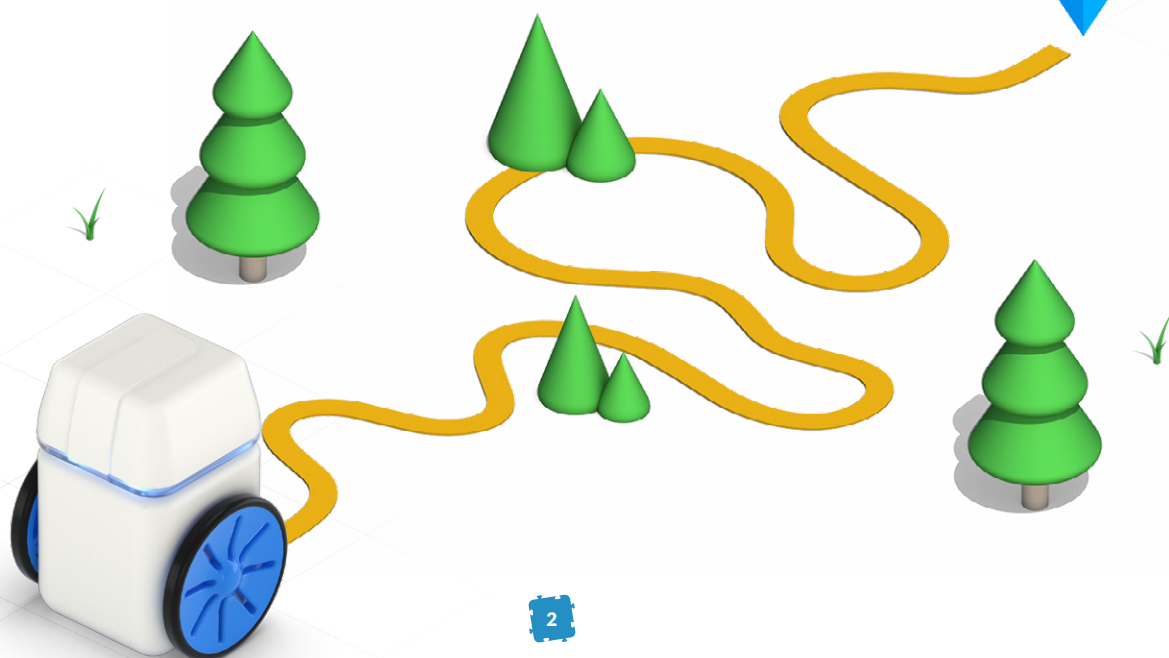




BLENDED LEARNING
SUSTAINABLE EDUCATION

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Heading into blended learning

At KUBO, we are proposing a new approach to learning how to code; one which has the potential to strengthen inclusion, increase learning outcomes, and secure individualized progression [1]. This approach is called *blended learning*.

Blended learning combines in-class education with online learning sessions. This approach is becoming increasingly popular, as it allows students to practice 21st century skills (creativity, collaboration, critical thinking, and communication) in the classroom while securing personalized and individual learning progression online. At KUBO, we do this by combining our physical KUBO robot in the classroom with our digital simulation, KUBO Play, at home or at school.

Technology is having an increasing impact on our daily lives and in society. In order to be an active citizen, future generations need socio-technological skills [2]. To ensure that all students become active and competent digital citizens, we must provide teaching tools which can accommodate different skill levels and capabilities. By using *blended learning* techniques, teachers can ensure that virtually no student is left behind due to lack of skill or lack of physical in-classroom participation, as each student can learn online at their own pace, space and time.

This has two important benefits; firstly, students can learn outside the classroom, and secondly, they have the opportunity to level with the other students, which enables better collaboration and inclusion in the classroom.

Blended learning is not limited to learning how to code and is proving to be a valuable approach to K-12 education. We want you to join the educational

expedition towards an understanding of how blended learning can help provide the best conditions and opportunities for learning.

