UNESCO

United Nations
Educational, Scientific and
Cultural Organization

MGIEP

Mahatma Gandhi Institute
of Education for Peace
and Sustainable Development

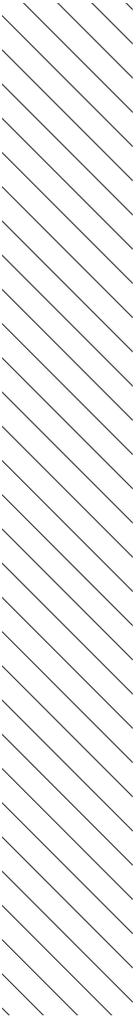# INDUSTRY GUIDELINES ON DIGITAL LEARNING: DISCUSSION DRAFT

INDUSTRY GUIDELINES
ON
DIGITAL LEARNING:
DISCUSSION DRAFT
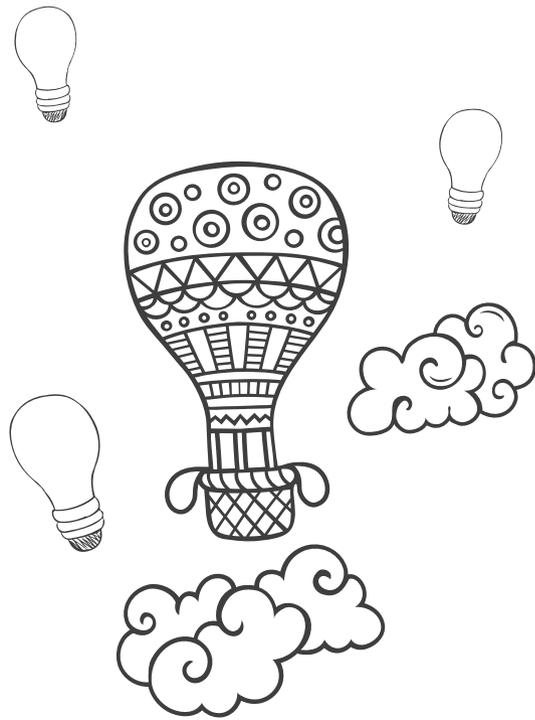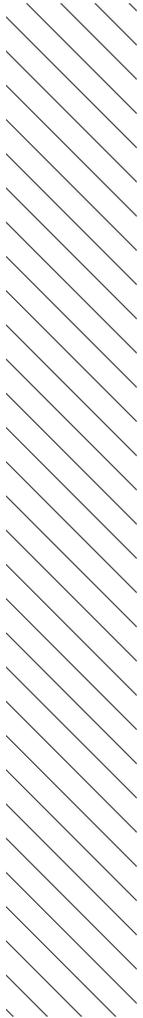
Foreword

Following the High Level Policy Forum at TECH 2018, the Vizag Declaration on Guidelines for Digital Learning called for the development of draft guidelines, and the need for such guidelines to be flexible and adapted to diverse local contexts and learner needs. The declaration identified the need to ensure a consistent and locally applicable system of features for identifying digital learning applications that would support and assist a range of stakeholders—including developers, designers, students, teachers, parents and administrators—in their efforts to develop or select high-quality, credible, and appropriate gaming and digital learning applications.

The guidelines offered in this document are a first draft to provide a holistic system of characteristics and parameters important for delivering active and engaging learning through digital solutions. We hope that these will be further elaborated with the active engagement of a broader group of specialists and researchers in the different fields of the sciences of education: developmental psychology, neuroscience, and education among others. These guidelines should evolve over time, in order to integrate the latest findings of research and field experiments and adapt to the rapid technical and societal evolutions.
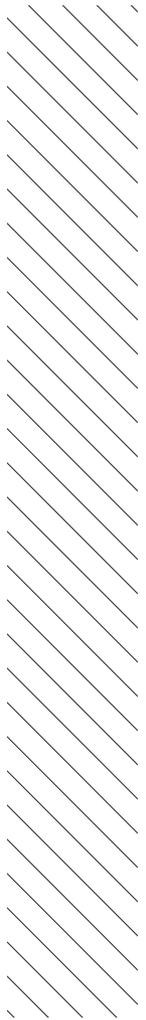
**ANANTHA KUMAR DURAIAPPAH**
Director, UNESCO MGIEP
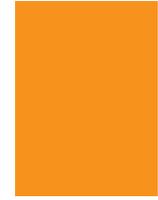
Introduction

Education is both a goal in itself (SDG 4) and a key to successful implementation of the other 16 well-being-related goals. It is generally accepted that a radical shift is required from a 'transmission' model which is a teacher centered approach of mere knowledge transfer to an 'active-engagement' pedagogy model where students take control and have agency over their own learning—a learner-centric approach.

Factors that influence learners' agency include engagement, motivation, ownership towards what they are learning, a sense of purpose, ability to express themselves. In addition to the above, making learning relevant, creating opportunities for students to play to their strengths and providing relevant and timely feedback to students is equally critical.

Emerging research indicates that mainstreaming social and emotional learning (SEL) in schools not only reduces academic stress and anxiety, decreases dropout rate, improves behavior but also improves academic performance. Moreover, teaching SEL skills leads to the cultivation of cognitive flexibility, mindfulness, emotional regulation, tolerance, empathy and sociability which have been proven to enhance learning and well-being.

Providing relevant and on-time feedback to students is also critical in this process. Key elements of the overall vision of learning include cultivation of a combination of intellectual and socio-emotional skills such as independent inquiry, systems thinking, critical thinking, communication, creativity as well as collaboration, mindfulness, resilience and empathy.
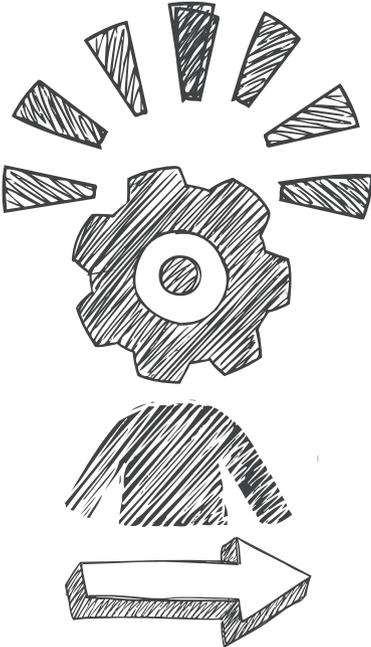
Pedagogies that support deeper learning, including personalized learning strategies, collaborative learning, situated and connected
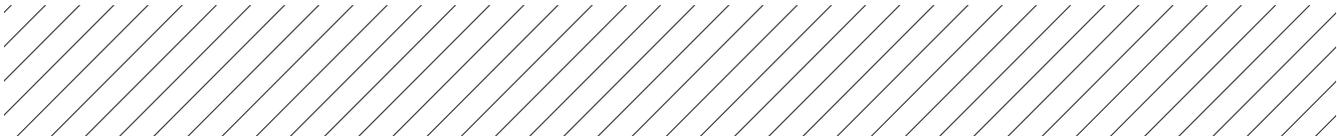
learning, are effective in fostering the above-mentioned skills in students.Fostering learner participation and offering personalized and customized learning opportunities are key to student engagement.

Technology enabled learning offers exciting innovative, interactive and immersive ways for augmenting deeper, engaging and active learning experiences. There is a need to create a 'digital ecosystem for learning' which should be optimally integrated to build new digital pedagogies for the 21st century.

Digital pedagogies combine pedagogical approaches with technological infrastructure and tools to facilitate teaching and learning. Some examples of digital pedagogies could comprise learning platforms, immersive interfaces, digital games and digital tech-books.

