students multiple options for hybrid learning. In selecting technologies and media, curriculum developers and instructors first need to figure out which teaching strategy is best: instructor-centered or student-centered? Then, they should figure out which technology, media, and materials can best support the chosen strategy. Next, it is better to have the teachers try the chosen technology out before the class starts so that they can ensure that the whole lesson will go smoothly.

The following principles could be considered when planning a technology-enhanced lesson (Huang et al., 2020b).

- To choose the learning resources, curriculum developers and instructors may consider the following criteria: (a) the resources can stimulate learners' learning interests; (b) the difficulty level and the scope of the content should be kept at a moderate level; (c) the structure of the contents should be straightforward, which can also help reduce cognitive load; (d) the content is well-designed to mitigate students' perceived fatigue.
- Curriculum developers and instructors can work together to plan and formulate Virtual Learning Communities following these requirements: (a) build a trustworthy environment by providing encouragement so that learners can get a sense of "belonging to the class"; (b) provide timely feedback to learners, so they will know the results and acquire a sense of achievement; and, (c) help learners gain a sense of emotional attachment and reduce the perceived isolation or "competition."
- Encouraging learners to seek help through using the following methods: (a) promote encouragement from the teachers and peers; (b) build a harmonious relationship between teachers and students; and (c) provide timely and effective feedback.

2) Selecting digital tools for supporting hybrid learning

Selecting and using the most appropriate learning tools is beneficial for learners to find and process information, actively develop knowledge, collaborate with peers, express their understandings, and evaluate learning outcomes efficiently. In addition, tools should be convenient to use and quick for setting up in order to (a) help curriculum experts or teachers effectively develop and manage resources, make announcements and manage students; (b) help students acquire resources and participate in activities; (c) help teachers and students interact with each other and, (d) help teachers, parents and schools know students' learning performance and make timely school-parent interaction (Huang et al., 2020b). In the following sections, four

types of popular digital tools are described.

- Live streaming Tools

With live tools, teachers and students in different places can participate in activities simultaneously. The live tools or platforms with full functions for teaching and learning can be divided into two categories: (1) the platforms for large-scale live-streaming classes, suitable for catering to large numbers of students. (2) tools are suitable for small-group live classes. The first type of tool can also support small class discussions, and the second type of tool can broadcast class on a large scale. These tools are also being upgraded and have added new features, such as interactive whiteboards, clickers, and quick-responders. Many tools and platforms are suitable for experiencing online lectures, such as Dacast, IBM Cloud Video, Vimeo, and Panoto.

- Instant messaging and social networking tools

Instant messaging tools can promote communication and collaboration in online environments. Both synchronous and asynchronous communication can help increase students' active participation in hybrid courses. Therefore, it can motivate, engage students, and support teaching and learning in a hybrid mode. Students should be trained to use these technologies to communicate and learn. Educators need to know how to use these communication tools to support hybrid learning. Some popular instant messaging tools include Blackboard Collaborate, Skype, Google Hangout, Today's Meet, Join.Me, WeChat, QQ, and DingTalk. (Communication Technologies: Promoting Active Online Learners, 2020)

Social networking refers to using social media websites and apps to connect and communicate with families, friends, and people with common interests. By developing a curriculum based on social network platforms and delivering teaching through social networks, we can help students not only collaborate with others during learning but also do research by using social networking tools.

- Concept and Mind Mapping tools

Concept-Mapping and Mind-Mapping tools are used to create diagrams demonstrating the relationships between concepts, ideas, or pieces of information. Concept maps are graphical tools for representing and organizing knowledge in a well-structured way (Concept Maps: What the heck is this?, 2020). In a concept map, a concept is usually indicated by a circle or box. The relationship between concepts or the propositions between two concepts can be represented by lines labeled with words. These words are used as labels for the concepts (Concept Maps: What the heck is this?, 2020). There are some popular concept mapping tools: Cmap, Visual Understanding Environment, CompendiumLD and BrainSharper. Figure 6.2 is a concept map, which describes the structure of a concept map.

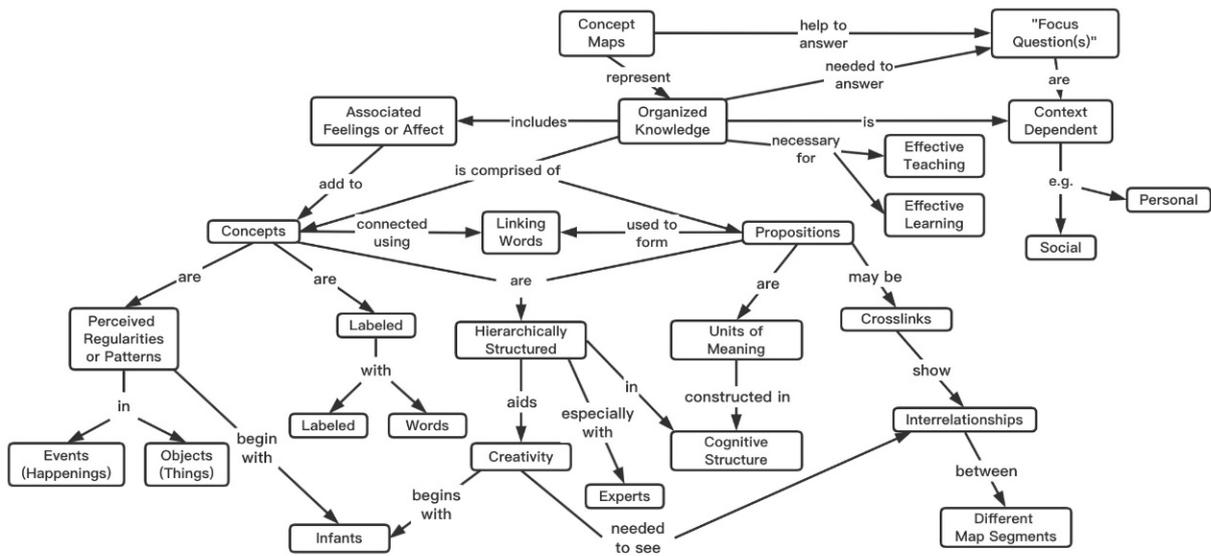


Figure 6.2. A concept map about concept mapping⁹

Mind mapping is an efficient way to organize information and produce visual representations of organized information. Lines, symbols, keywords, colors, and images can be added to mind maps. Mind maps can convert complex information into well-organized charts, which can help students memorize the content. As the figure shown below, the principle for creating a mind map is to keep the content simple and easy for information processing. Therefore, mind mapping can be used for taking notes in a structured way. Here are some popular mind-mapping tools, such as Mindmeister, XMind, Freemind, MindApp, and MindManager. Figure 6.3 shows an example of a mind map, outlining a survey plan about online teaching.

⁹ Source: <http://cmap.ihmc.us/docs/theory-of-concept-maps.php>



Figure 6.3. A mind map which represents a survey of online teaching

- Collaborative Authoring Tools

Collaborative authoring allows users to contribute to the same document synchronously or asynchronously. Tools for collaborative authoring can be used by curriculum developers, instructors, and learners throughout the collaborative writing process. Users can access and track writing progress, communicate with team members, provide feedback, make revisions, and review peers' contributions and progress from the beginning. Team members can work together in a face-to-face way or work remotely (Kaur, 2017). The advantage of this type of tool includes flexibility for meeting the needs. They are primarily cloud-based, convenient for users to access, manage, and cost-effective. Some examples of popular collaborative authoring tools include Office 365, Google Docs, Elucidat, Compositica, EasyGenerator, Gomo Learning, Articulate 360, and Adobe Captivate Draft.

6.4 Designing and delivering activities and resources

In hybrid learning, there can be various forms of learning activities: learners can search for information on the internet and online libraries; practice exercises to establish the connection between the learning contents; with the feedback received, students can know their performance and then adjust their learning methods accordingly.

Hybrid learning activities can have four phases. "Intro" phase: a teacher will clarify learning objectives and teaching plans, explain and facilitate learning activities, present learning materials, engage students in learning tasks, and show them how to interact. Lecturing phase: teachers will teach students the content, initiate and facilitate discussions, compose group reports, or facilitate

other learning activities online or offline. Self-directed learning activity phase: learners will complete the tasks in small groups or as individuals. Evaluation phase: students will present the reports, evaluate learning outcomes, reflect on and share the used learning methods and learning experience, take exams and develop improvement suggestions.

1) Curriculum Resources for Hybrid Teaching and Learning

Digital Learning Resources (DLR) can make curriculum development and instructional design more convenient and efficient and make learning more accessible, engaging, and contextualized. With the integration of ICT in education, DLR includes not only various types of multimedia materials but also well-designed course resources such as Massive Open Online Courses (MOOCs), Small Private Online Courses (SPOCs), or online video micro-courses.

Term 6. Digital Learning Resources

Digital Learning Resources refers to materials included in a course that supports learners in achieving the pre-defined learning goals. These resources consist of graphic images or photos, audio, video, simulations, animations, and prepared or programmed learning modules (Epigeum, 2019).

2) The Availability of Digital Learning Resources

Many digital learning resources have been created, including courses, policies, toolkits, as well as guidelines on hybrid learning. During the campus closures, these resources were used to assist a student in maintaining learning. UNESCO provided a list of Massive Open Online Course (MOOC) Platforms where open digital learning resources were used during the COVID-19 era. See table 6.1.

Table 6.1. Platforms and their resources used during the COVID-19 outbreak

Platform name	Resources
Alison	Online courses from experts, available in English, French, Spanish, Italian, and Portuguese
Canvas Network	Course catalog, accessible for free for teachers to support lifelong learning and professional development

Coursera	Online courses taught by instructors from well-recognized universities and companies
European Schoolnet Academy	Free online professional development courses for teachers in English, French, Italian, and other European languages
EdX	Online courses from leading educational institutions
iCourse	Chinese and English language courses for university students
Future Learn	Online courses to help learners study, build professional skills, and connect with experts
Icourses	Chinese language courses for university students
TED-Ed Earth School	Online lessons about nature, available continuously during a 5-week period between Earth Day (April 22nd) and World Environment Day (June 5th).
Udemy	English, Spanish, and Portuguese language courses on ICT skills and programming.
XuetangX	Online courses provided by a collection of universities on different subjects in Chinese and English.