Questions of what blended learning is and why we should implement it in teaching are answered by investigating the benefits that come with blended learning. We propose coding as a particular example of how blended learning can work in practice.

At KUBO, we think it is crucial that teaching takes place in safe environments that enable students to thrive, both individually and collectively. Students should have the means to catch up or dive deeper into subjects of interest in order to participate in learning with other students in a meaningful and collaborative way.

We strive to support children's well-being and improve their educational framework, and we believe that blended learning can support this goal.

This paper offers a look into some benefits of blended learning and approaches to teaching that we find sustainable. Long-lasting approaches to development, problem-solving, and well-being should be taught by engaging students in creative, communicative, and collaborative ways. Education in K-12 contexts should contribute to lifelong learning, and we believe that blended learning provides helpful resources that enable this to happen.



Democratizing education

While the future is uncertain, technology will play a vital role in preparing learners of all ages to meet the demands of the 21st century and the challenges of a competitive global society. Possible risks and uncertainties with negative outcomes stress the importance of being able to reflect critically. Critical thinking is an ability of great importance and will remain so in the future [3] [4] [5].

Although not all learners will work with technology development as engineers or computer scientists, most will be affected by technology one way or another. Therefore, it is paramount that we, as educators, create the right educational conditions to develop, support and ensure that young learners will acquire the necessary skills, knowledge, and values that enable children to navigate and thrive in times of pronounced technological influence [6].

Educational contexts should promote inclusiveness and improve ways students can express themselves in two-way communicative settings. Every student should be able

to receive proper feedback and target specific potentials in order to activate participation and learning outcomes.

Blended learning helps include students where they are, when they need it.

Besides accessibility and inclusiveness, blended learning approaches help students become interdependent, able to choose learning paths, and take responsibility for their own learning. On that basis, blended learning can be seen as a means of democratizing education and as a sustainable approach to contributing to globalized welfare.

Future risks and uncertainties must be taken into account when decisions are made, and education plays a major role in providing children with the necessary tools to help create sustainable solutions in a world that rapidly changes. Thus, blended learning, contemporary education, and sustainability should be tied closely together in K-12 education.

What is blended learning?

Blended learning consists of online and classroom lessons working together in a symbiotic way. It engages K-12 students, helping them acquire the necessary skills and knowledge to handle the demands of the 21st century. Yet, the question of meeting the demands of tomorrow is no longer if we use the technology we have, but how we use it [7].

How do teachers achieve the right 'blend' between online and classroom learning? Blended learning can more easily be operationalized if the term is differentiated from the extremely broad use of EdTech in schools, and if it remains wide enough to allow for variation.

The following three criteria [8] cover content for blended learning that can be used as a framework for supporting learning designs:

1. Formal education programs must include online learning with at least some element of student control of time, place, path, or pace.
2. Students must learn at least in part in a supervised brick-and-mortar location away from home.
3. The modalities along each student's learning path within a course or subject are connected, to provide an integrated learning experience.



As an educator, you are probably already familiar with blended learning - perhaps without even realizing. For example, when incorporating tablets, apps or instructional technology formats (e.g., videotape, CD-ROM, Web-based training, film) [9] into the classroom along with the lesson,

blended learning is implemented. The physical learning environment does not need to change, and students are typically easily engaged in the interactivity of a blended learning approach since they can move at their own pace [10].

Why blended learning?

Due to an increased student population and the need to reduce educational costs [9], the blending of online and face-to-face instruction is expected to be standard practice in many classrooms in the future [11]. At KUBO, we believe that appropriate components of online and classroom techniques can support and promote creative, critical, and complex thinking skills in meaningful and socializing ways that equip children with necessary educational skills.