MOTIVATION
& REWARD

EXPERIENTIAL

COLLABORATIVE

New **Digital Learning** Ecosystem

IMMERSIVE

LEARNER-LED

PERFORMANCE
BASED
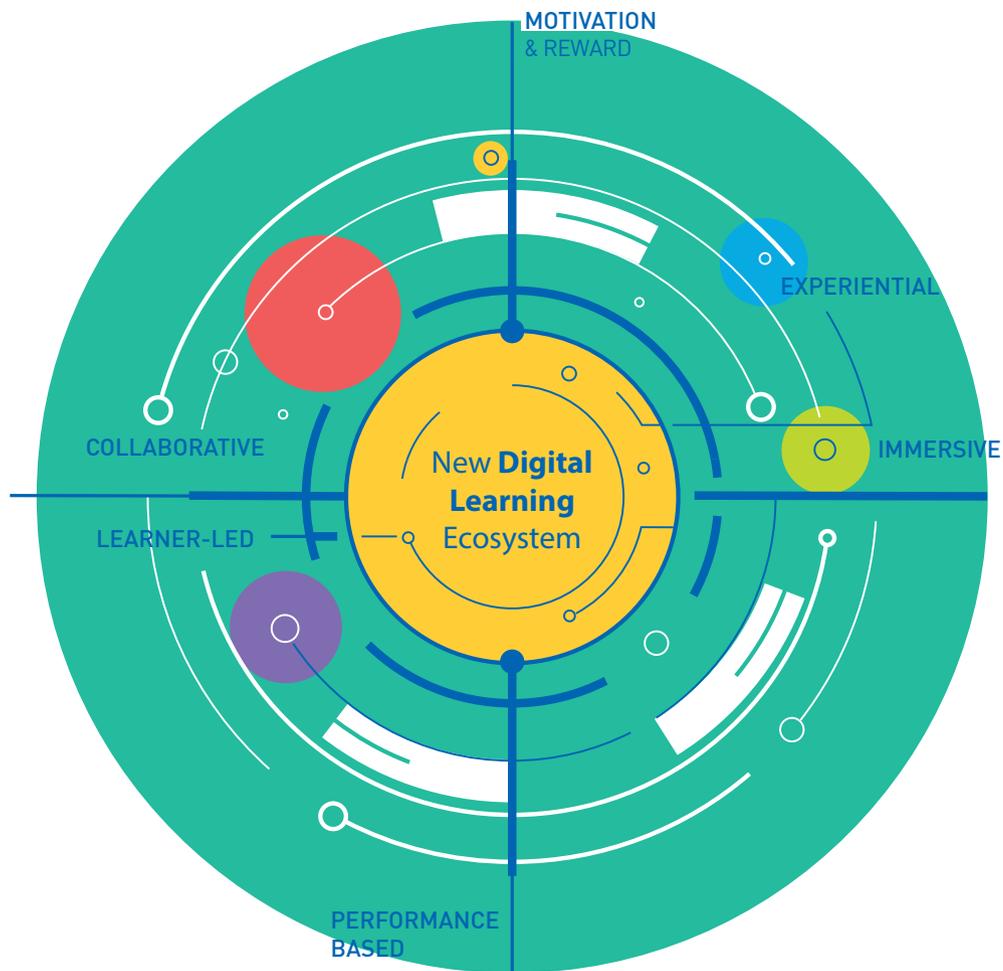
Digital Pedagogies are defined as the skillful, artful and mindful fusion of digital learning solutions with digital delivery systems. They represent a form of learning and teaching that creates both new challenges and opportunities. As mentioned above, some features of a digital ecosystem as indicated in the figure could include:
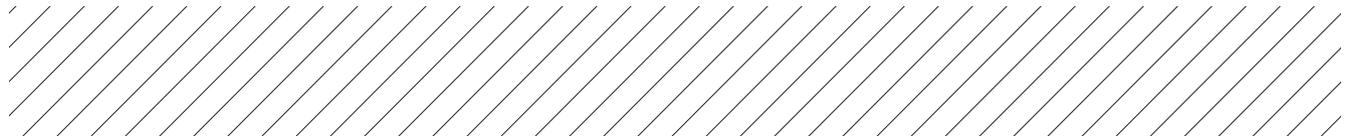
• **Learning Platforms** defined as digital environments that comprise a framework of tools that work together "seamlessly" to deliver learning experiences along with a database that keeps track of connections among tools, learning materials, online resources, educators, students, and activities. One popular example, which has gained significant popularity, is the Massive Online Open Courses (MOOCs) platform.

• **Immersive Interfaces** referring to the subjective impression one experiences when interacting with a realistic digitally-enhanced environment such as in the context of Virtual Reality (VR), Mixed Reality (MR) or Augment Reality (AR) and Multi User Virtual Environment (MUVR). Interactions within an immersive environment produces a willing suspension of disbelief which is further enhanced through design strategies that draw on sensory, actionable, and symbolic factors . Immersive Environment (IE) represents an active approach to learning. Well-designed IEs that incorporate theoretically grounded learning principles can also be intrinsically motivating and engaging for learners .

• **Digital Games** designed to provide content in an engaging, interactive, and disarming environment that can facilitate both learning and rapid assessment in challenging simulated real-world circumstances. Well-designed video games encourage skills such as critical thinking, systems thinking, lateral thinking, perspective taking, calculated risk-taking, attention control , as well as complex information processing, peer interactions and social learning. Under appropriate circumstances and with supportive learning materials, they can lend themselves as effective tools for teaching mathematics, science, humanities, and social-emotional skills. Another key element of learning through games is the social setting, the big 'G' in which the soft game is placed and all the interactions among players that happen, either offline or online. This social setting is crucial.

• **Digital Tech-Books** as interactive and multisensory 'books' that provide content in the form of text, videos, photos, animations, and audios, which can be easily and rapidly annotated, updated and shared. Users can make modifications, add and edit, interact with the tech-book and share their creations with fellow users and educators. These kind of digital tech-books can support adaptation and customization of educational tools for users and for the overall context.
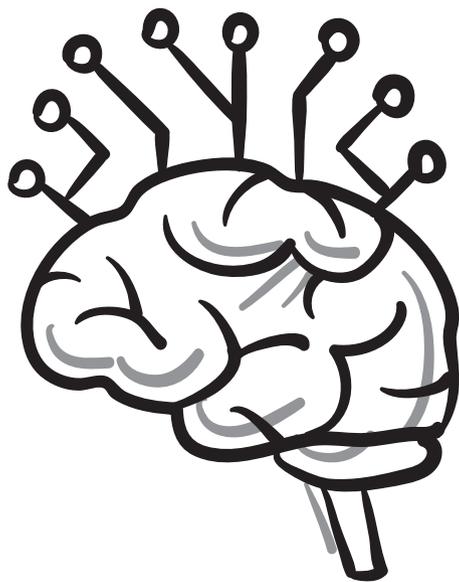
Globally, the overall Ed.Tech. market is expected to hit $252 billion by 2020 with Asia Pacific, North America, and Western Europe being the largest markets. And this growth of technology is expected to soar even higher over the coming years. Looking towards interactive technology, according to the 2017-2022 Global Games-based Learning Market Report by METAARI, the five-year compound growth rate for game-based learning has been estimated at 20% and revenues are predicted to more than double, likely exceeding $8 billion by 2022 (up from $3.2 billion in 2017).

These opportunities have given rise to a plethora of educational applications available on various digital stores across platforms and devices. Recent studies suggest that under appropriate circumstances and with supportive learning materials digital games can be effective tools for teaching mathematics, science, humanities, and social-emotional skills.
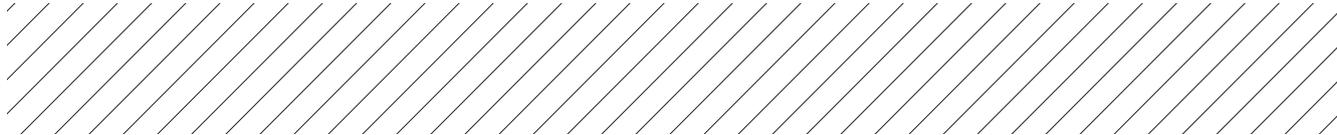
Studies in neuroscience of gaming also indicate promising effects on students' motivation, engagement and performance.

At the same time, the evidence on instructional games is fragmented; much of the work on evaluation of games has been anecdotal, descriptive or judgmental. There is a palpable need for more longitudinal, empirical research on the impact of technology-enabled learning, including games based learning and simulations, on learning.

The massive influx of digital learning solutions has made the task of selecting the appropriate learning game, application or tool difficult for teachers, parents and school leaders. The recent identification of digital gaming as a medical disorder by the WHO,calls for a system of checks and balances to reflect upon design of digital educational games as well. We need to build digital learning solutions which promote active learning, well-being for all, build 21st century skills and socio-emotional skills among learners. These challenges highlight the importance of creating a framework or set of guidelines for educational technology developers to integrate principles of good

learning principles with digital pedagogies that are well aligned with the values of peace, non-discrimination and sustainable development as enshrined in the UN SDGs.
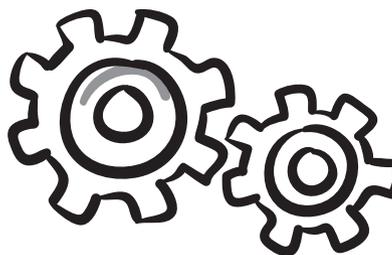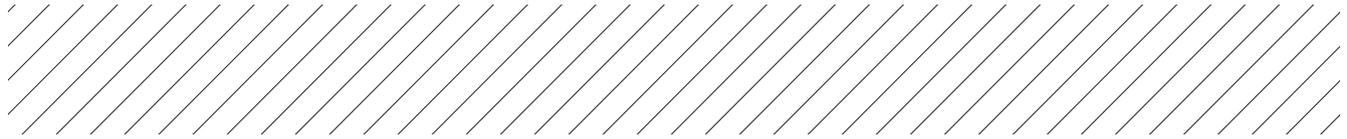
Guidelines

Purpose

The guidelines are primarily developed to:

• Identify characteristics and parameters important for delivering and engaging learning through digital solutions,
• Guide developers of digital learning solutions to better align their products with principles and core values of UNESCO MGIEP and SDG 4.7.

Principles

The following are general principles that describe the scope and nature of these guidelines:

Content-agnostic
The purpose of these Guidelines is not to supplant educational institutions, neither national nor local. Educational content should fit the cultural, social and economic contexts of a territory, and that is the role and the prerogative of the local educational institutions. The choice of the disciplines/branches/subjects/topics taught in the digital learning applications is beyond the scope of these guidelines.