One current problem with Open Educational Resources (OER) is that there is no complete list of all available OER. To find appropriate OER, curriculum developers or instructors need to adopt several searching strategies. Here are a set of search methods to find appropriate OERs (Huang et al., 2020c).

- Use operators, such as “OER +” and “OER &” to connect two or more terms. For instance: OER + technology.
- Use the minus sign to eliminate results containing specific words, for instance: OER – open data.
- Use an asterisk within quotes to specify unknown or variable words (e.g., “OER is a public resource that *”).

- Use quotes to search for a determined phrase, such as “OER is defined.”

When integrating Digital Learning Resources into curriculum content and teaching activities, curriculum developers and teachers are suggested to select or create a suitable resource for learning from these four aspects:

- To be supportive for achieving learning objectives and contents, as well as or necessary to solve problems for students;
- To be moderate in difficulty and scale so that students will not be cognitive overloaded; the organization of learning contents should be clear to avoid getting students confused;
- The quality from the technical aspect should be acceptable. For example, videos or visuals should be clear and concise.
- Different learning resources can be organized and combined. These resources include but not limited to text, video, animation, and virtual experiments.

Curriculum developers and teachers also need to consider if the target learners have the necessary skills to effectively and actively use the selected digital resources. It is necessary to give learners opportunities to develop a sense of agency in their learning and be trusted that they can manage their learning based on their efforts and abilities.

Term 7. Agency in learning

Learners with an agency can “intentionally make things happen by their actions,” and “agency enables people to play a part in their self-development, adaptation, and self-renewal with changing times” (Bandura, 2001). To develop agency in learning, learners should have the opportunity to make choices about their learning, and need to practice doing so effectively (U.S. Department of Education, 2017).

6.5 Choosing appropriate delivery methods

Hybrid learning has the online part, where teachers and learners are separated. For dealing with such a situation, curriculum developers and instructors can consider and plan the use of suitable telecommunication tools, delivery methods, and instructional strategies to connect students, resources, and teachers and carry out activities.

1) Webcasts in hybrid education

Huang et al. (2020a) defined webcasting as “sending digital information over the internet for reception, viewing and listening by the public, possibly involving some interactions between the sender and recipients” (p. 12). Webcast can distribute information from one person to many other

people using publishing, subscribing, or broadcasting methods (Miles, 1998). Webcasting/video conference platforms have some beneficial functions, allowing teachers and students to do a range of tasks (Rainbow, 2020).

- Talk to each other with webcams and microphones.
- Share (almost) everything that can be shared offline, such as texts, pdf files, video or audio, images, and slides.
- Review the lectures after the live session is finished.
- Post questions or answer questions, or take polls.
- Do group-based learning.

There are three modes of using webcasting technology to deliver lectures, including live streaming/live broadcasting, pre-recorded, and video-on-demand. During the COVID-19 outbreak, webcasts showed their advantages in offering online learning (Strain, 2020): (1) break physical boundaries for increasing access to learning; (2) enhance interactivity; (3) record classes and use them on-demand; (4) involve guest speakers; (5) host online exams; (6) webcast for campus tours. We list some suggestions for using webcasts at three stages.

- Before the live broadcast, curriculum developers and instructors can conduct careful design for curriculum content and instructional design. Specific learning content and methods should be selected which are appropriate for learning in this special context of broadcasting. Before or at the very beginning of the live broadcast, instructors announce related tasks to students through multiple channels, such as posting questionnaires or preview materials in the form of URLs or QR codes. The instructor should collect and analyze the student's feedback before the class;
- During the live broadcast, instructors give lectures in live classrooms, and students listen to lectures online via the internet. Instructors can teach according to the data/feedback collected before the live broadcast. If necessary, teachers can interact with online students through the platform features;
- After the live broadcast, teachers need to post a set of tasks to the students. Students give feedback about their perceptions of the live broadcast classroom so that curriculum developers and instructors can improve curriculum and instructional design and provide differentiated guidance to students (Ni & Ding, 2017).

Using a video conference/webcasting platform need careful preparation¹⁰: testing audio and

¹⁰ Source: <https://www.cambridge.org/elt/blog/2020/03/16/using-video-conference-platform-teaching-online/>

<https://edtechmagazine.com/higher/article/2019/10/how-videoconferencing-platforms-help-connect-campus-communities>

video, conducting quick tests about the activities, making teaching accessible on any device, requiring participants to use their real names, being prepared if something goes wrong unexpectedly, and keeping calm with a gentle smile in case something goes wrong.

2) Learning with MOOCs

Massive Open Online Courses (MOOCs) are usually published in online repositories, which are defined as digital databases containing learning resources (McGreal, 2011). In these repositories, curriculum developers, instructors, and learners can search, view, and download learning materials and get their metadata. MOOCs have several components, e.g., videos, assignments, discussion forums, interactive sessions, and additional resources. In addition, MOOCs have some characteristics: large scale, openness, personalized learning formats for students, and instant record of learning behaviors and processes.

Term 8. MOOC

A MOOC is an online course aimed at unlimited participation and open access via the web (Kaplan & Haenlein, 2016). Many MOOCs provide interactive courses with user forums or social media discussions to support community interactions and immediate feedback on quick quizzes and assignments. MOOCs provide an affordable and flexible way for curriculum developers, instructors, and learners to learn new skills and deliver quality educational experiences at scale.

MOOC is one type of Open Educational Resources (OER). OER is defined by UNESCO as “teaching, learning, and research materials in any medium – digital or otherwise – that reside in the public domain or have been released under an open license that permits no-cost access, use, adaptation, and redistribution by others with no or limited restrictions” (UNESCO, 2019a, para. 1). The OER vision was to provide educational resources that are free and open for everyone. MOOCs can also be used as additional resources for hybrid learning based on learner characteristics, contents, and required learning resources. Curriculum developers and teachers can create a hybrid course that incorporates the MOOCs developed by other authors. Hybrid course developers and teachers can select and adapt online components of the hybrid course from the MOOCs and others and develop in-class content components. This method can simplify hybrid course design (Bruff et al., 2013).

Term 9. Open Educational Resources (OER)

Open Educational Resources (OER) are learning, teaching, and research materials in any format and medium that reside in the public domain or are under the copyright that has been released under an open license that permits no-cost access, re-use, re-purpose, adaptation, and redistribution by others (UNESCO, 2019a).

To effectively integrate high-quality online resources into one's course or teaching activities, curriculum developers or teachers can follow these tips: (1) Think about what content you want to include in your course. (2) Determine the way you like when using the online materials. (3) Search for MOOCs based on the selected topic. (4) Determine the availability of the specific MOOC. (5) Gauge the credibility of the MOOC before deciding to integrate. (6) Ensure the MOOC content is accessible to the target students. (7) Determine if the MOOC is appropriate for the desired teaching modes. (8) Determine the social-epistemological dimensions of the course. (9) Make sure the goals, learning activities, resources, and assessments are well aligned with each other. (10) Instruct students on how to access the MOOC content. (11) Provide clear instructions about how to utilize the MOOC. (12) Determine the success of MOOC integration (De Jong et al., 2019).

3) Flipped instruction with video clips

Flipped instruction is also called flipped learning or flipped classroom. Flipped learning uses lecture videos as homework and class time for more in-depth learning, such as discussions, projects, experiments, and individualized guidance for students. To implement flipped instruction, curriculum developers or instructors should design and develop video/digital media courses in advance so that these course materials can be exposed to students before the class. Besides, students must be requested to complete assignments/quizzes before the class. Finally, teachers must respond to students' questions through class time teaching and allow them to practice and apply what they have learned from materials received before the class (Al-Samarraie et al., 2019). The in-class interaction and discussion can be enabled with some interaction software or webcasts.

There are a variety of benefits associated with flipped instruction: (1) Flipped instruction can engage students in the learning process and elicit excitement and motivation. (2) It can overcome the challenges of the traditional classroom environment by reducing class size and increasing the teacher-student ratio (Berrett, 2012) when there are financial constraints. (3) It can help teachers understand students' learning styles and difficulties better, use class time more effectively and creatively, customize courses and provide personalized guidance and peer collaboration to meet the learning needs of different student groups (Roehl et al., 2013). It has changed the dynamics

in the traditional classroom since students are required to watch instructional videos as homework and use class time to solve problems and have meaningful and specific discussions.

Term 10. Flipped instruction

Flipped instruction is a pedagogical strategy primarily to deliver lectures in pre-recorded video clips before class and spend students' engagement in collaboration and interaction for in-depth learning.

For organizing flipped instruction, there are a lot of things that need preparation in advance. The flipped instruction preparation can be made through the following (Kim et al., 2014):

- Record the lectures and post them online.
- Require students to watch the video lectures in advance and come to class prepared to work on problems.
- In addition to hosting one large lecture section, offer weekly review sections for a small group of students. Students can be broken down into small groups and expected to work together on sample problems.
- The in-class time could be spent on guiding problem-solving.
- Organize weekly quizzes, exams, and a final exam.
- Start Each lesson with a short quiz.
- Assess learning outcomes through group discussions during class time.
- Course sizes can be like that in traditional lectures.
- Evaluate the effectiveness of these methods from the dimensions of attitude, retention, and performance (Kim et al., 2014).

In the flipped classroom, various pedagogical tools and methods have been developed and adopted by curriculum developers or instructors. For instance, interactive software or web-based materials in class, complete online delivery of content, problem-based learning, and social interaction between students and their teachers are critical ingredients to the program's success.

4) Group learning

Group learning is used interchangeably with cooperative learning or group learning (Faculty Innovation Center of The University of Texas at Austin, 2019). It can be used at different levels,

from two students solving a simple problem to a team completing a comprehensive project. Group learning can take the forms of project-based learning, inquiry-based learning, and problem-based learning. To make group learning more effective, students need to practice team-building skills and be responsible for themselves and the group.