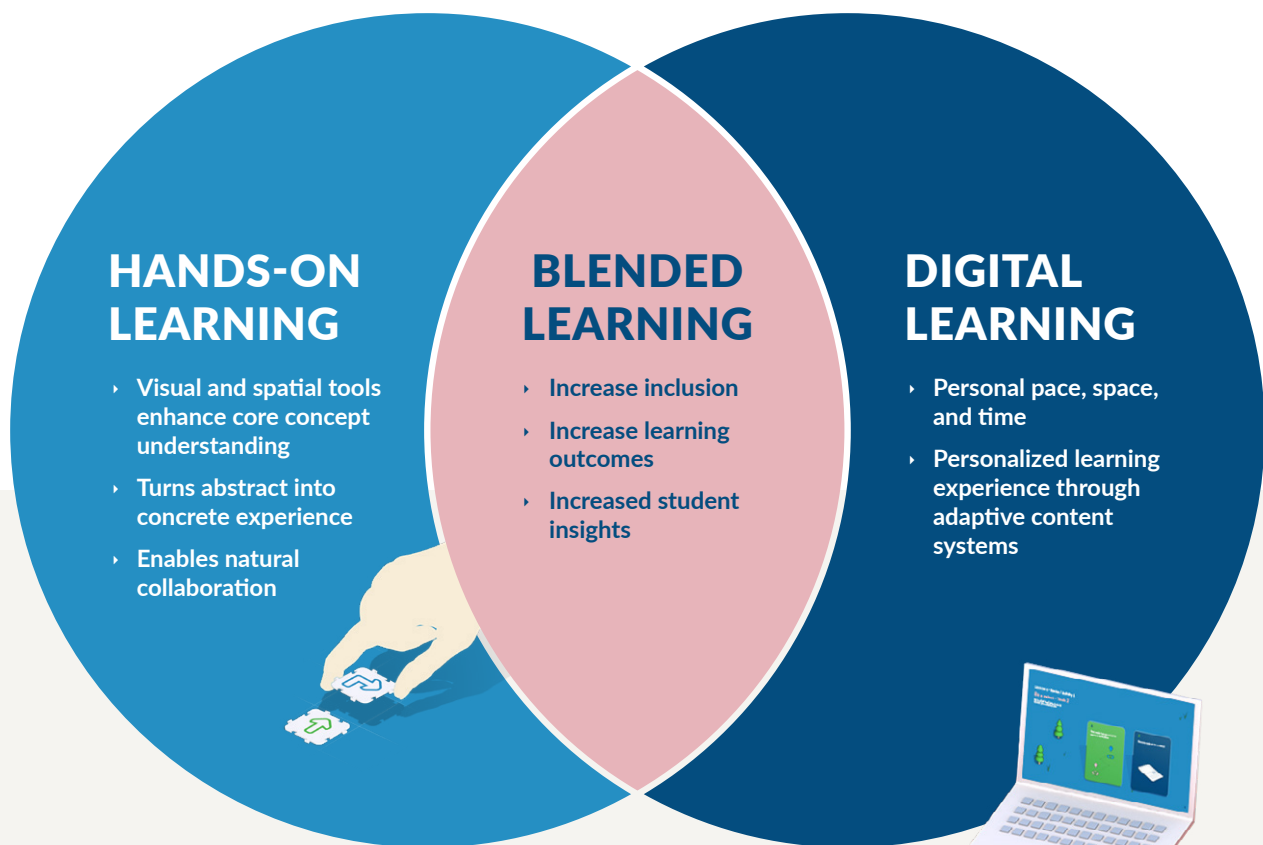
Creativity, critical thinking, collaboration, and communication - the 4Cs [11] - problem-solving, and coordination are regularly listed as some of the top 10 skills students need to survive a rapidly changing world [3] [4] [5].

It is essential then, to question how blended learning can help us support and develop creative, critical, and complex thinking skills in ways that socialize students and enable them to better collaborate and communicate.