Flexible
In addition to permitting the educational institutions to define the content that best suits the situation and needs of their learners, the guidelines are flexible enough to adapt to the rapidly changing and largely unpredictable societal and economic needs. They will also take into account the specificities of the different age groups: primary, secondary, and tertiary education. Finally, the guidelines are designed to be flexible enough not to constitute an obstacle to developers' creativity or entrepreneurship.

Evolutive
The guidelines will be further elaborated with the active engagement of a broader group of specialists and researchers in the different fields of the sciences of education: developmental psychology, neuroscience, and education among others. As mentioned previously, this document is likely to evolve over time, in order to integrate the latest findings of research and field experiments and adapt to the rapid technical and societal evolutions.

Holistic
These guidelines encourage embedding socio-emotional learning along with disciplinary knowledge within the design of digital learning applications.

Structure

These guidelines have been divided into two broad sections—Mandatory and Recommended. Mandatory characteristics feature preliminary requisites for any digital learning application, while, the recommended characteristics list desirable features that align the application with the core values of UNESCO MGIEP and SDG 4.

Mandatory

| no discrimination | no gratuitous violence | learner-centric |

Recommended

1. CONTENT

i. Knowledge
- multi-disciplinary
- up to date knowledge

ii. Skills
- creativity
- critical thinking
- collaboration
- communication

iii. Character Qualities
- inquiry
- empathy
- mindfulness
- resilience

2. LEARNING STRATEGY

i. Active learning
- learning enviroment
- interactive experience
- intrinsic motivation
- fun experience

ii. Reactive learning
- creativity
- critical thinking
- collaboration
- communication

iii. Social learning
- multi user offline
- multi user online
- peer evaluation
- peer review

## 3. ACCESSIBLITY

4. DATA PRIVACY
- app data policies
- user data sharing
- user data ownership

5. HEALTH CONCERNS
- optimised learning sessions
- in-app physical gathering mechanisms
- limited overall screen time

Mandatory Characteristics

Since wars begin in the minds of men and women, it is in the minds of men and women that the defenses of peace must be constructed. - UNESCO Constitution
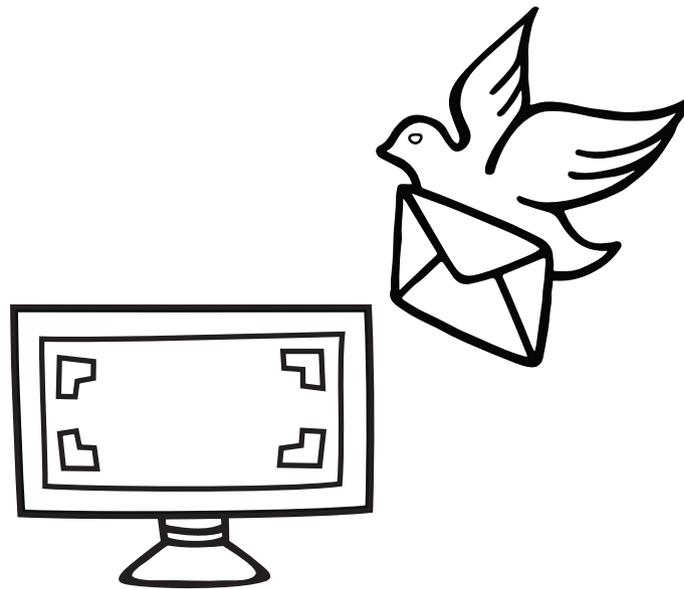
These guidelines are guided by a vision to make the content of digital learning materials inclusive, free of harmful cultural, gender, religious and other stereotypes, and aligned with the principles of peace, sustainability and global citizenship. The digital learning applications must respect the ethics and values promoted by UNESCO. Specifically, but not exclusively:
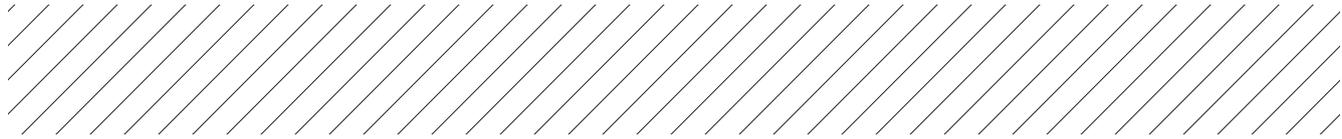
No discrimination

The digital learning application should not demonstrate any form of discrimination towards any human irrespective of race, cultural heritage, ethnic background, age, gender, religious beliefs, economic status or any other factor. Digital learning applications must ensure that they are free of any disrespect and discrimination in any form directly or indirectly, through their story, artwork, representations, UI, UX or by any other means.

No gratuitous violence

While a dose of competition might be good/useful for emulation or evaluation purposes, there's no need for unnecessary violence. Respect for human beings should be expressed as regard for the welfare, rights, beliefs, perceptions, customs and cultural heritage, both individual and collective, of people likely to be affected. In any case, violence should not be central or primary motivation in any form directly or indirectly, through the application's story, artwork, representations, UI, UX or by any other means.

Learner-centric

The digital learning application must adopt an active learning approach and make effective/optimal use of the vast interactive possibilities offered by Digital Pedagogies in order to create rich, immersive and efficient learning experiences. Learner should not just be a passive consumer of content but be actively engaged and central to the process of acquiring knowledge and skills.

Recommended Characteristics

1.Content

### A. Knowledge (what you know)

i. MULTI-DISCIPLINARY

Studies probing the structure of scientific fields have revealed that while there is specialization, interdisciplinary work is often integral to important advancements in knowledge and technology.

Multi-disciplinarity also promotes the development of transferable skills like critical thinking, synthesis and research which can then be applied to future learning experiences. For example, while trying to teach a mathematical concept, an application could provide multiple perspectives from history and evolution of that concept and not just one scientific thought process behind its development.

Digital learning applications should encourage learners to make connections between different concepts and disciplines.

> Note that in an application there might be no discipline at all, if for example the developer chooses to make an app that focuses strictly on character qualities such as curiosity, empathy, mindfulness, resilience and responsibility
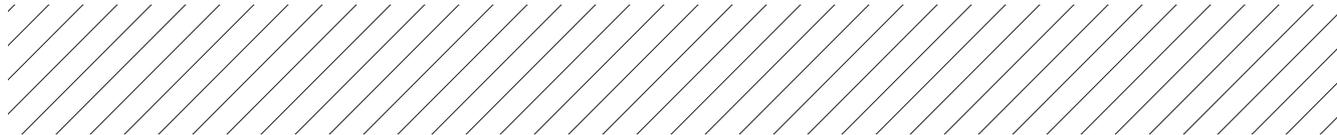
ii. UP TO DATE KNOWLEDGE

Knowledge today is evolving faster than ever. Digital Learning solutions should anticipate the eventual evolution(s) of the discipline(s) they teach and provide effective means to keep their knowledge content up to date.

Digital learning applications should regularly update the knowledge content of the application.

i. CREATIVITY

Creativity is a complex construct and has been defined as the act of turning new and imaginative ideas into reality or the tendency to solve problems or create new things in a unique way. It is characterized by the ability to perceive the world in new ways, to find hidden patterns, to make connections between seemingly disparate phenomena, and to generate solutions.

Research indicates that such connections can be accomplished by cultivating divergent thinking skills and deliberately exposing oneself to new experiences and to learning.

Digital learning applications should adopt approaches that enhance creative thinking, such as problem-based or project-based learning methods.
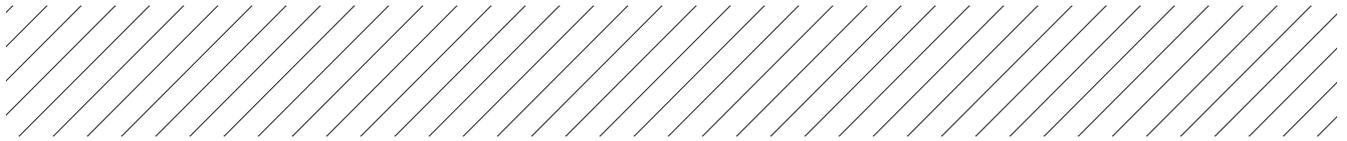
ii. CRITICAL THINKING

Critical thinking can be defined as "the intellectually disciplined process of actively and skillfully conceptualizing, applying, analyzing, synthesizing, and/or evaluating information gathered from, or generated by, observation, experience, reflection, reasoning, or communication, as a guide to belief and action."

In essence, critical thinking refers to questioning claims, rather than accepting them at face value, which is particularly useful for problem solving, decision making, researching, effective reasoning and systems thinking.

Teaching and training critical thinking can be achieved in very different manners, e.g. by projects that involve interpreting information, analyzing parts and wholes, analysis and synthesis, evaluating evidence, taking multiple perspectives, discerning patterns, and grasping abstract ideas.