- Cooperative learning

Cooperative learning is one form of group learning, which usually has four components: teacher-student interaction, student-student interaction, materials, and specialization in tasks, roles, expectations, and responsibilities. Five essential elements mediate the effectiveness of cooperative learning, including positive interdependence, individual and group accountability, group processing, social skills, and face-to-face promotive interaction (Huang et al., 2020a).

Term 11. Cooperative learning

Cooperative learning is the instructional use of small groups so that students work together to maximize each other's learning effect. In cooperative learning, there is a positive interdependence among students' goal attainments; students perceive that they can reach their learning goals if other students in the group also reach their goals. Cooperative efforts can motivate participants to strive for mutual benefits so that all members will benefit from each other's efforts (Johnson & Johnson, 2017).

To promote learning through peer cooperation and communication, curriculum developers and teachers should make sure the designed content allows students to choose the content and objectives of learning activities while not giving too specific instructions. In addition, teachers need to guide students to participate actively in the process of acquiring and constructing knowledge; Last, students should help each other learn, share ideas and resources, and jointly learn content and methods (Davidson & Major, as cited in Huang et al., 2020a).

Five steps can be taken to establish a task structure for a cooperative learning activity (Borich, 2014): (1) Specify the goal. (2) Structure the task. (3) Instruct and evaluate the process. (4) Monitor group performance. (5) Debrief. Group members could rate each other's performance and get their group averages to know their strengths and shortages. The group development process has five stages shown below (Huang et al., 2019):

- Forming: students come together to formulate a group to achieve the same learning goals.
- Storming: students should be open to others, giving explanations, testing ideas, and so on to generate solutions.
- Norming: clarifying the interaction processes and taking actions to address any emerging

issues. Once students can settle a conflict and achieve harmony, the members will become more positively engaged. They will be more willing to share information, communicate with each other, and solve new problems.

- **Performing:** members are genuinely interdependent. They collaborate smoothly and take their roles according to the actual needs of the groups. The main task at this stage is solving problems in the best way to approach the group's goal.
- **Adjourning:** At last, the group work can be ended when the task is completed or for other reasons. The important thing is to conclude the activity and recognize members' achievements and contributions.

The group process can loop back to the former stage when there are unresolved conflicts, new members join the team, or other difficulties in understanding emerge. Rules of participation established in the early stages will help solve new problems at later stages.

- **Project-based learning**

As a form of group learning, Project-Based Learning (PBL) is a teaching method in which students learn by actively engaging in real-world and personally meaningful projects. Students will design, develop, and construct solutions to a real problem. The focus of PBL is on cultivating students' abilities to develop creative, realistic, tangible solutions to complex problems (Project-Based Learning, 2020). Students solve problems by asking and refining questions, debating for ideas, making predictions, designing plans, conducting experiments, collecting and analyzing data, drawing conclusions, communicating their ideas and discoveries to others, raising new questions, and creating artifacts (Blumenfeld et al., 1991). During this process, teachers should coach the team to keep students on task and ensure they work productively. By making and receiving peer feedback, students can learn more substantive content. The final product is often presented to the whole class, demonstrating their understanding of what they learned (Huang et al., 2019).

Term 12. Project-based Learning (PBL)

PBL takes place in the context of authentic problems, continues over time, and brings in knowledge from many subjects. PBL can help students develop 21st-century skills, including creativity, collaboration, and leadership, and engages them in complex, real-world challenges that help them build a critical thinking competency (U.S. Department of education, 2017).

The implementation of project-based learning involves four key phases: (Project-Based Learning, 2020)

1. Define the problem: Students should understand the problem, define the problem in the given contexts and identify the nature and scope of the problem.
2. Generate ideas: Multiple ideas should be generated through brainstorming. One or more solutions should be proposed at this step.
3. Prototyping solutions: Once potential solutions are formulated, students need to design and prototype solutions with products or services.
4. Testing: When the prototype is completed, the students should present it to the audience to show how well their products or services can work in a “live” or authentic setting. Feedback must be given so that they can use it to improve the product.

5) Co-teaching

In co-teaching, teachers from different schools can collaboratively teach classrooms that include students attending online lectures and local teachers as observers. These co-teachers may have different strengths and limitations in teaching some courses, and the joint online courses could be planned to meet the needs of each school and address this problem. Co-teachers must establish mutual trust, develop channels for communication, work together creatively to overcome the inevitable challenges and problems, anticipate conflicts, and address them professionally. Technology can be utilized to enhance co-teaching, and the joint online course could be implemented by integrating two-way telecommunication tools.

Term 13. Co-teaching

Co-teaching is two or more instructors sharing the responsibility for teaching some or all of the students assigned to a classroom. It involves distributing responsibility among instructors for planning, instruction, and evaluation of a class of students (Villa et al., 2013).

There are a set of strategies to facilitate learning when curriculum experts and teachers open a joint course (Villa et al., 2013)

- Coordinate teachers’ work to fulfill the common, publicly agreed-on goal
- Share a belief system that each team member has the unique and needed expertise.
- Demonstrate parity through playing the dual roles of expert and novice, teacher and learner, giver and recipient of knowledge or skills alternatively.
- Distribute the task and responsibility of one teacher to multiple co-teachers in the joint course.
- Utilize positive interdependence, face-to-face interaction, performance management, monitoring and processing of interpersonal skills, and individual accountability to cooperate.

More specifically, there is essential work needed to be done before, during, and after each lesson in co-teaching. Curriculum developers or co-teachers may need to specify how to divide the work among co-instructors. For example, one teacher gives lectures, and the others facilitate the follow-up activities. In the preparation part, the instructional delivery method must be decided. These methods include live video, learning by MOOCs, and flipped learning. Also, the way of grouping students should be determined. Students from different schools can form new groups according to the principle of homogeneity between groups, heterogeneous in the group, or grouping by their affiliated schools.

6.6 Providing customized learning support and services

The hybrid learning context is complex and can be challenging, and affect learning outcomes. Thus, students should be well supported and provided services in a customized and personalized way. Therefore, it is necessary for curriculum specialists and instructors to know and apply the common methods described in this section to support online interactions, help students to achieve meaningful learning, and motivate students to learn in hybrid contexts.

1) Supporting interaction and communication

Multiple methods could be used to enhance interaction and communication, for example, lecture via webinar, online discussion, project-based learning, online debate, brainstorming, experiential learning, and gamifying learning.

(1) Lecture via webinars

In lectures via webinars, instructors and students are present in classes simultaneously. In this context, instructors can host online lectures teaching the same content they would teach in an offline classroom. To support online lectures, there are several essential things to be done (Sugar et al., 2010).

- Intentionally pause the process every twenty to thirty minutes and arrange some interactive learning tasks to increase students' involvement, such as completing a poll or typing some short answers in the chatbox.
- Check for understanding by asking questions such as "Do you have any questions?" Students can respond by clicking the checkmark or simply putting a smiley face (emoji) in the chatbox.
- Ask students to participate and manage the discussion. For example, instructors can lecture for 15 minutes, then ask the students to have a group discussion in the "breakout room" and then they go back to the main class "zoom room" to share their ideas with all.
- Use interactive platforms, hyper videos, and bullet screens¹¹ to enhance interaction.

¹¹ Bullet screen is a social experience in China and Japan, where audiences watch online videos

- Use annotation tools to take notes of the critical contents on slides, make marks, and circle an area on a graph. This annotation can remind students about what is going on.

(2) Online discussion

(a) Synchronous online discussion

The synchronous discussion provides opportunities for students to ask and answer questions in real-time (Hrastinski, 2008). It can also help e-learners feel like they are participants without being isolated. Two methods can mitigate isolation. First, keeping continuous contact with the class, particularly synchronously. Second, prompting students that they are members of a community rather than being isolated individuals communicating with machines (Haythornthwaite & Kazmer, 2002). In synchronous online discussions, a set of methods can be used by curriculum experts in the design and development stage or instructors in the development and teaching phase to enhance student engagement (Brown et al., 2016).

- Choose a valuable topic.
- Recommend relevant learning materials to students.
- Write comments and questions in a word document in advance. For posting a question or comments, teachers can simply copy and paste the content into the chat room discussion without delay.
- Provide etiquette guidelines and chat rules, including items such as the order of questions, how to address questions or comments, when to raise a hand to ask questions, have private discussions, and make an agenda for the discussion.
- Avoid sarcasm, idioms, slang comments, and jokes.
- Motivate, question, and praise the participants when necessary.
- Respond only to the posts in which teachers are explicitly cued or to those posts where their response will make a contribution.
- Do not try to multi-task since other online technologies can bring distraction.
- Keep a record of what was discussed and decided during the chat, which will be valuable for the later course (Brown et al., 2016).

(b) Asynchronous online discussion

Asynchronous online discussions involve delayed interaction and do not require simultaneous participation. (Brown et al., 2016) It is considered as an extension of instructional practices that promote dialogue, reflection, knowledge construction, and self-assessment (Gerosa et al., 2010).

while reading and sharing comments on the screen.

Asynchronous discussions support more in-depth conversation and more thoughtful learning than face-to-face discussion (Hawkes, 2006). Because the entire discussion is available for reading carefully, providing learners opportunities for identifying, examining, revising, and reflecting upon their ideas (Collison et al., 2000).

To facilitate asynchronous discussions, teachers can follow the methods below.

- Clarify the expectations, such as how often learners should participate in a discussion and how the discussion's participation will be assessed.
- Schedule each discussion activity and indicate when teachers will participate in the conversation.
- Only respond to those discussion posts that attract teachers or to these posts where teachers' response will make a valuable contribution. Balance the quality and quantity of the made contribution.
- Use theme threads to save the time and effort required for reviewing discussion posts.
- Do not read too much into the statements of learners. Miscommunications are common online since many of the nonverbal communication cues are missing.
- Teachers edit and review their responses to the discussion to avoid miscommunications.
- Demonstrate high-quality responses, give examples and explanations, and help learners improve the quality of their responses.
- Teachers archive the postings to a word document which they may use later.

(3) Project-based learning

Group-based projects usually have real-world implications since it allows students to investigate authentic problems, propose hypotheses and explanations, discuss their solutions, challenge others, and test out new ideas via internet forums, web conferencing, and video sharing services (Krajcik & Blumenfeld, 2006).