With blended learning, technology should be implemented gradually. Learning activities should not blindly be substituted by technologies every time a new one is presented, but instead, they must be adapted to the proper teaching context [5]. This emphasizes an important point: blended learning always should be operationalized for meaningful impact.

This approach is valuable, as it takes advantage of personalization on the one hand, and socializing purposes on the other. The structure of blended learning enables fun and interactive learning of crucial skills that suit individual interests and needs.

Blended learning is likely to emerge as an essential teaching model of the future in K-12 education [11] [12]. In the next three chapters, we explore the benefits of creative, communicative, and personalized content in blended learning environments.



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Why coding matters?

Today's computer science curriculum provides students with a snapshot of what technology is already doing. For technology learning to be of real value, we must continually push the boundaries of what is possible within the classroom.

This is why coding matters.

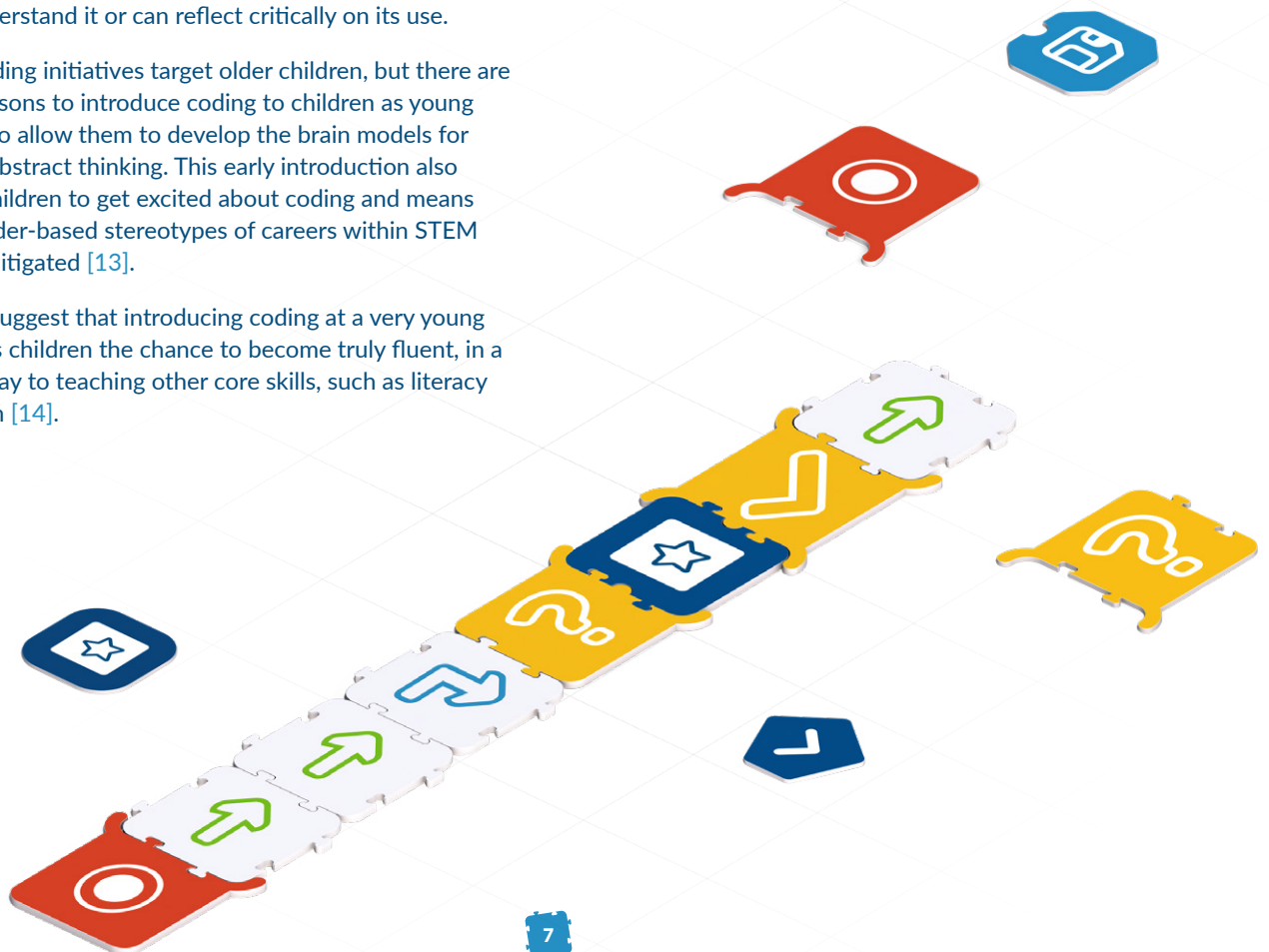
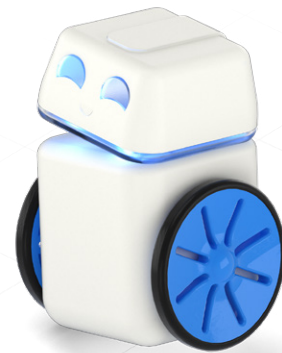
When the future is shaped by technology, those who are able to understand, use, and influence it will be granted much greater decision-making power.