Digital learning applications should include experiences, opportunities and exercises which require the learner to think critically.
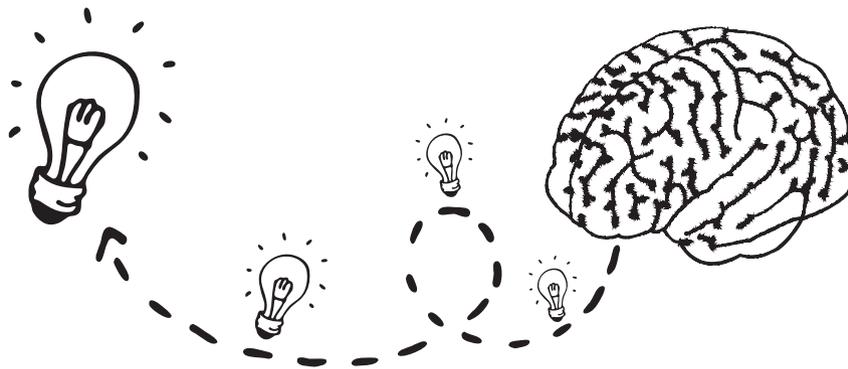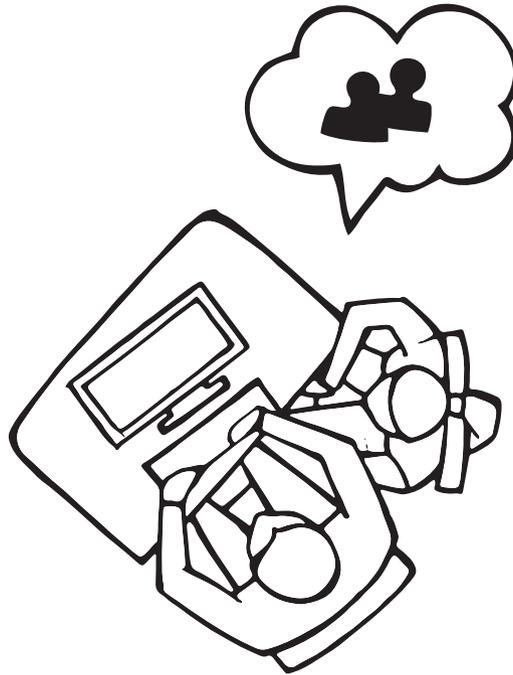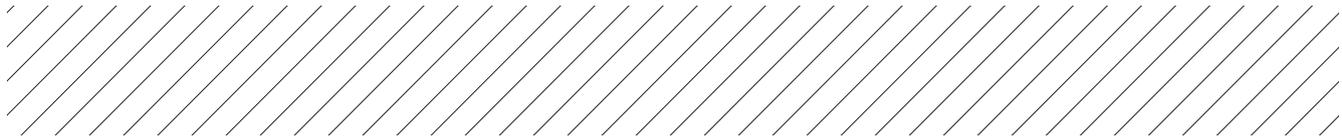
iii. COLLABORATION

In a world of increasing complexity, the best approaches to solving multifaceted problems involve collaboration among people with different skills, backgrounds and perspectives. Collaboration enables a group to make better decisions than any one individual would on his own, since it allows for the consideration of multiple viewpoints.

Collaborative learning has been found to be more effective in producing academic achievement than individual or competitive learning , inculcating positive attitudes towards school, enhancing critical thinking and creativity.

Digital learning applications should integrate different pedagogical tools that utilize collaborative learning in the design of the application and delivery of content.

iv. COMMUNICATION

All professions require various forms of collaboration on a regular basis: negotiating, giving instructions, advising, building relationships and resolving conflicts to name a few. Strong communication abilities including the capacity to express thoughts clearly and persuasively both orally and in writing, articulate opinions, communicate coherent instructions and motivate others through speech, are highly valued in the workplace and public life. This supposes active listening, clear thinking and writing, and persuasive presentation.

Digital learning applications should inculcate communication skills by incorporating collaborative tasks, peer interaction and dialogue.
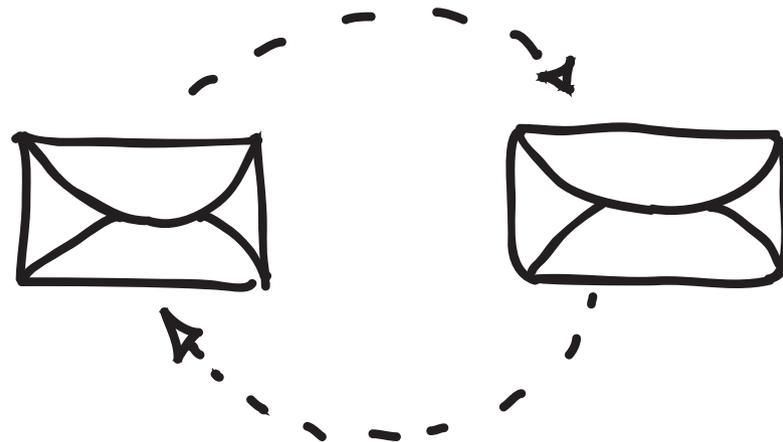
Character education is about the acquisition and training of virtues (qualities) and values (beliefs and ideals), and the capacity to make wise choices for a well-rounded life and a thriving society. Character education helps build a foundation for lifelong learning, support successful relationships at home, in the community and in the workplace and develop the personal values and virtues for sustainable participation in a globalized world.

Digital learning applications should, in addition to knowledge and skills, also try to cultivate character qualities such as a spirit of inquiry, empathy, mindfulness, resilience and agency in the learner.
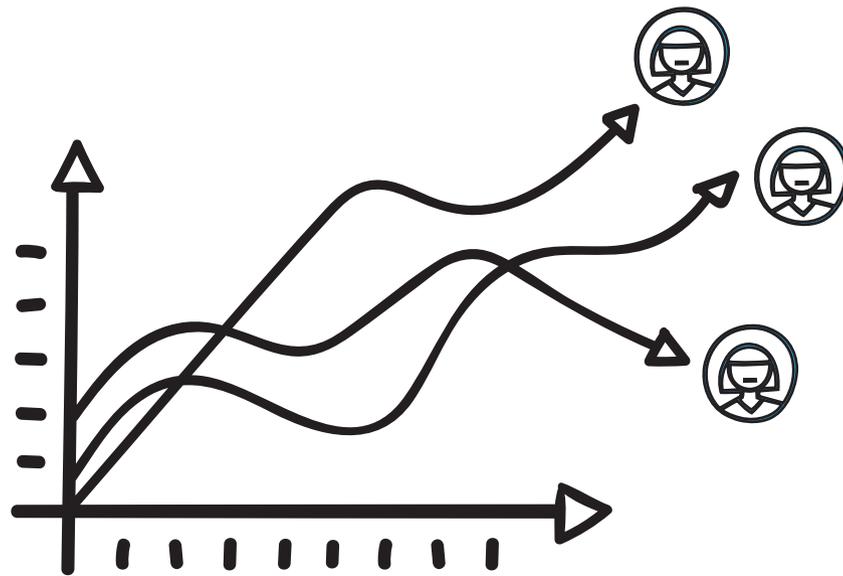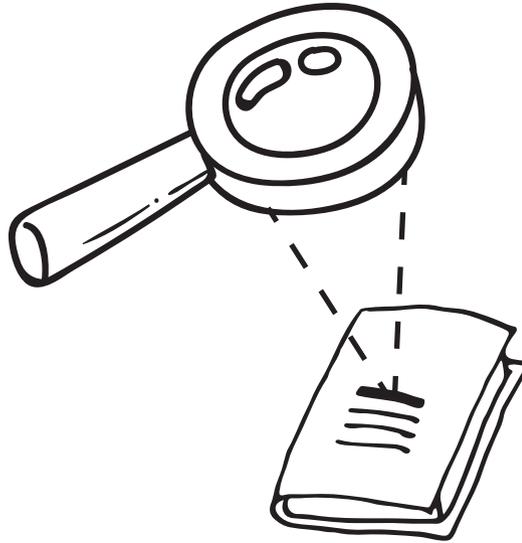
i. INQUIRY

We naturally try to understand the world around us, and when we cannot, we try to resolve the uncertainty. This spirit of inquiry is a natural learning process where a learner engages in, as they seek to obtain new information, resolve doubt, and solve problems.

Fostering a sense of inquiry puts learners in the driving seat along the path of life-long learning. It encourages students to seek answers to their questions through observations, thinking, and reasoning based on their judgment and experience.

Teaching skills of independent inquiry equips students to deconstruct and reconstruct claims, definitions, and concepts to arrive at conclusions, both independently and collectively, that are robust, logical, and humane. It promotes intellectual resilience and sound decision-making. However, there is a need to temper cold rationality with the warmth of care and consideration for others.
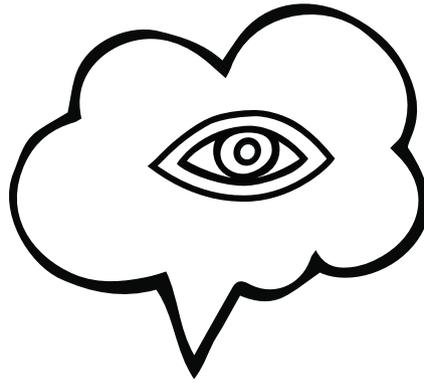
ii. EMPATHY

Empathy is the ability to see the world from another person's eyes (cognitive), also known as Theory of Mind (ToM), and feel what the person is feeling (affective). Empathy is considered as a motivating factor for unselfish, prosocial behavior.