Capsim (2020) provided six techniques for designing and implementing project-based tasks, which can be used by curriculum developers or instructors.

- Design the project focusing on a challenging problem with a real-world context.
- Encourage students to make inquiries with supportive resources.
- Tell learners about how to get support, then allow students to manage their learning process and make decisions individually or collaboratively.
- Integrate interactive scenarios and simulations that require a broad range of skills. Every choice students make in a simulation leads to unique consequences.

- Encourage students to reflect upon their learning processes.
- Encourage peer feedback via online forums or other tools (Larmer et al., 2015).

(4) Online debate

Debate is a method in which learners argue around specific issues and express their ideas. In a debate, learners are assigned to the “for” side or the “against” side, debating a topic related to the course. Synchronous online debates can be held via video/voice conference, and asynchronous debates can be held on discussion boards.

The procedure below can be followed to organize an online debate (Keller et al., 2001).

Phase 1: Preparation

- Break students into two groups—For and Against the proposition.
- Assign or let students choose roles in the debate
- Explain the types of evidence that students need to use to support their claims

Phase 2: During the debate

- Post the proposition on the discussion board.
- Use a timer and track the process.
- Monitor students’ participation.

Phase 3: After the debate

- Collect comments from all students
- Have students vote to indicate which side presented the most convincing argument

(5) Brainstorming

Brainstorming is a technique by which efforts are made to find a solution for a specific problem by gathering a list of ideas spontaneously contributed by group members. All the ideas should be recorded without criticism. After the brainstorming session, all the generated ideas will be evaluated (Hicks, 2004).

To organize brainstorming, the tips below can be followed.

- Identify the aim of the brainstorming. The aim can be to generate as many ideas as possible within a set time frame or the target number of ideas that should be generated.
- A brainstorming session needs a facilitator, a brainstorming space, and a topic on which to write ideas. The facilitator should guide the session, promote participation, and document generated ideas (Zhan et al., 2012). Team members can contribute their ideas through electronic devices synchronously or asynchronously.
- Create a relaxing environment with adequate workspace and resources and free from

distractions.

- Participants spend 10 to 15 minutes generating ideas. Then, divide them into pairs to compare ideas, and add any more ideas that come to mind. Then bring the pairs into the bigger group to share ideas and add more.
- Ensure that there is no criticism or suppression. If the brainstorming is asynchronous, teachers can encourage students to post using platform features, such as “likes” or comments.
- In the end, students’ feedback about the process and their achievements will be collected through a formal evaluation.

(6) Experiential learning within virtual space

Experiential learning activities are carefully thought-out designs with a definite learning purpose and intended outcome. Everything that participants do should facilitate the accomplishment of the goal. Each learning activity includes complete instructions for the activity and a clear purpose, suggested group size and timing, materials required, an explanation of the process, and alternative options. If there are limitations in operation facilities and environment, virtual reality can be applied to set up a virtual desktop lab (Ferreira et al., 2009). To design virtual labs, there should be careful consideration of the aspects below.

- Tell students the specific requirements, operation tools, operating procedures, and methods of the operation exercises.
- Clarify the purpose of the virtual laboratory and the context where the lab is intended to be used.
- Determine the type of application to use: simulation, laboratory, or demonstration.
- The units of operation should be appropriate in their size. Complex processes should be decomposed into sub-tasks.
- Use the simple design and technology which can still meet the requirements efficiently.
- Adjust the levels of fidelity and accuracy for the intended student group and the intended learning outcome.
- VR can visualize things that are not possible in a physical laboratory. However, it may be necessary to balance this potential against the advantages of having a virtual lab that comprehensively mimics real-life lab exercises by setting an appropriate level of fidelity.
- Regard a virtual laboratory as a playground that can provide explanations and also requires external support. These supports can be guiding, explanatory texts, or teacher debriefing (Wästberg et al., 2019).
- Self-assessment, peer assessment, and teacher’s evaluation can be conducted after the class.
- Guide students to reflect on their operations along the way.

(7) Gamified learning

Educational games are virtual worlds where players can test their ideas and explore the consequences of manipulation. In games, students can enhance their understanding of knowledge and skills development (Squire & Jenkins, 2003). To make learning engaging, here are the suggestions for curriculum developers or instructors to develop and use educational games.

- Stick to the instructional goals and make gamified learning fun and scientific.
- Have an adaptive difficulty level of the designed game so that students can gradually learn the content.
- Player interaction is a crucial aspect, which can be designed based on validated theories about interaction.
- Connect the game and the rest of the course by promoting reflections and discussions (Moreno-Ger et al., 2008)
- Virtual simulation can be applied in games to simulate activities that cannot be done in real-life.
- Data acquisition techniques can be used to obtain learning process data to support learning evaluation and teaching adjustments.

2) Promoting meaningful learning

To promote meaningful learning, a series of strategies in self-directed learning and collaborative learning can be applied under the hybrid mode.

(1) Self-directed Learning

Self-directed learning is a situation where learners take full initiative and ownership of their learning and complete activities with support from teachers. Curriculum developers and teachers need to provide learners with the resources that can help them achieve learning objectives and carry out knowledge building. Self-directed learning takes various forms: students work individually or collaboratively through their course content (Envoplan, 2020).

Term 14. Knowledge building

Knowledge building refers to the process of generating new cognitive outcomes through group discussions and the synthesis of ideas based on shared goals (Bereiter & Scardamalia, 2003).

To promote meaningful self-directed learning, there are several strategies for teachers or curriculum developers.

- Provide guidance for students to regulate their learning and manage distractions.
- Provide navigation tips throughout the learning journey so that Each activity may have explicit explanations about how to complete the tasks.
- Teach students self-learning strategies to enhance their self-learning skills throughout life.
- Set and organize Q & A sessions and collect feedback from students.

(2) Group learning

Curriculum developers and instructors should make it clear and facilitate the process of group learning, provide appropriate resources, and organize learner activities. Representing a subject domain, curriculum developers and instructors need to ensure the subject domain's core concepts, practices, standards, and principles are fully integrated into the learning cycle (Bates, 2015). There are a set of methods for curriculum developers and instructors to develop meaningful group learning.

- Use appropriate technologies (e.g., software that allows for threaded discussions, collaborative editing, and idea visualization).
- Textbooks, readings, and other resources should be chosen to support the discussion, not the opposite.
- Give a clear guideline on students' online behaviors and ensure they are implemented.
- Offer orientation sessions, including technology orientation and explanations of the purpose and the goals of discussion.
- Allow choices of topics that complement and expand the issues in the study materials.
- Set an appropriate "tone" or requirements for discussion (e.g., respectful disagreement, evidence-based arguments).
- Define clearly what are the learners' roles and the expectations of participation.
- Track the participation of learners, respond to them accordingly and provide appropriate scaffolding or support, direct them to study materials, or explain issues when students seem confused.
- Maintain ongoing instructor "presence" by monitoring the discussions and preventing students from getting off-topic, providing encouragement for those making meaningful contributions, tracking those not participating, and guiding them to participate.

3) Motivating learners and scaffolding learning

In hybrid learning, learning tasks can be challenging for students to complete. Curriculum specialists and instructors can embed motivational elements in the designed curriculum and teaching process and encourage students to actively engage in learning and interactions.

(1) Understand the target learners and be a good listener

In online learning, the role of instructor changes from “expert presenter” to designer, organizer, and facilitator of learning. In such a context, curriculum developers and instructors must listen to and understand students’ thoughts, questions, and requirements (Garrison & Arbaugh, 2007).

- Curriculum developers and teachers should investigate and analyze learners’ views, clarify problems, identify what help is needed and help learners.
- Curriculum developers and teachers should understand learners’ ideas and thoughts, identify the level of learners’ cognition and whether they know the methods of applying the knowledge they learned, and improve teaching guidance to help learners.
- Teachers should be non-authoritarian. Instructors become learners’ “quiet learning partners,” encouraging them to communicate with others, share opinions freely, understand learners’ problems, and identify their needs (Berge, 1995).
- Teachers should listen to students to see whether they feel uncomfortable and if they accept support from peers and teachers.

(2) Providing instant feedback

As a facilitator of hybrid learning, teachers need to address learners’ issues or questions and provide timely feedback (O’ Rourke, 2012). There are several methods for teachers to give feedback.

- Synthesize conversations into a summary that may prompt students to investigate the topic further.
- Give timely feedback on assignments. The feedback should confirm learners’ work, comment on problems and deficiencies, suggest an improvement, and guide students about what to do next.
- Reply to learners’ questions rapidly, especially for technical problems. If the instructors cannot solve the problem right away, inform the learner immediately that “I have asked for help from others for you” to indicate that instructors are willing and prepared to provide support (Berge, 1995).
- Inform learners of the learning progress of other learners timely. This method may mitigate

students’ perceived isolation.

- Confirm learners’ ideas and efforts, highlight their excellent work, and help them develop confidence.
- Use friendly language and express emotions appropriately so that learners feel that teachers are easygoing.

(3) Motivating students to learn

One of the facilitator’s jobs in hybrid learning is to use necessary strategies to enhance students’ motivation and involvement in learning (Berge, 1995). Here are a set of methods that can be embedded in the designed curriculum and then used by teachers to increase students’ motivation.

- Encourage participants to introduce themselves by sending welcoming messages, carrying out ice-breaking activities, or building study groups.
- Post praise letters, send reminders, issue task checklists, and conduct peer evaluation to help learners connect learning with the real world.
- Check learning data weekly. The characteristics of learners can be analyzed and identified through the log data generated on the learning platform. Confirm and praise the active participants timely, comfort and encourage the lurking participants, and remind non-participants to get involved in learning promptly (Berge, 1995).