By providing all children with technological knowledge and skills through formal education, control is shared and teaching to code becomes a democratizing act.

Children appear to master technology at a very young age, and they intuitively explore and use a wide variety of technology. But while being raised with computing might make children masters of consumption, it does not mean they understand it or can reflect critically on its use.

Most coding initiatives target older children, but there are good reasons to introduce coding to children as young as four, to allow them to develop the brain models for greater abstract thinking. This early introduction also allows children to get excited about coding and means that gender-based stereotypes of careers within STEM can be mitigated [13].

Studies suggest that introducing coding at a very young age gives children the chance to become truly fluent, in a similar way to teaching other core skills, such as literacy and math [14].





Engaging students through creativity

What benefits come with creativity? Creativity engages learners and builds confidence, which helps students take responsibility for their own learning [15]. It becomes easier to navigate critically through choices, dialogues, problem-solving, and communication.

Confident and responsible students are more apt to choose how to learn, find individual ways of solving problems, experiment by trial and error, discuss answerless questions, enter dialogues and interdisciplinary projects with real-world applications, and share projects with people outside the classroom [16]. These skills are all encouraged by creativity.

Approaches to blended learning in K-12 educational contexts offer different ways to implement and frame creativity. Using the blended learning approach, teachers can introduce online educational tools, apps, interactive learning activities, hands-on devices, and mixed media presentations that add variety and appeal to their lessons. The variety of instructional methods resists monotony,

boredom, and the risk of losing focus [17], and makes learning more fun and compelling [16].

For instance, by bringing online educational tools into play, students have increased agency and time for experimentation, which, in turn, boosts creativity. By learning and practicing skills online, more time can also be spent on group work and projects in the classroom accommodating 21st century skills.

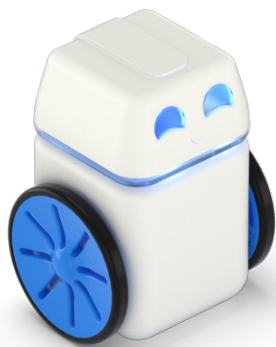
Utilizing the potential of coding and computational thinking in class and online helps students enter creative processes [18]. Teachers can create rich learning experiences by introducing or advancing coding and computational thinking skills.

Creativity should be pursued in K-12 education, and teachers can make learning easier and more appealing by blending components of classroom and online teaching into creative settings. Individual skills are put into play in socially stimulating ways.

From long to short feedback loops

Blended learning provides resources that suit teaching purposes and encourage student participation. Group work can be done remotely or in class. Teachers can perform real-time monitoring of an assignment execution process and provide additional consultation for the teams in order to avoid productivity loss [19] and stalled processes.