It allows for recognizing and accepting differences and diversities in people's perspectives, diffuses rigidity of thoughts and beliefs, encourages cognitive and personal flexibility.

It is also a fundamental skill for collaboration, team-work and cultivate positive relationships. Moreover, research also suggests a positive association between Theory of Mind and academic performance. Therefore it is a valuable skill for effective social interactions and well-being in life.
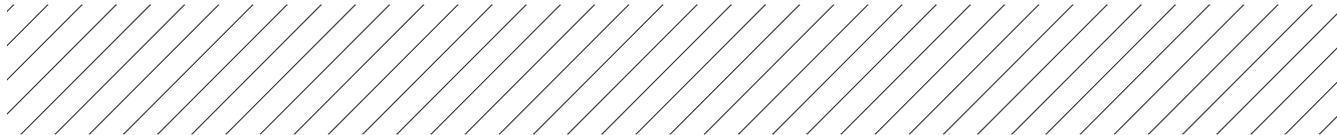
iii. MINDFULNESS

Mindfulness has been described as "bringing one's complete attention to the present experience on a moment-to-moment basis" and as "paying attention in a particular way: on purpose, in the present moment, and non-judgmentally". Mindfulness practices are designed to cultivate conscious awareness of

a) where attention resides
b) how emotions are experienced in the body, and
c) how thoughts, beliefs, values, and emotions may influence one's ability to pay attention and regulate emotion.

Research suggests that mindfulness training can enhance attention and focus, and improve memory, self-acceptance, self-management skills, self-understanding, self- esteem and optimism. These in turn improve student's academic performance, classroom engagement and overall well-being of students and teachers.
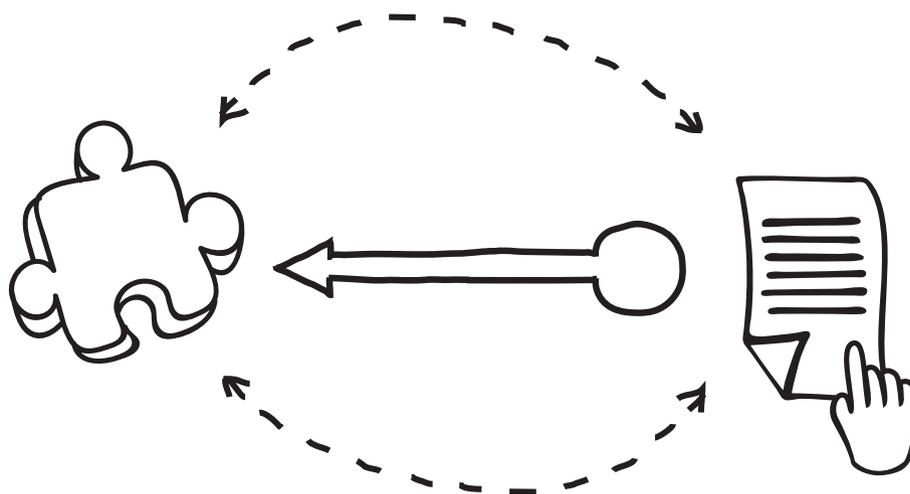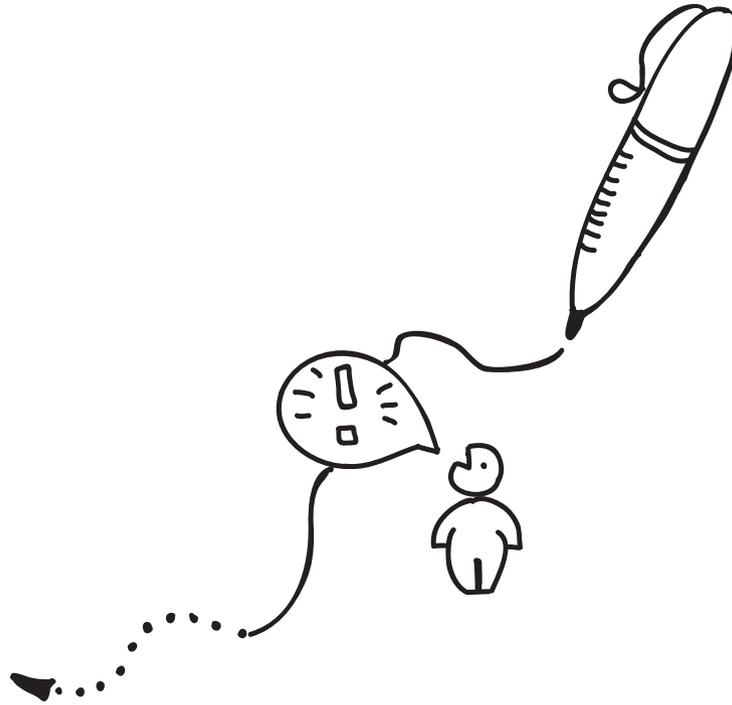
iv. RESILIENCE

Resilience can be defined as our capacity to bounce back or recover from difficult experiences. It is a process of adapting well in the face of adversity, trauma, tragedy, threats or even significant sources of risk (APA). The way we perceive a situation significantly affects the outcomes.

Some of the factors that positively influence resilience are caring relationships, communication of high expectations, opportunities for meaningful involvement and participation   along with a spirit of challenge, commitment to goals and personal control.

Resilient students are better able to face disappointment, learn from failure, cope with loss and adapt to change.
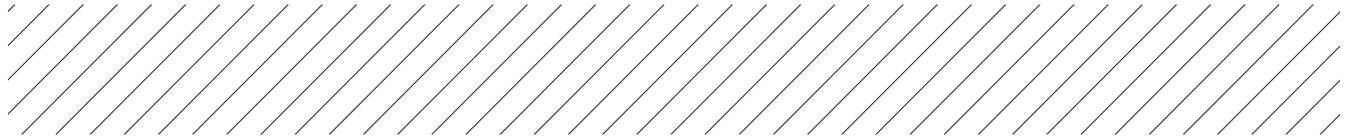
v. AGENCY

In the context of education, fostering learners' agency can be understood as students directing their own learning, based on their interest and goal, and taking an active role in seeking and internalizing new knowledge. Research has demonstrated that students taking self-responsibility of their own learning has positive effects on motivation and performance. , Responsible learners take on challenges and take on tasks that require greater personal involvement.

Some of the components of learners' agency are future orientation, self-regulated learning, meta-cognitive self-regulation, mastery of orientation, locus of control, perseverance of effort, perseverance of interest and self-efficacy.
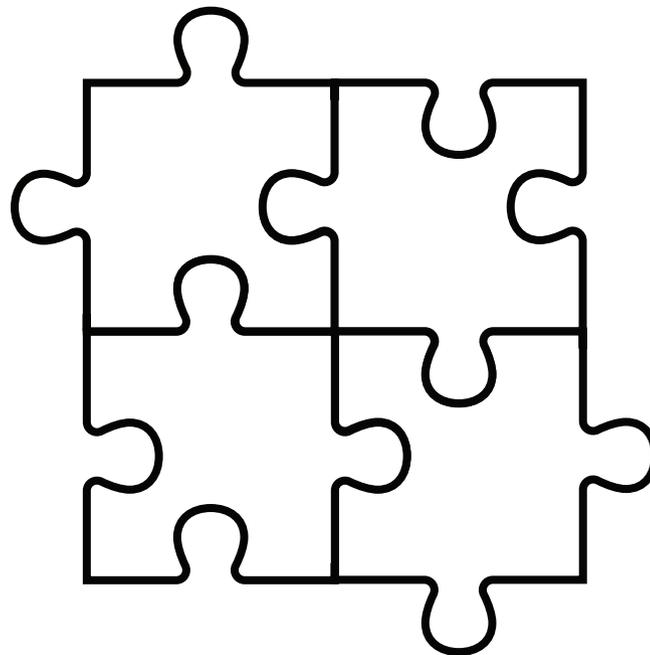
2.Learning Strategy

When knowledge is acquired passively, without engaging skills, it is often only learned at a superficial level (memorized but not understood) and therefore not readily transferred to new environments. Conceptual understanding and real-world transfer can occur when content knowledge is activated through the execution of relevant skills, so that one enhances the other.