(4) Provide scaffoldings on demand

Appropriate scaffoldings can be included in the designed curriculum and used by instructors to help learners solve complex problems, especially when new concepts and skills are first introduced to students. These supports may include recommended resources, demonstrated examples, templates, and guides for analysis. Several types of scaffolding and their features and the applications of each type of scaffolding are presented in the table below:

Table 6.2. The types of scaffolding

Scaffolding Type	Features	Applications
Example Scaffolding	Goal-oriented	Provide examples, templates, and models for learners to imitate and use them for reference to complete tasks, especially in the case study
Problem Scaffolding	Enlightening; Able to shift learning	Ask questions from easy to difficult to inspire students’ deep thinking. Let

	responsibilities from instructors to learners; Able to conduct continuous diagnosis; Have guiding effects, Easy to operate	students answer independently first, and then give answers.
Suggestion Scaffolding	Temporary; Dynamic; Able to give students feedback in time	Provide learners with suggestions, tips, and methods.
Guide Scaffolding	Cognitive structured	Provide systematic guidance to students according to their cognitive characteristics.
Chart Scaffolding	Structured; Visualized; Systematic	Make it easier for students to learn through intuitive visualization
Tool Scaffolding	Diverse, Easy to operate; Characterized by situation	Provide students with tools to solve problems.

(Source: Huang et al., 2020a)

To construct learning scaffolds, there are four main principles to follow.

- Scaffolding should be temporary. As students master the assigned tasks, the support should gradually be removed.
- Scaffolding should be adaptive. The scaffolding should be adjusted accordingly to the dynamic zone of proximal development.
- Scaffolding should be tailored according to task features. The more the cognitive requirements are, the more scaffolding is demanded.
- Scaffolding can be provided by teachers, learning partners, and even learners themselves (Sawyer, 2005).

7. Constraints Analysis

Constraints Analysis refers to analyzing factors that can affect the achievement of instructional goals in the context of hybrid learning. The targets for analysis include social constraints and technical constraints. Social constraints focus on the constraint factors that affect social interactions or collaborations during learning. Technical factors focus on those factors, which be a lack of necessary technical support system, tools, or skills (Huang et al., 2009).

7.1 Reasons for conducting constraints analysis

Hybrid teaching and learning have unique features that significantly affect learning effectiveness (Huang et al., 2009). These features include but are not limited to (1) dynamic learning environment and process; (2) uncertain instructional environment and condition; (3) multi-dimensional diversity among learners' traits. Therefore, all these features must be considered and constantly analyzed for adjusting instruction. Each of these features is described below.

- Hybrid environments, conditions, and learning processes are dynamic. Learning itself is a dynamic process of changes in behaviors, knowledge, and skills. Across the different developmental stages throughout the process, students can demonstrate different behaviors and master differing knowledge and skills. Teachers need to constantly check, analyze, and evaluate students' learning status to provide the most appropriate teaching methods. Moreover, this dynamic situation can be further enhanced under the hybrid modes since, during the instructional process, different situations may take place as time passes by. For example, students go to the physical classroom when the COVID-19 is over, but they have to go back to online mode when severe COVID-19 cases appear (Mount Holyoke College, n.d.). Thus, the learning and teaching modes will be dynamic according to each situation.
- The hybrid environment and conditions are uncertain. It is uncertain when instructional disruption will occur due to the outbreak of unexpected issues, such as COVID-19 (Fullan & Quinn, 2020). Additionally, hybrid learning involves the online part using technologies integrated into the educational environment, which are unreliable (SRM, 2016). Technical issues, including but not limited to internet disconnection, and online servers going down, can bring uncertainty to the hybrid teaching and learning process. It is difficult to predict when issues will occur, and it is necessary to periodically conduct constraint analysis to check the multiple dimensions (including but not limited to technology and resources) in hybrid teaching systems.
- Learners in hybrid learning are pedagogically and culturally diverse. Pedagogical diversity is based on developmental aspects, such as differing cognitive, metacognitive, emotional, attitudinal, and social-cultural aspects. From a broader perspective, cultural diversity can also

promote students’ growth and reflection. From the cultural diversity perspective, the possible effects of students’ race, ethnicity, gender, sexual orientation, nationality, religious tradition, socioeconomic class, and age should be carefully considered and addressed (Hollister, 2020). Hybrid learning can provide a broader scope of diversity inclusion since it offers an online platform for students to complete their learning activities. In this self-regulated learning, students can develop their learning paths at their own pace, place, and time (Teachonline.ca, n.d.), which invites more diverse students and calls for specific instructional treatment for personalized learning.

7.2. The purpose of a constraints analysis

Because of the diversity among learners, dynamic processes and conditions, and uncertainty of the learning environment, there can be various challenges in hybrid learning, particularly in its online aspect. Haron et al. (2021) have summarized these challenges, including network, interaction, subject-related learning, and mental issues (see Figure 7.1). These challenges may influence how to adjust instructional environments using specific features and tools to accommodate students. Constraints analysis must be conducted periodically (Huang et al., 2009) once the hybrid teaching and learning process starts. The purpose is to ensure that the most current set of environments and tools are appropriate and that students with diverse backgrounds and learning processes can be best supported in a personalized way.

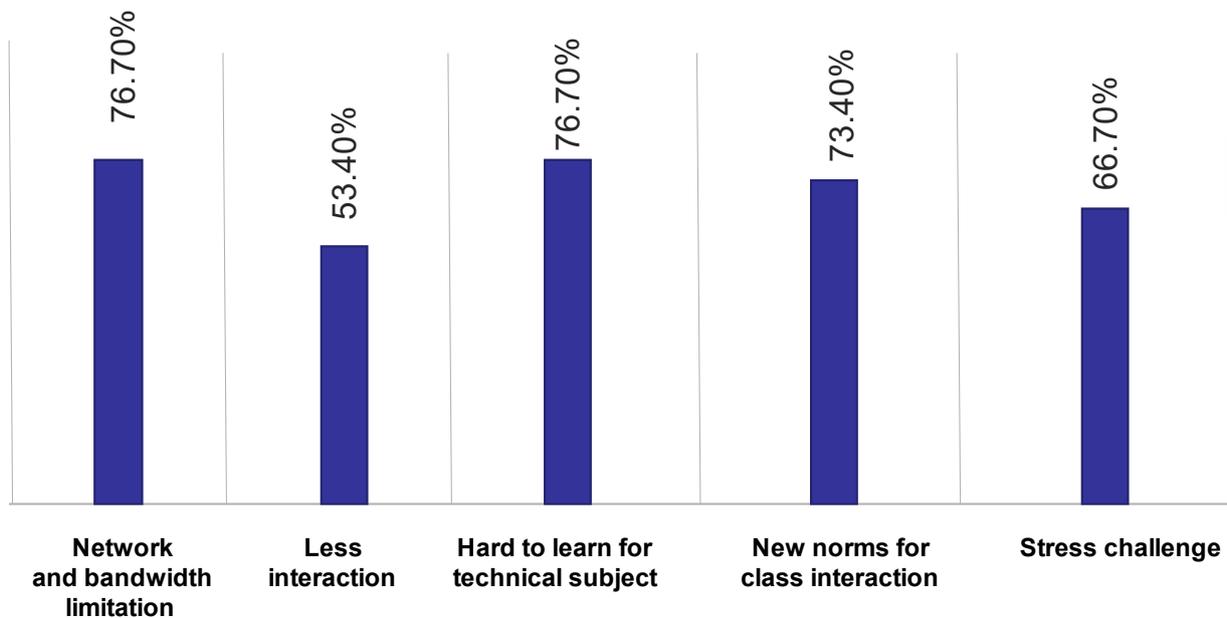


Figure 7.1. Perceived issues and challenges in online learning

(Source: Haron et al., 2021)

7.3. The major tasks in constraints analysis

In constraints analysis, the constraints related to learning environments, tools, and social factors should be analyzed because they can influence interactions in the teaching and learning process (Huang et al., 2009).

1) Checking constraints associated with hybrid environments and tools

Constraints related to a hybrid environment can be limited access to systems and tools of support, such as limited access to essential educational technology, hardware, Wi-Fi, camera, LMS, or computers. It could also be poor reliability or quality of the used technologies and students' limited technical skills (e.g., slow typing, digital reading, lack of confidence in tech use). Haron et al. (2021) provided real-world examples of this type of constraint and the associated problems (see Table 7.1).

Table 7.1 Possible constraints related to learning environments and tools in hybrid modes

Types of constraints	Problems
Network and Bandwidth Limitation	Network and Internet problem
	Interruption during real-time communication/interaction
	Data bandwidth limitation
	Required more data for software installation
Hard to Learn for Technical Subject	Data bandwidth limitation which it hard for learning technical subject which requires hands-on

(Source: Haron et al., 2021).

2) Checking social constraints affecting learning interaction

In the hybrid mode, some constraints can cause students to miss the social aspects of learning, which are referred to as social constraints here. These constraints may include but are not limited to (1) limited engagement of the participants from the physical and online side of the hybrid class; (2) students' poor mental status, such as perceived isolation (particularly these students from the online side); (3) student's poor motivation for participation in hybrid classes; (4) factors causing timing issues for synchronous communication, such as time zone where participants are located. Haron et al. (2021) provided real-world examples of this type of

constraint and the associated problems (see Table 7.2).

Table 7.2. Possible constraints that affect the social aspects of hybrid learning

Type of constraints	Problems
Less interactions and communication	Limited teacher-student and student-student interactions
	Only rely on the digital platform for teaching and explanation
	Challenging group work without face-to-face interaction
Unfit conventional style of learning via digital platform	Lagging and noise during conventional interaction of Question-and-Answer sessions
	Less quality of learning
	Needs to re-skills for self-learning
Stress	Personal home responsibilities at the same time and place
	Exhausted from a long class
Hard to learn the technical subject	Requires hands-on

(Source: Haron et al., 2021)

8. Learning Assessment

Learning assessment examines the extent to which students have achieved the intended learning outcomes. Assessment should be aligned with learning objectives and performance criteria and the specific learning environment. When curriculum developers or instructors design assessments, they can use learning outcomes as the basis of what is assessed and how it is assessed. In the hybrid model, there are different types of assessment methods that can be used. Each one of them is described in the following subsequent sections.

8.1. Online examination

The online exam is a fundamental way to assess what students have learned. It includes the following types: essay and objective questions. An essay is usually used to measure reasoning, interpretation, and criticism, as it requires students to state their arguments in essay form.