Measurable programs allow both formative and summative assessment mechanisms to evaluate student skills [12] with short feedback loops suited to the specific interests and needs of the student. This allows a transparent review of each student's abilities, with the possibility of involving parents to create positive feedback and the best learning conditions.





Adapting your teaching

By taking a blended learning approach, interests and needs can be personalized for the benefit of a better learning outcome. Teachers can transform the learning environment to maximize students' time for personalized learning and redistribute educational forces into more compelling and meaningful ones.

Students become acquainted with or expand their knowledge of topics with easy access to learning materials where and when it suits. By spending less time on one-way instructions, teachers can use an increasing amount of time to guide and support students interactively. Educational forces are improved towards a personalized and better learning outcome.

By achieving higher STEM scores in blended learning environments, the effects of traditional science instruction and blended learning respectively speak in favor of the latter [20]. Blended learning helps students learn at their own pace and express their opinions, it improves

the interaction between students and teachers, and it facilitates group discussions and collaborative learning [20] [21] [22] [23]. These benefits of blended learning enforce and develop language skills as well [24].

Blended learning offers convenience and flexibility for students and teachers. Students can independently explore the potential of blended learning beyond the limitations of knowledge found in conventional classrooms and during lectures [22], with the benefit of tailoring educational goals to suit relevant learning aspects of personal interests and needs. Where appropriate, students can learn at home in a safe learning space, which is crucial for learning outcomes [25].

Blended learning sets the stage for a shift in educational culture with a better use of time and teaching content towards dialogue-based group work and project-based collaboration, supporting students to feel safe and secure.

An operational approach to blended learning

One way to make blended learning work in practice is by introducing coding and computational thinking into the curriculum and everyday teaching.

Teachers can introduce digital educational tools in courses to teach coding and computational thinking skills. Beginning with haptic, practical, and experiential activities before gradually moving to plugged-in, more abstract and demanding ones, teachers can apply gamified tools to the youngest and oldest respectively in K-12 educational contexts, and blend classroom and online activities.

Contemporary online educational tools, in which coding and computational thinking have to be applied, have proven to represent an informal and interactional everyday context that creates convenience and initiative [26]. Evidence suggests that story-based, collaborative, and physical explorations of coding and computational thinking foster creative and social skills [18] [27].

Unplugged and screenless activities can help students code and solve problems strategically.[20] Playing with

a hands-on educational tool and manipulating objects in space sensory activities encourage participation and collaboration while learning experiences of basic coding concepts and computational thinking processes becomes embodied [28].

Plugged-in activities can be used as a novice-oriented introduction or to improve existing coding and computational thinking skills. Programming contexts can be employed and applied in STEM disciplines. For instance, students can devise effective sequences of commands by combining constants, variables and operators correctly [27].

Teachers can introduce coding and computational thinking in ways that blend physical hands-on learning in class with online additions. Important 21st century skills can be taught in creative, communicative, and collaborative settings by introducing coding and computational thinking into every curriculum.



KUBO's approach to blended learning

At KUBO, we believe that the best approach to learning new and abstract concepts, such as coding, is hands-on. Hands-on learning allows students to use visual and spatial manipulation to construct mental models of abstract concepts in a very concrete way. At a young age, this is an essential way of learning, as the more complex cognitive learning mechanisms – such as abstract thinking – are still developing [29].

By using hands-on learning tools, you also allow for easy communication and collaboration between students, as everyone can participate and pick up parts of the learning tool in order to focus on a specific subject.

By referencing the real world, it is often easier for students to remember a specific learning session, and teachers can thereby ensure “stickiness” of learning.

When using collaborative hands-on learning tools, teachers get the opportunity to spend more time

on facilitating and supporting students, rather than instruction. This improves engagement and enhances social and emotional learning in the classroom [30].