A. Active learning

Active Learning is an approach to instruction that focuses on engaging students in higher order thinking by placing a greater degree of responsibility on them. This approach enables the learner to develop a strong understanding of concepts, therefore, assisting them in applying their knowledge better. These techniques improve levels of engagement, social development, general knowledge, and practical proficiencies.
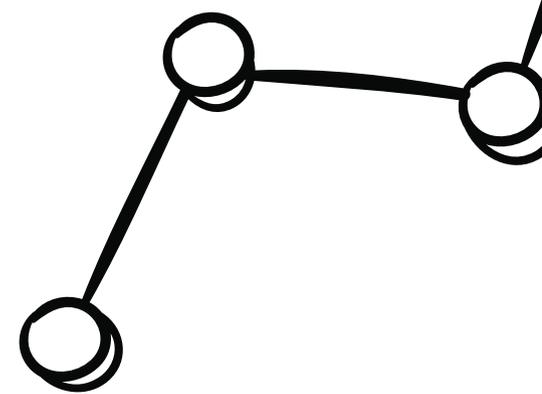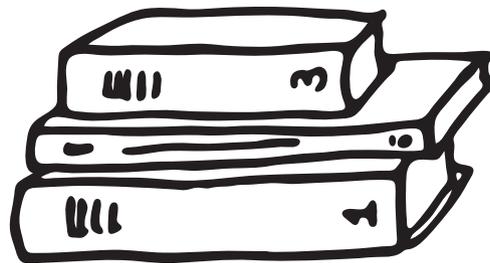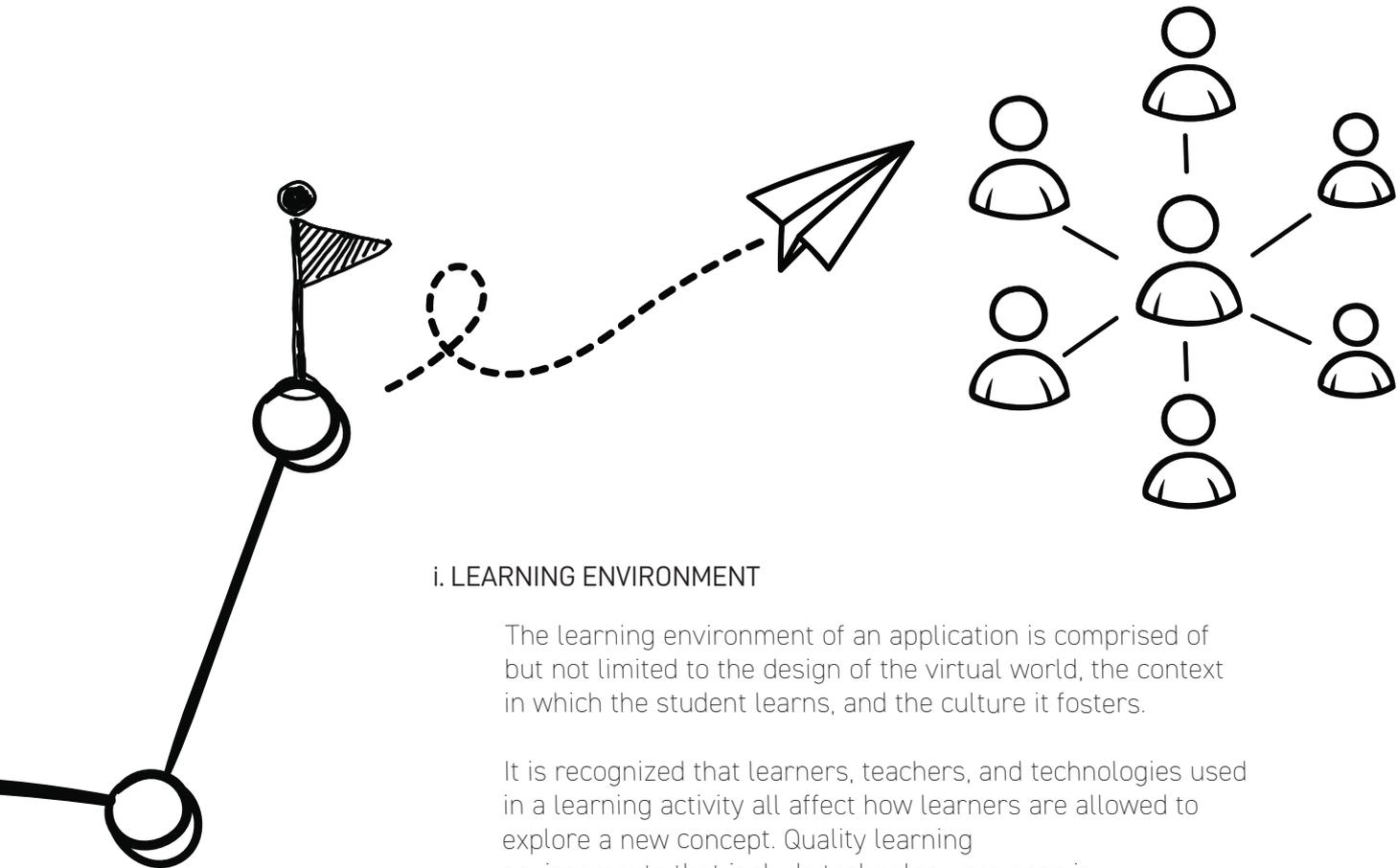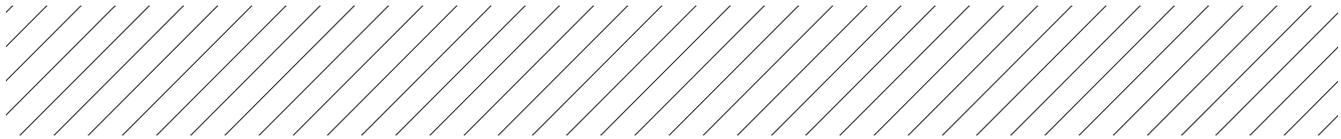
i. LEARNING ENVIRONMENT

The learning environment of an application is comprised of but not limited to the design of the virtual world, the context in which the student learns, and the culture it fosters.

It is recognized that learners, teachers, and technologies used in a learning activity all affect how learners are allowed to explore a new concept. Quality learning environments that include technology are ones in which the technology and pedagogical practice expand students' exploration and reflection of a concept.

Digital learning applications should aim for consistency in the learning environment: as a setting, with the discipline(s) taught, the learning goals, pedagogy. and with the target age group.

ii. INTERACTIVE EXPERIENCE

Education in the modern world ought to consider how the underlying aspects of media and technology in the interactive age affect learning and schooling. Studies
have demonstrated that interactive learning techniques encourage learner autonomy, increase retention, and help them perform better.

*Digital learning applications should design experiences that allows for exploration, experimentation, problem-solving, and decision-making, while remaining consistent with the discipline(s) covered and relevant
to the age group of the intended learner.*

iii. APPEAL TO INTRINSIC MOTIVATION

Intrinsic motivations include fascination with the subject, an understanding of its relevance in life and the real world, a sense of accomplishment in mastering it, and a sense of calling to it. Such motivations can be long-lasting and self-sustaining.

Digital learning applications may implement this by allowing for increased learner agency, tailoring training & assessment for competency employing techniques that foster a feeling of relatedness.
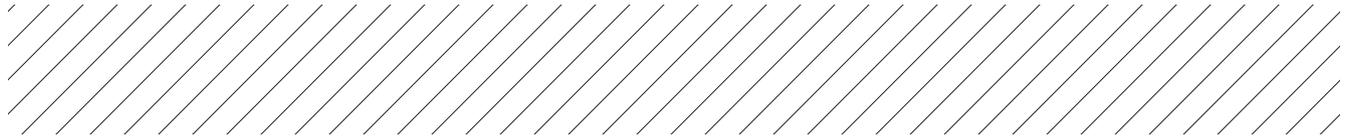
iv. FUN EXPERIENCE

Playing is the most natural and effective way of learning. Neuroimaging studies and measurement of brain chemical transmitters reveal that students' comfort level can influence information transmission and storage in the brain. It has also been demonstrated that superior learning takes place when the learning experience is enjoyable.

Defining 'fun' is challenging as it is subjective. However, digital learning applications should try to integrate components that are fun to engage with and occupy learners in an interactive way rather than in a passive approach.

Digital learning applications should aim to make the process of learning fun and not rely overly on the use of external rewards systems that draw focus away from the learning process.
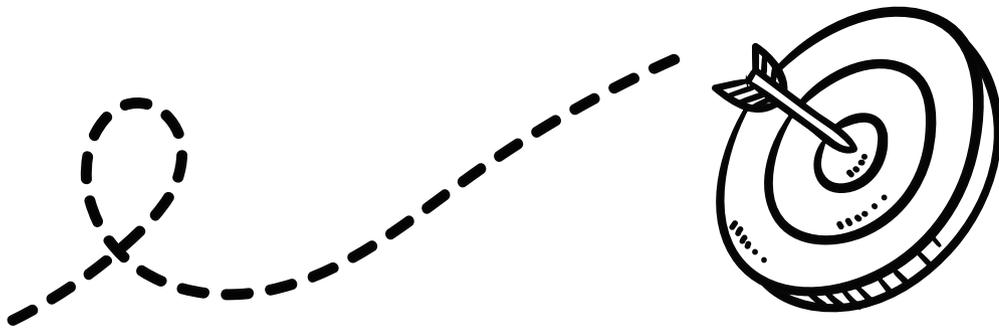
The quality of feedback is paramount for an interactive experience to be satisfactory, as it is for a learning experience to be successful. In an optimal interactive learning experience, feedback has to be immediate, accurate, relevant, and if possible adaptive. Such a system should resolve major issues and misconceptions. This information is used to promote positive and desirable development by directing learners on what to focus on next.

i. ACCURATE FEEDBACK

Several studies show firm evidence that innovations designed to strengthen the frequent feedback that students receive about their learning yield substantial learning gains. Accurate feedback is that which is descriptive yet specific enough such that the learner finds it valuable and provides them with direction.