Objective questions can be answered by typing in one or two words or numerals, filling in the blanks, choosing one from multiple responses given, etc. In objective-type tests, knowledge retention can be assessed. Due to the straightforward and clear scoring criteria it follows, the objective-type test can be a reliable, valid, and highly efficient tool to support hybrid learning assessment (Union University, 2020).

8.2. Assessment via projects and rubrics

Rubric refers to a scoring guide used to evaluate the quality of students' responses. A rubric can be used in an individual assessment within a course, project or capstone project, which usually evaluates higher-level or complicated learning skills (Becker, 2011). To design an effective rubric, the following elements can be considered:

- The purpose: Task-specific rubrics are created to help teachers assess individual assignments, whereas generic rubrics are to help teachers assess multiple assignments (Teachingcommons.stanford.edu, 2020)
- A list of the critical qualities to be demonstrated by students in the assignment: It may be helpful to review several high-quality assignments before developing a rubric and think about the elements they all have in common, such as the features of the argument, the use, and presentation of content, including visuals and formatting guidelines.
- A consideration of how the criteria will be weighted in grading (White, 1985).

8.3. Checklist for self-evaluation

The self-checklist is a tool that states specific criteria and guides students to gather information and identify the presence or absence of conceptual knowledge, skills, or behaviors. Instances of a checklist include document analysis, such as students' written work, and off-class reflections (Irish Department of Education and Skills, 2020). Well-designed checklists can assist students in evaluating their learning performance and identifying the steps that they should take to complete complex tasks. This scaffolds students' metacognitive development and fosters the development of confidence and independence (Rowlands, 2007). The following elements can be considered by curriculum experts and instructors when designing and using a checklist.

- Depending on the learning content, curriculum designers or teachers can choose the form of a self-checklist, such as rating scales and tables.
- The design of a self-checklist should be aligned with the learning objectives and processes. For example, in a self-checklist, clear descriptions of how to present the homework should be provided.

- Allow students to provide their response to the checklist items in a simple way, such as “Yes” or “No,” or by using descriptors indicating the quality or frequency (e.g., always, usually, sometimes, and never).
- Provide working sheets with the suggested format that show the required sub-sections ordered coherently.
- Provide space for students where they can easily take notes.
- Encourage students to join in developing the criteria section of the assessment (British Columbia Institute of Technology, 2020).
- Guide students carefully to use a self-checklist for learning evaluation, self-supervision, and reflection.

8.4 Learning contract

The learning contract (LC) is an agreement negotiated between a learner and a supervisor to ensure that certain activities will be undertaken to achieve a given learning goal (Ibrahim & Eldemerdash, 2018). The process with LC will generate evidence, which can be collected to demonstrate that the goal has been accomplished. When a student is one party of a learning contract, he/she becomes more engaged in learning, and the learning process becomes more self-directed. The responsibility granted to the students increases their intrinsic motivation. In addition, the learning contract gives students an overview of the expectations other than just working for scores; it is helpful for the student to perceive satisfaction from meeting their goals.

Curriculum experts and instructors can follow the steps below to create and use a learning contract.

- Analyze students’ skill levels and identify the learning gap.
- Set a series of negotiated objectives, also include supportive strategies and resources, the evidence to show the achievement, and the assessment method (Ucdoer, 2020).
- Make checklists and anecdotal records, monitor and discuss students’ progress or problems, check students’ work jointly, and share evaluation results.
- Revise the learning contract with the students when necessary.
- When the learning goals cannot be reached, take additional measures to maximize learning assessment.
- Students should submit the evidence of accomplishment to the instructor at the end of the learning contract, and the teacher should give grades and feedback.

8.5 E-Portfolios

The e-Portfolio is an intentional collection of students' sample work that can showcase students' learning progress, achievement, and evidence of what they can do. The collection can include essays and papers, blogs, multimedia recordings of demonstrations, interviews, and/or presentations. A good e-Portfolio is both a product and a process of reflecting on those artifacts and what they represent (Teaching. berkeley.edu, 2020).

To assist students in developing an e-portfolio, curriculum experts and instructors can follow the guidelines below.

- Explain the benefits of e-Portfolios to students since such explanations may help promote deep learning, advance skills attainment, and help learners be aware of how they can learn (Paulson & Paulson, 1991).
- Provide clear criteria for selecting artifacts. These criteria can be the type of e-portfolios and the standards for collection and inclusion of materials. (Basken, 2008). Clear criteria can help students know how well they should perform and make their learning more goal-oriented and motivated.
- Teachers can create sample e-Portfolio for themselves and demonstrate them to their students. This work helps teachers understand the challenges and benefits of maintaining an e-Portfolio. Furthermore, it will also persuade students that it is a valuable endeavor (Bass & Eynon, 2009).
- Guide students to develop their portfolios and provide scaffolds to help them overcome the challenges in learning. Have students make self-evaluations and reflections based on their portfolios since these evaluations provide valuable feedback to students about themselves and assist in their development (Taylor, 2014).
- Collect materials for evaluation since these materials can reflect and indicate every change in students' learning process and efforts.
- Tie e-Portfolios to assessment because if an e-Portfolio is just an optional assignment but not required for assessment, most students will not do it (Kuh et al., 2005).
- Integrate peer-reviewing on students' e-Portfolios as part of the assessment. For example, you could create a discussion forum where students make helpful and encouraging comments on their peers' e-Portfolios (Entwistle & Karagiannopoulou, 2014). The use of peer review provides opportunities for students to interact with peers and learn from them.

9. AI-supported Hybrid Learning and Assessment

9.1 The potentials of Artificial Intelligence in HELA

The term Artificial Intelligence (AI) was proposed at a workshop held in 1956 at Dartmouth College, a US Ivy League university, to describe the “science and engineering of making intelligent machines, especially intelligent computer programs” (McCarthy et al., 2006, p. 2). Nowadays, AI involves using machines to imitate and perform certain intelligent functions of the human brain and develop related theories and technologies (Gao & Guo, 2019). UNESCO’s World Commission on the Ethics of Scientific Knowledge and Technology (COMEST, 2019) described AI as involving machines being capable of imitating certain functionalities of human intelligence, such as perception, learning, reasoning, problem-solving, language interaction, and even producing creative work (COMEST, 2019). For this publication, AI might be defined as computer systems that have been designed to interact with the world through capabilities that we usually think of as humans (Luckin et al., 2016).

Term 15. Artificial Intelligence

AI might be defined as computer systems that have been designed to interact with the world through capabilities that we usually think of as humans (Luckin et al., 2016).

The application of Artificial Intelligence in Education (AIED) has been the subject of academic research for more than 30 years. AIED can be applied to achieve two goals; the first goal aims to promote the development of adaptive learning environments and other AIED tools that are flexible, inclusive, personalized, engaging, and effective (Luckin et al., 2016). The second goal aims to use accurate calculation and clear form to express ambiguous knowledge in education, psychology, and sociology (Self, 1999). In this way, AI can be an essential tool for understanding the occurrence of learning and the learning process.

As to HELA, the application of AIED can support personalized learning, provide appropriate services in the teaching, and improve the accuracy of learning assessment.

- Support personalized learning

Artificial intelligence can effectively support independent inquiry and collaborative learning so that the learning mode transfers from unified collective learning to personalized learning. An intelligent assistance system or an educational robot will make this learning mode transformation possible. First, acquire learning behavior data, and provide appropriate learning resources and paths for learners with the help of big data and learning analytics technology. Second, learners can participate in learning activities anytime and anywhere when provided with an immersive

virtual learning environment. Third, promote the transformation of learners' cognitive levels and emotional states, and make them learn with positive attitudes. For example, the intelligent teaching system matches learning activities with cognitive needs and emotional states by imitating learners' cognitive and emotional states to ensure students' deep involvement in the learning process.

- Provide appropriate teaching services.

In a distance education environment, teachers and students are separated in time and space, which may lead them not to understand each other well. To ensure learning efficiency and quality, an appropriate learning support service system must be provided to enhance teacher-student communication and interaction. AI can be used to analyze data from computers, wearable equipment, and cameras. With this data analysis, artificial intelligence technology can be used to track learners' and teachers' behaviors, obtain specific needs for specific objects, and then recommend appropriate learning content, teaching experts, and learning resources to users.

- Improve the accuracy of learning assessment

Learning analysis technology provides a new solution for collecting learners' data produced in the learning process from elementary school to university. Additionally, learning analysis technology can use multiple analysis methods and data models to explain and predict learners' learning performance (Lee et al., 2016), hence achieving the teaching objectives accurately, adjusting teaching strategies, and optimizing the teaching process. Furthermore, academic evaluation based on learning analysis can also capture students' emotional state and physiological behavior data.

According to our instructional model of hybrid learning and assessment, AI can provide three ways to improve the teaching effect (see Figure 9.1).