Collaborative learning tools also allow for peer-to-peer teaching (i.e. students teaching other students), which can both improve the understanding of the subject for the more skilled student (as the student explicitly gets an opportunity to express and communicate their understanding) and the less skilled student, who can build on their existing understanding with help from peers [31].

The zone in which a student can learn new skills through guidance and encouragement from peers or the teacher is often called the “zone of proximal development” [32].

When the gap between students' skill levels is too wide, there is a risk that some students end up outside the zone of proximal development, meaning that peer-to-peer teaching no longer is sufficient.

A student outside the zone of proximal development can be managed positively in many ways, but often will require extra resources from the teacher, meaning that fewer resources can be spent on the rest of the students.



By introducing a blended learning approach to the problem, students get the opportunity to not only experience great collaborative learning in the classroom, but also personal and individualized learning, ensuring that the student is in fact in the zone of proximal development [31]. This is what happens with our digital solution, KUBO Play.

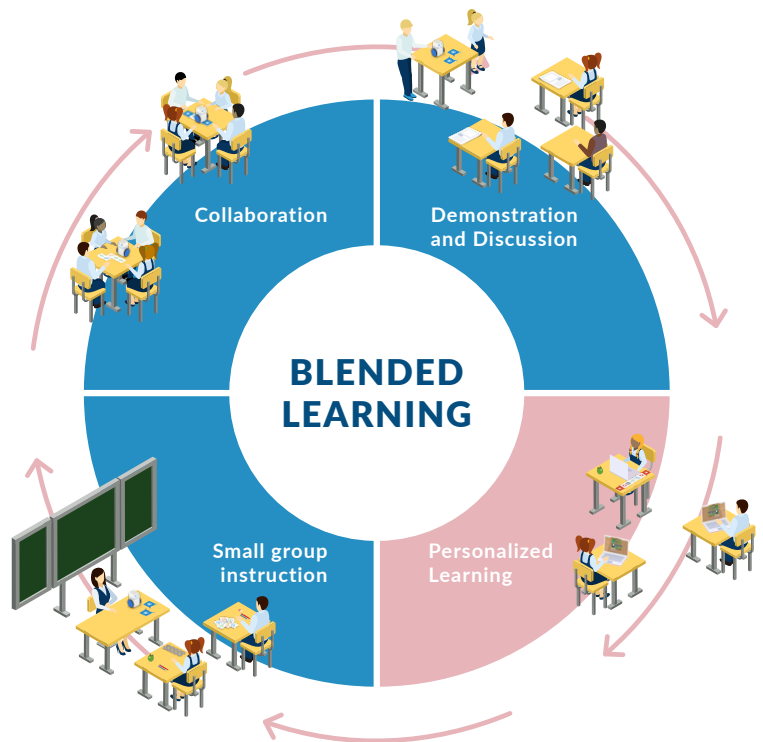
Using KUBO Play enables students to level with their peers or dive deeper into various coding subjects at their own pace, space, and time, which creates a safe environment. This means that teachers can spend even less time on instruction in the classroom and more time on group-based activities.

With KUBO Play, not only will students experience a personalized learning journey at their own pace – from any place and at any time but teachers will also get an understanding of the individual skill level of each student, as well as at a class level. This means teachers will get familiar with the computational curriculum and its terminology whilst having more information to adjust and prepare for the next lesson.