Digital learning applications should aim to enable the learner to experiment and draw inferences, and therefore learn, the application should ensure that the feedback is tangible and accurate.
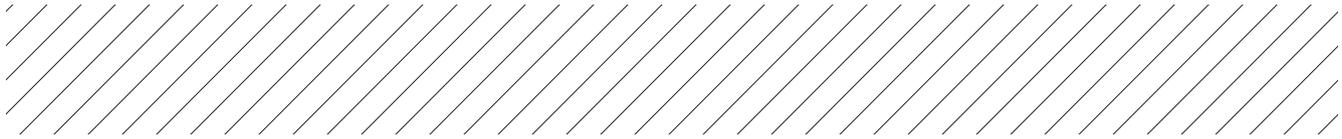
ii. RELEVANT FEEDBACK

Relevant feedback is that which is accessible to the learner in both language and concepts, allows them to keep progressing, and ensures they aren't overwhelmed by feedback that attempts to correct everything. Hence, prioritization by instruction is important. It is important that both strengths and weaknesses are highlighted so as to not discourage effort and achievement.

Digital learning applications should provide relevant feedback that is actionable and that enables the learner to clearly identify what worked and what did not.

iii. ADAPTIVE FEEDBACK

Adaptive feedback is that which acknowledges the needs of the learner, makes them feel more valued, and motivates them. This allows the application to gauge the learner's progress effectively and helps to realign their efforts in accordance with the goal.

Digital learning applications may, depending on the learner's profile and past actions/performance, propose a specific exercise adapted to their needs.

C. Social learning

Learning occurs in a social setting, through observing others' behavior, attitudes, and outcomes of those behaviors. Most human behavior is learned observationally through modeling: from observing others, one forms an idea of how new behaviors are performed, and on later occasions this coded information serves as a guide for action. Social learning theory explains human behavior in terms of continuous reciprocal interaction between cognitive, behavioral, and environmental influences.

While implementing social learning features, digital learning applications should promote positive reinforcement through non-toxic ways of peer comments and feedback.

Digital learning applications may leverage the advantages of 'social learning' by developing multi-user systems where inter-action between users—offline or online—is incorporated as part of the core design of the application.
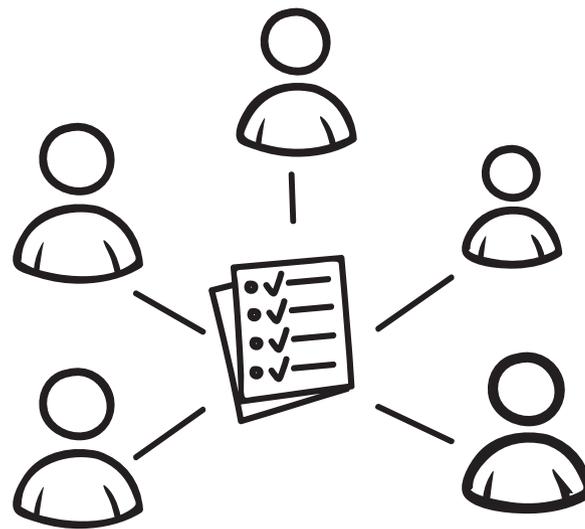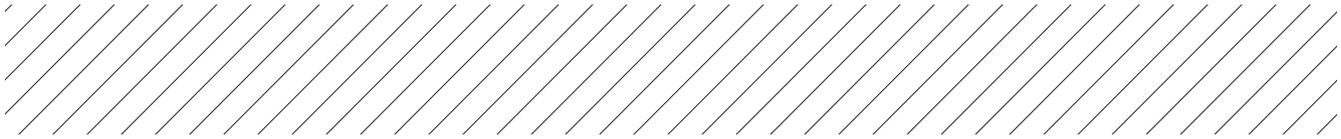
i. MULTI-USER OFFLINE

The users can interact with other users offline.
Interaction in learning is a necessary and fundamental process for knowledge acquisition and the development of both cognitive and physical skills. These interactions may be designed to increase understanding, share perspectives, resolve conflicts etc.

Digital learning applications should enable, incentivize or provide flexibility to promote offline user interactions with other learners or educators which may then be fed back into the application when users get online.

ii. MULTI-USER ONLINE

The users can interact with other users online.
Collaborating with other learners to find solution to a common problem requires the user to demonstrate understanding and tests their ability to work amicably. This ensures each learner has a specialist knowledge as well as a general common knowledge.

Digital learning applications may encourage cross-functional cooperation by requiring learners with different strengths to work together.

iii. PEER LEARNING

Peer learning refers to a host of learning experiences including peer tutoring, cooperative learning, and peer response groups that are designed to promote collaboration and consolidation of knowledge and skills.

It can be described as a way of moving beyond independent to interdependent or mutual learning. This motivates learners to develop a better understanding and fosters sharing as their contributions are valued and encouraged.

Digital learning applications should help facilitate peer learning which is mutually beneficial and involves sharing of knowledge, ideas and experience between the participants.
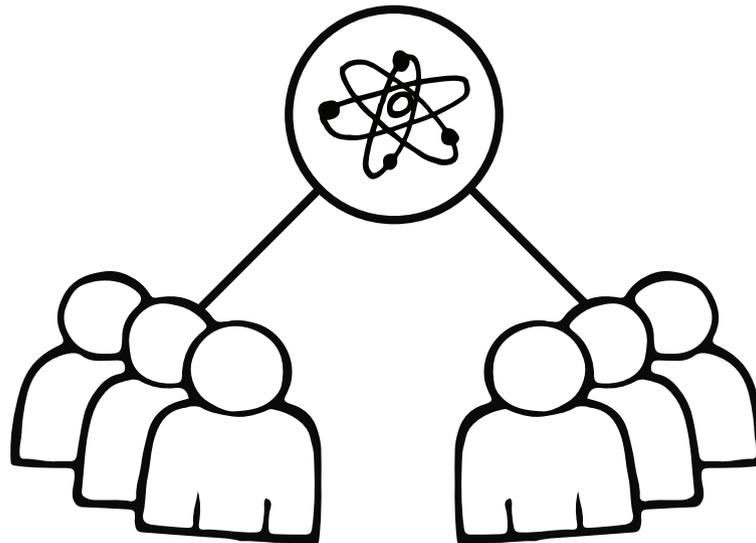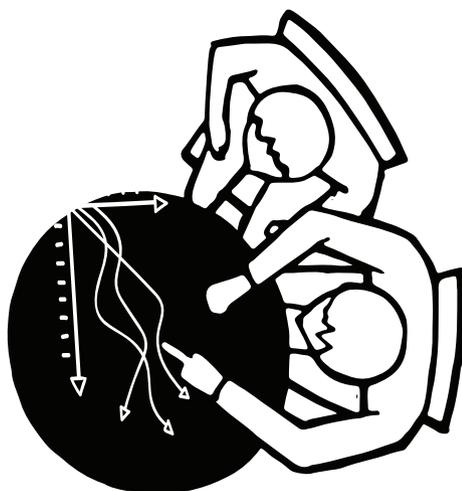
iv. PEER EVALUATION

Peer evaluation is an assessment methodology that allows learners to provide input into the assessment procedure by evaluating each other's' performance in learning activities.
This helps in making it possible for the application to accurately gauge the learner's performance and personalizes the learning experience potentially motivating continued learning.

Digital learning applications may integrate peer evaluation mechanisms, especially when evaluating skills and character qualities.

Digital learning applications may provide additional learning resources, suggestive lesson plans and implementation strategies for teachers and educators to be able to make optimal use of the application.

3. Accessibility

Not all minds are capable of learning and absorbing knowledge in the same way. There is a need of moving towards a design which gives everyone an equal opportunity to succeed. Education systems need to accommodate, learners with hearing and visual impairments, those who have special learning needs, and focus on those with learning disabilities as well.

Digital Learning applications should optimize the design and delivery of content, teaching-learning strategy and interaction which is suitable for individuals with different needs and capabilities.
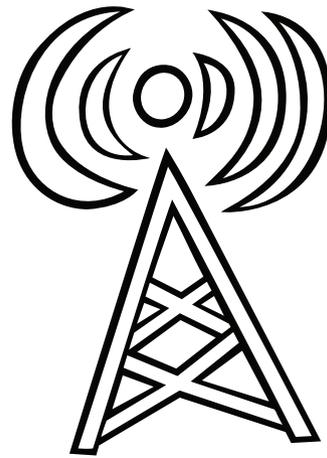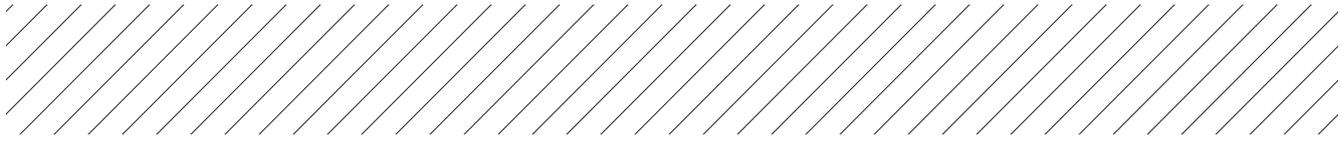
4. Data Collection and Sharing

A large amount of data can be retrieved by a digital learning application by recording users' actions.