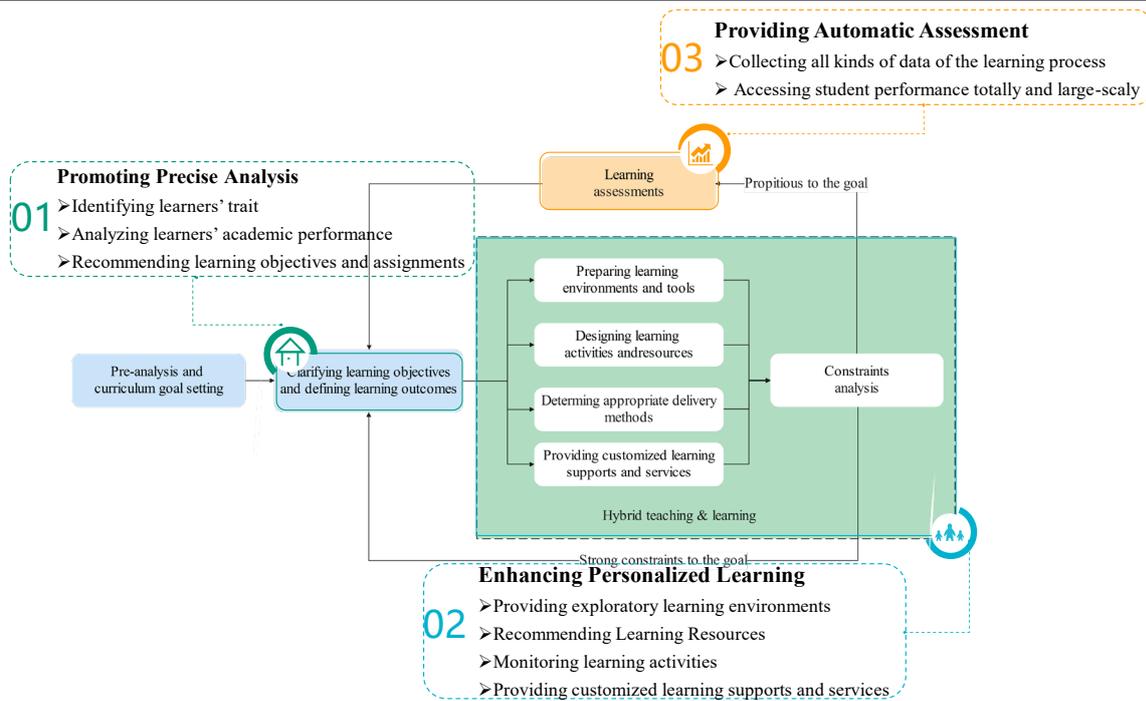


Figure 9.1. AI supports Hybrid Learning and Assessment

9.2 Promoting precise analysis

Analyzing the learner is always the first step of teaching. Understanding the learners’ prior knowledge, age, and other individual characteristics provides a basis for organizing the teaching process and improving learners’ learning engagement. Using technical means to analyze the large-scale data generated during learners’ learning process helps comprehensively understand learners’ learning characteristics. These characteristics then can be used to evaluate learners’ academic process, predict future performance, and discover potential problems (Wang et al., 2018).

The differences in learners’ information technology ability and existing knowledge level may affect the teaching process of HELA. Therefore, before carrying out teaching activities and formulating teaching goals, it is crucial to analyze learners’ characteristics, existing academic performance, and learning content. Technologies such as learning analytics, educational data mining, and machine learning can support learner analysis and teaching goals recommendations.

In learner characteristic analysis, learners can be analyzed by collecting their characteristics-related data and adopting learner modeling technology. Such characteristic-related data includes online learning behavior data, existing learning performance, learning preference, and personality. Regarding learning content analysis, domain knowledge modeling technology can automatically identify the relevant content according to the knowledge map of certain course domains. It can then analyze and provide learning content based on the learner’s prior knowledge to help

formulate appropriate teaching objectives.

Term 16. Learning Analytics

Sometimes a data-mining approach known as learning analytics is used to analyze the big data generated in learning management systems to provide information for teachers and administrators and sometimes guidance for students. For example, some learning analytics predict which students are at risk of failure. Outputs often take the form of visual “dashboards” (Verbert et al., 2013) and are used to inform data-driven decision-making.

For example, Cope and Kalantzis (2016) indicated that through analyzing the track data, such as clicks, time of log files, keystrokes, and editing history during the learning process, we could understand how students solve problems, make mistakes, make modifications, and react to slow learning progress and misunderstand concepts.

9.3 Enhancing personalized learning

With the help of big data mining and multi-modal learning analytics, learners’ cognitive process (learning performance, testing, tests), emotional process (NLP, sentiment analysis), and behavioral process (click streaming data) can be understood. This kind of instant learning analysis feedback is beneficial for personalized learning in any learning environment, especially in Massive Open Online Courses or other massive online learning environments where thousands of learners work together on one course.

For HELA, the online and offline hybrid model increases the difficulty of teaching design. In teaching design and implementation, in addition to the differences among learners, the learning resources and tools that learners need in different learning environments should be considered, as well as the learning activities that learners can participate in and the learning support services that they need. Targeting this problem, big data, learning analysis, Virtual Reality (VR)/Augmented Reality (AR), and adaptive technologies can be used by 1) providing exploratory learning environments, 2) recommending learning resources suitable for learners, 3) monitoring the process of learning activities, and 4) providing personalized learning services.

● Providing Exploratory Learning Environments

Exploratory learning environments (ELEs) encourage learners to actively construct their knowledge by exploring the learning environment and making connections with their existing knowledge schema. To provide an immersive experience, Virtual Reality (VR)/Augmented Reality (AR) is usually utilized. VR makes users feel that they have been transported into a range

of real-world or virtual environments, such as the surface of Mars. AR can overlay computer-generated images on the user's view of the real world (much like a fighter pilot's heads-up display). The role of AI in ELEs is to minimize the cognitive overload which is often associated with exploratory learning by providing automated guidance and feedback based on knowledge tracing and machine learning. This feedback addresses misconceptions and proposes alternative approaches to support students when students are learning (Miao et al., 2021).

- **Recommending Learning Resources**

Learning Resources Recommendation is not to predict or cater to learners' potential behaviors but to assist learners in finding learning resources that match their personalized demands reasonably during an appropriate learning process to maintain learners' enthusiasm and support them to effectively complete learning activities. Wu et al. (2021) recommended appropriate exercises for learners based on their characteristics, such as question type, difficulty level, and content covered, to stimulate learners' interest in learning. Nowadays, many learning systems also involve functions of recommending resources, such as Khan Academy, EDX, Songshu AI, and other course websites or intelligent tutor systems.

- **Monitoring Learning Activities**

Learning analytical technology makes the previously completely opaque autonomous learning process visible by tracking students' emotions, social interaction, and cognition (Järvelä et al., 2020), which realizes learning activity monitoring. For instance, SmartSparrow System allows teachers to create content according to their own rules and procedures. Later, combined with data analysis, SmartSparrow analyzes students' real-time information and allows teachers to see their students' performance. It can analyze the knowledge that learners have not mastered according to the wrong questions and give teachers feedback. The teacher can then provide the needed support accordingly. SmartSparrow also provides teachers with real-time analysis of the learner's knowledge level.

The ACT Test Research Group adopted the mobile application Companion for real-time testing, providing timely analysis and feedback on student progress and outcomes (ACTNext, 2020). The system uses "dynamic cognitive diagnostic models and machine learning algorithms" to analyze test results and the use of learning resources. It promises to support students' daily lives with tools such as Amazon's Alexa and Apple's Siri.

- **Providing Customized Learning Supports and Services**

In the hybrid learning process, the implementation of every teaching activity can form processes and evaluation data to help improve the effectiveness of the next step of teaching. With this data, the implementation of the dynamic adaptive learning process can be supported by applying

artificial intelligence tools. Since new assessment tests and scales continue to develop, large-scale data can be analyzed to build general learning “trajectory” modeling (expert systems). These expert systems can compare individual students’ performance with typical performance models based on the majority of the student population, in the form of scaffolding teaching or formative assessment intervention, and real-time feedback can be appropriately given to students in the problem-solving process. For example, Intelligent Tutoring Systems (ITS) can determine an optimal pathway through the learning materials and activities and identify the reasons for individual students’ faults and successes by drawing on expert knowledge about relevant subjects and cognitive sciences. The intelligent personal assistant would provide continuous support, building on the individual student’s interests and goals, to help them decide what to learn and where and how. It could also guide the student in individualized learning pathways to help them address their emerging goals, connect their learning interests and achievements, and encourage them to reflect on and revise their long-term learning goals.

9.4 Providing automatic assessment

AI is also expected to foster new measurement methods, such as adaptive and continuous measurement (Luckin, 2016). At present, intelligent assessment has made progress in the student ability and knowledge level assessment, personality and mental health assessment, and teaching process assessment (Luo et al., 2021).

In HELA, the evaluation of students’ academic performance mainly involves 1) collecting relevant evidence according to learning objectives, 2) analyzing and explaining the evidence, and 3) feeding back the results to students so that they can fully understand their academic performance.

Artificial intelligence can play a major role in this process by using data mining techniques to collect all kinds of data involved in the learning process. These data include structured data (i.e., forecast and capture the data by computer) and unstructured data (i.e., data exhaust). By analyzing these data, students’ performance can be comprehensively and large-scaly accessed. For example, the data of students’ eye movements, facial expressions, body postures, gestures, and classroom speeches can be collected via video cameras, tape recorders, smartwatches, and wristbands. These data can then be used as evaluation parameters in the teaching activities process. By analyzing the data, peers’ interactions and even emotional states can be evaluated and shown to students (Yuan et al., 2021).

For example, the Embrace system used dynamic tracking data to provide students with immediate formative feedback on their performance on a visualized online reading comprehension task (Walker et al., 2017). Aljohani and Davis (2013) used mobile phone digital dashboards to give

students access to test results, provided immediate feedback on students' overall academic performance, and assessed their cognitive performance according to Bloom's taxonomy.

Many teaching-oriented AI technologies focus on reducing the burden on teachers, such as automating homework marking, unit testing, and exam evaluation. However, little evidence shows learning analysis based on AI, and big data can significantly improve learning outcomes. Therefore, the use of artificial intelligence to evaluate and assess students should be highly cautious. Otherwise, it will not promote students' learning but will bring many adverse effects.

10. Cases of Implementing Hybrid learning

Case 1. “Flipped classroom” meeting online teaching in Shanghai, China

Confronted with the COVID-19 outbreak, “Flipped classroom” meeting online teaching is the way out for teachers and students in Shanghai. On March 2, 2020, the School of Information Science and Technology, ShanghaiTech University, opened 25 undergraduate courses and 20 graduate courses through the modern teaching method——Flipped Classroom, a combination of offline course recording and real-time online interaction. The courses adopt several teaching methods, including self-study before classes, questions and answers during classes, and simulation training after classes. Through this novel teaching mode, students are stimulated to learn independently and think deeply. In addition, this mode further cultivates innovative and diversified ways of thinking and learning habits to achieve a more in-depth and better learning effect.

“Flipped Classroom” is an education model that many universities are practicing. Students watch teaching videos and read materials before class to complete the “large size class” about theoretical knowledge learning. In the “small-size class,” teachers help students to digest and understand the theoretical knowledge by organizing many classroom activities, achieving the goal of guiding practice by theory. Therefore, this is a student-led classroom class, and the class is full of teacher-student interaction.