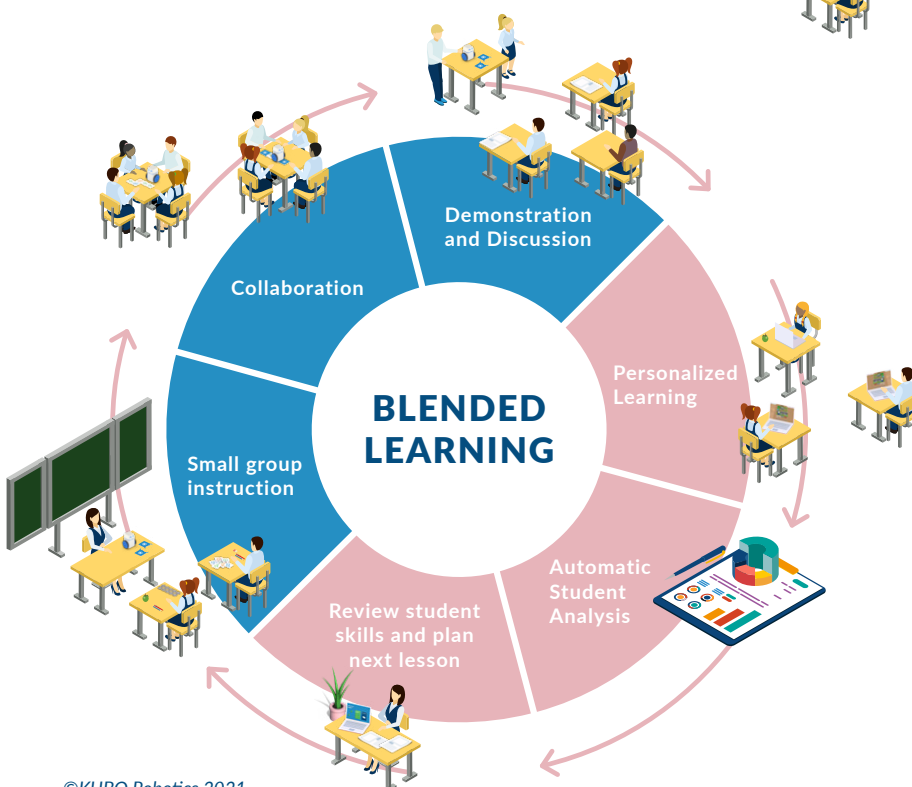
In practice, we suggest a blended learning approach where new concepts are introduced by the teacher through small group instruction. Thereafter, students practice the concepts collaboratively in groups. Upon completion of a collaborative activity, we suggest

that students demonstrate and discuss solutions through facilitation of the teacher. After a lesson, we suggest that students are encouraged to practice the new concepts individually through KUBO Play, either in school or at home.

As students use KUBO Play, teachers follow their progression and use this knowledge to prepare their next lessons.



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Towards the future we want

Our approach to blended learning is meant as a means to achieve a particular goal: to engage students and improve learning in K-12 educational contexts.

Teachers can blend online and in-class learning to help students enter a route of development in education that helps them meet the demands of tomorrow – both on an individual level and in terms of collaboration.

We think it is crucial that children learn in environments that support ways to feel safe and secure in order to acquire and use their creative, critical thinking, collaboration, communication, and problem-solving skills.

With blended learning, students can learn at their own pace, place and space, experimenting and gaining confidence.

Using blended learning, teachers can gradually implement technology in teaching to engage students in experimentation, dialogues, and group work in projects that have applications outside school. Besides, it will empower students to move at their own pace without being disincenitized by their efforts when facing new challenges. Real-world contexts that suit personal

interests and needs can be integrated into lessons.

Creativity, communication, and personalization serve as three main topics from which we suggest a range of benefits can be achieved in playful, meaningful, and socializing ways. Digital educational tools in which coding and computational thinking have to be applied in combination with in-classroom teaching work as an example of how blended learning works in practice.

As we have seen, blended learning approaches offer engaging and effective ways to help students acquire necessary skills and knowledge in K-12 educational contexts to handle what the future will demand of them.

We, at KUBO, believe that sustainable approaches to education improve learning by supporting and promoting the well-being of students, teachers, and parents, along with meaningful and effective learning outcomes.

With KUBO, there is an opportunity to follow a blended learning approach, paving an educational path towards a future where all children can thrive by making coding easy and fun. Even the most technology-shy, will enhance creativity, collaboration, critical thinking, and communication skills. Hence, all students will be prepared for the future.

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