A. App data and policies

It is the right of a user to have complete knowledge of what they are signing up for when they begin using a digital learning tool. Data and privacy concerns of an application must be governed by local government laws, the country in which the application is available/used/implemented.

Digital learning applications should be transparent in providing information like what kind of data it collects, targeted user age group, intended learning objectives and potential hazards.

B. User data ownership

It is important that the learner as a user must be aware of how the data generated by him/her is intended to be used.

Digital learning applications should provide total control, on what user data is shared and with whom it is shared, to the user (or his parents and teachers, when he/she is underage).

C. User data sharing

Digital learning applications should ensure high local and global standards of data protection and data privacy. At the same time, the data collected from all the users could benefit the whole community. Properly collected, curated and anonymized learner data can be useful for researchers, who could better understand and refine the learning processes, and for educators, school administrators and policymakers.

Digital learning applications, only after obtaining permission from the users, may share the data retrieved by applications to be used as a valuable resource for researchers in education sciences.
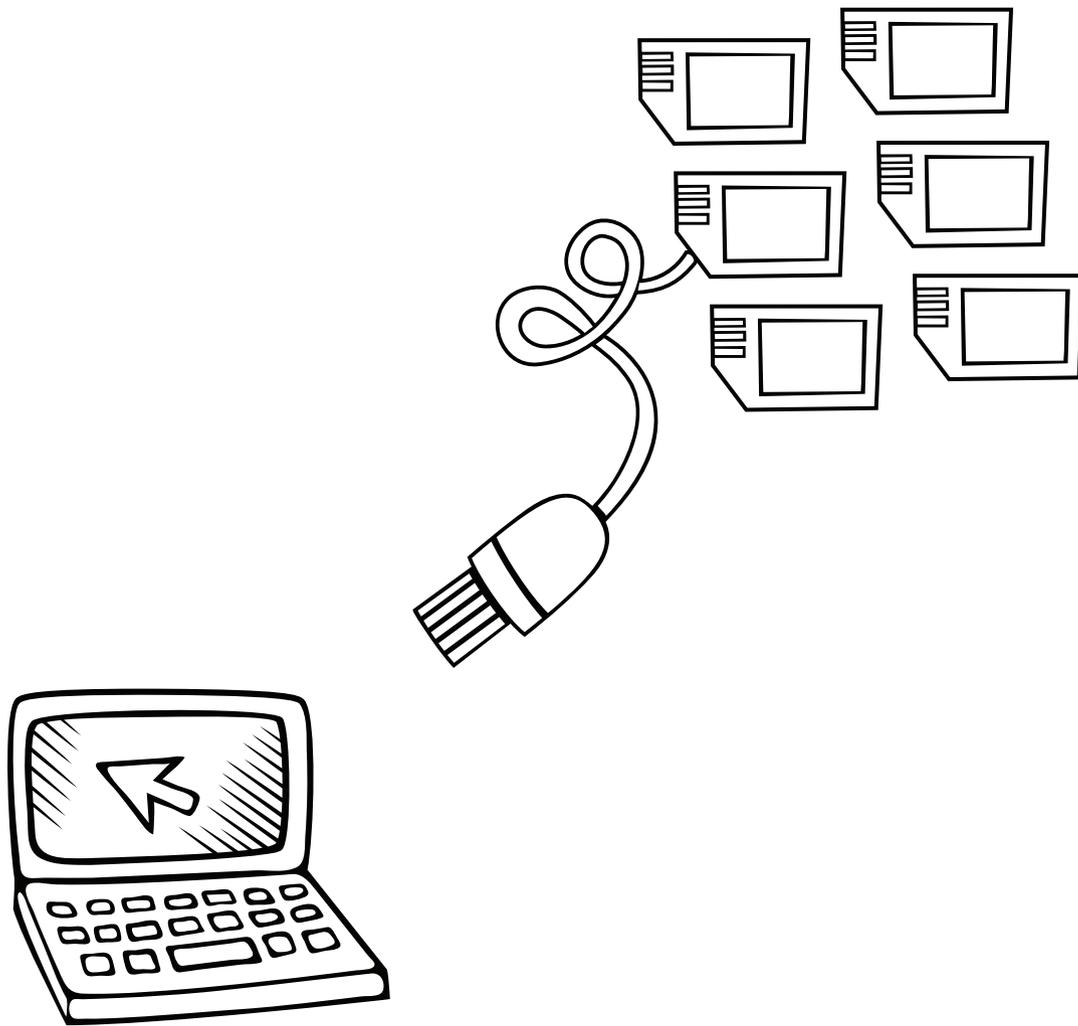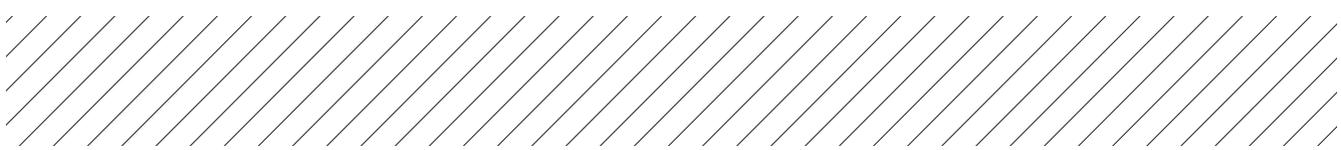
5. Health Concerns
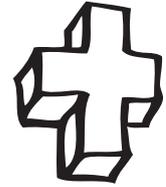
Digital applications do come with some health risks associated with them.

Withdrawal-like behaviors The compulsive use of digital technology can have a negative impact upon developmental, social, mental and physical well-being, especially on children. Digital learning applications should also avoid including 'gambling mechanics' in the design.

End of face-to-face socializing We don't solely learn by ourselves, for ourselves; we learn with and by others, and to integrate into the human community. The global digital community and its infinite diversity can do a lot for accessing to a global conscience and develop collaboration, critical thinking, empathy and mindfulness, but it doesn't have to replace face-to-face socializing.

a. Active Learning

A. Optimized Learning Sessions

The human brain can only focus its undivided attention for a limited amount of time. Exceeding these physiological limits weakens the learning outcomes.

Digital learning applications should mobilize the learner's undivided attention between twenty minutes to a maximum of one hour, depending on the learners' age group and the type of exercises required of him/her.
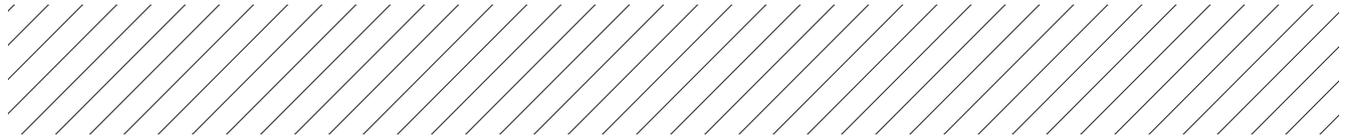
B. Limited-overall Screen Time

An interactive app, such as a video game, should track all the user's actions. It can, e.g. detect signs of fatigue (loss of attention, lapses in response time, etc.), and encourage the learner to quit. Modern digital technologies have the capacity to determine the frequency and length of engagement and should use this information to suggest breaks and maximum use times to learners.

Digital learning applications should adapt the length of digital interactivity to the age group of learners and the intensity of the attention effort required of the user.

C. In-app physical gathering mechanisms

As mentioned previously, digital learning applications should encourage real-world user interaction and collaboration. At the same time, capturing real world experiences could provide valuable insights into patterns that could in turn be employed for feedback and improved learning paths.

Digital Learning applications should integrate mechanisms to promote physical encounters with peers and/or mentors and help organize them.

Conclusion

The primary purpose of these Guidelines is to help the emerging Digital Learning community develop effective solutions that will be in-line with SDG 4, and the societal and economic needs of the 21st century.

These common foundations are envisioned to help teachers, parents and end users of Digital Learning solutions evaluate and compare the overall quality, relevance and learning outcomes of the multiple applications and services at their disposal so that they can make informed choices.

Finally, they could support for the implementation of consistent, transparent, and independent processes for the creation of Digital Learning solutions.

Authors and Reviewers
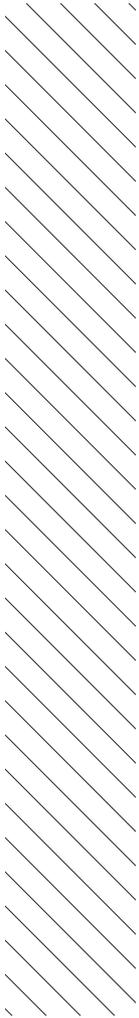
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