The course “Instant Location and Map Construction” introduces the technologies and algorithms required to enable smart mobile devices to track their location in a given environment. Professor Laurent Knip said that “this sudden change in online teaching generated new challenges and pressures for both teachers and students, but we must also see the advantages of online instruction.” Laurent Knip believes that “students can adjust the learning pace by replaying and

pausing. And I also have the opportunity to stop listening to the video I recorded, make further adjustments according to the video effect, and work hard to make students have a better listening experience.”

2017 graduate student Huang Shuai learned the content of the course in advance through the video recorded by the teacher; in the online course, he followed the professor to solve the key and complex parts. “When Professor Laurent draws on a shared screen, I feel like sitting in front of a blackboard. The recorded videos, online courses, and notes greatly facilitate our review process after class.” Huang Shuai said, “Learning in the classroom is difficult for shy students to ask questions, especially when sitting at the corner of the classroom. Now, we can easily communicate online. It feels like having a private tutor.”

During the COVID-19 pandemic, the School of Information Science and Technology also added teaching counselors to better assist and cooperate with teachers to carry out teaching activities. The teaching counselor will help the professors record the course in advance, and record the students’ attendance rate, and interaction with the class. After the class, the teaching counselor and the instructor hold a meeting to discuss the development and recording of the follow-up courses. The recorded online explanations and Q&A were also shared with the students to watch repeatedly.

The School of Information Science and Technology, ShanghaiTech University, has carried out “Flipped Classroom” for more than a month. Teachers polish the course before the class to find problems early and then improve and ensure that the formal online teaching goes smoothly. Students gradually adapted to the new teaching model through continuous communication and adjustment in the early stage, which is “self-study—reflection—interaction—feedback.”

(Source: <https://baijiahao.baidu.com/s?id=1663094982017853063&wfr=spider&for=pc>)

Case 2. Squirrel Ai Intelligent Teaching Platform empowers education in public schools

- The case and its problems

Cuiyun Public Hope School, located in Hongtuya Town, Baishan City, Jilin Province, is a nine-year public school. There are 27 junior middle school students in this school, eight of whom are in Grade 9. The results of the ninth-grade students in the first mock exam were far from satisfactory. With such performance, they would be unable to enter senior high schools for further study.

Due to the lack of educational resources and the students' poor basic knowledge, it is hard for the students to learn synchronous courses. The weak area of each student is different. What is even worse is that their teachers do not have enough time or energy for personalized counseling.

- Squirrel AI solutions

Squirrel AI is the first educational AI company in China that provides artificial intelligence adaptive learning systems for primary and secondary schools. Squirrel AI can provide customized learning solutions according to the situation and features of students, which can be integrated into hybrid education to better support students based on their learning status.

Squirrel AI's intelligent adaptive teaching platform is based on technical and theoretical support such as big data, AI algorithms, and an intelligent adaptive learning engine. Based on the notion of "teaching students according to their traits," its solutions cover three teaching scenes before, during, and after class, and serve five stakeholders (i.e., teachers, students, parents, school managers, and regional managers). "Teaching," "Learning," "Testing," "Evaluation," "Research," and "Management" can be supported by multidimensional and comprehensive intelligent education solutions.

Squirrel AI provides two lines of service/product: closing loopholes of knowledge points in previous grades and the synchronous test, evaluation, and practice of courses. The first product, closing the loopholes of knowledge points in previous grades, begins with personalized traces based on the knowledge graph. It enables students to identify their weak areas of knowledge from the very beginning. This product is applicable to all kinds of teaching. In class, it can assist teachers in teaching, monitor students' learning, and provide statistical analysis of students' knowledge mastery. When class ends, students can review content on the platform independently. The second product, The Synchronous Test, Evaluation and Practice of Courses, is the only marketed intelligent adaptive teaching auxiliary product based on the K12 synchronous course for knowledge point vulnerability detection, hierarchical evaluation, and precision teaching. One advantage of this product lies in its detailed split of knowledge points, and based on the knowledge graph with the knowledge mastery of different students, accurate one-on-one tutoring can be achieved without immersion in test questions, and the stratified teaching can be truly realized.

- Solution implementation process

On April 12th, 2021, responding to the invitation from the leaders of Cuiyun Hope School, the teachers of Squirrel AI went to the school to jointly explore the possibilities of the application of AI adaptive learning to help students there.

At that time, students only have two months to prepare for the senior high school entrance

examination. After a comprehensive investigation of schools, teachers, and students, the teachers of squirrel Ai made a detailed plan for the students. Firstly, through the knowledge diagnosis platform, the weak knowledge points of students were quickly found with algorithms (see Figure 10.1). Then, based on the knowledge graph, the optimal learning path, and other logical algorithms, the learning platform offered videos teaching the content that students did not master. Students used Squirrel AI adaptive teaching platform to interact with AI teachers for self-study while teachers supervised students and answered questions. This approach greatly improved students' self-regulated learning ability.



Figure 10.1. Test Analysis –Identifying unmastered Knowledge Points

Moreover, the system delivered personalized learning content customized for each student, which solved the problem that teachers could not give equal attention to students at different levels and also greatly reduced the burden on teachers (see Figure 10.2. & 10.3).

Figure 10.3. Individualized Learning Planning (Mathematics). Customize learning plans for preparing for the high school entrance exam for students according to their knowledge mastery.

The combination of AI-support learning and traditional in-person learning supervised by human teachers provides students with AI-supported hybrid learning solutions. After the trial, Cuiyun Public Hope School gradually opened adaptive courses in subjects such as Mathematics, English, Chinese, Physics, and Chemistry for the students. Dr. Cui Wei, the chief scientist of Squirrel Ai, led a team, provided on-site guidance, and made a learning plan for each student for the next stage according to students' study reports and learning results. At the same time, local teachers were trained to use the system to supervise classes, prepare lessons, and analyze students' learning data reports.

● Effectiveness

After a one-month study, there is already some good news (See Figure 10.4). One of the students, Sun, his total score of five subjects increased by nearly 110, from 242.5 to 351. After using the system for two months, the scores of the eight students had improved significantly in the final examination, with an average improvement of 51.69. The one who progressed most improved by 82.75. Among them, two students were successfully admitted to the key high school in Baishan City.

A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	AA	AB	AC
姓名	一模	二模	语文	提分	一模	二模	数学	提分	一模	二模	英语	提分	一模	二模	物理	提分	一模	二模	化学	提分	政治	历史	总分	体育成绩	总分	一模五科	中考五科	提分
由炫	83	88.5	97.75	14.75	81	81	72.0	-9	57	50	92.5	36.5	36	53	53.5	17.5	16	27	29.0	13	44.5	52.0	441.25	26.5	467.75	273	344.75	71.75
王艺菲	81	74.5	88.0	7	72	81	75.0	3	64	58	84.5	20.5	44	46	47.5	3.5	19	20	36.0	17	45.0	44.5	420.5	26.8	447.3	280	331	51
安中旭	66	88.5	87.5	21.5	60	78	88.0	28	53	36	64.25	11.25	40	47	54.0	14	20	14	28.0	8	44.5	45.5	411.75	26.2	437.95	239	321.75	82.75
毕美琪	80	84	82.5	2.5	41	62	48.0	7	55	59	58.5	3.5	31	41	48.0	17	19	19	30.0	11	43.0	48.0	358.0	26	384	226	267	41
赵欣瑶	77	89	90.25	13.25	36	44	49.0	13	52	48	66.0	14	43	37	53.5	10.5	19	17	27.0	8	38.5	41.0	365.25	17.1	382.35	227	285.75	58.75
孙彤	85	95	89.0	4	43	95	69.0	26	57	68	65.25	-1.75	52	59	45.0	-7	6	34	18.0	12	29.5	37.0	342.75	25.4	368.15	243	276.25	33.25
刘海英	63	74.5	79.5	16.5	23	29	30.0	7	47	35	47.5	0.5	13	23	36.0	23	14	13	26.0	12	43.5	29.0	291.5	16.3	307.8	160	219	59
高云贺	64	77.5	80.5	16.5	60	78	26.0	-34	48	47	49.5	1.5	22	41	43.0	21	5	13	16.0	11	37.5	23.5	276.0	24.5	300.5	199	215	16

Figure 10.4. The evidence indicating learning performance improvement

The AI-powered hybrid learning solution has the potential to improve learning and can be applied to other schools. Since it has the potential to scale up personalized learning at a relatively low cost, Squirrel AI solutions can solve the problems of teacher shortage in remote areas and improve education quality while ensuring equity.

11. Conclusion

The teaching and learning modes have been evolving, driven by various factors, including

technology application, pandemics, natural disasters, and dominating educational philosophy. This evolution has rapidly increased during the COVID-19 pandemic. To cope with the emerging challenges during the COVID-19 and the new normal after the pandemic, we recommend applying hybrid education, learning, and assessment modes (HELA). Aligned with the HELA initiative proposed by UNESCO-IBE, in this guideline book, we provide a broad description of the background of system transformation in education so that HELA can be better understood. Policymakers in different educational departments who plan to implement hybrid education can refer to the framework outlined in this guideline to understand crucial aspects they can consider. We also describe the key stakeholders who will be involved in a hybrid education and their specific roles. All these stakeholders should closely work with each other to ensure the successful implementation of hybrid education. For curriculum specialists, pedagogical advisors, and teach(er) trainers, we also provided a clear guide along with critical terms and cases about implementing hybrid teaching, learning, and assessment in a systematic way.

Technology is continuously penetrating the world of education today and in the future, calling for innovative strategies to improve education. We believe that hybrid education will be a new mode that can support the future of education for several reasons; the application of HELA can bring flexibility and convenience for teaching and learning; broaden and democratize learning opportunities; promote the development of a set of interconnected competencies; enhance the diversification of learning strategies; help educators effectively lead, manage and take responsibility for the education of new generations; ensure equality, and thus help achieve SDGs, etc. The pedagogical strategy supported by HELA can help redefine the relationships between educators and students; promote trust and collaboration between the State and civil society; enhance the opportunities for the production, circulation, and dissemination of knowledge and; provide opportunities to rethink the relationships between schools, learners, student families, and communities. Thus, we recommend HELA to be diligently studied, appropriately customized, and globally applied.

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