KOKOA EDUCATION STANDARD - FINLAND

mBot & mBot Ranger

mBot is an Entry-level educational robot kit to learn the basics of robotics and programming. mBot Ranger offers more advanced features and new possibilities.

mBot and mBot Ranger work together with MakeBlock and mBlock apps and mBlock 3 desktop programming app.

The Kokoa Standard Evaluation
The Process

Access

Our experts in UX and pedagogy are provided with full access of the product and its relevant materials, such as lesson plans or teacher's guide.

Kokoa Evaluation Software

While our experts use the product, they analyse its pedagogical approach and usability with KOKOA evaluation software.

Outcome

The evaluation report is presented to the client during a video call. If the product meets the standards, it will be granted the Kokoa Standard certificate.

CERTIFIED
EDUCATIONAL QUALITY
KOKOA STANDARD
2017

All Kokoa certified products can be found from **www.kokoa.io**

Results

mBot
High Educational Quality Aspects

1. Makeblock provides a meaningful way to practice construction and programming with a modifiable robot.

2. The robot can be instructed in multiple different ways and it comes with a few different application. There is right difficulty level whether you are a beginner or more advanced with programming.

3. Makeblock robots come up with a large variety of different educational materials, e.g. lesson plans and project works.

4. MBot and mBot Ranger are versatile and robust robots, which can be used for having fun or creating ambitious creations.

KOKOA EDUCATION STANDARD - FINLAND

Pedagogical Approach **98 %**

Learning Engagement **3.8**

CERTIFIED

EDUCATIONAL QUALITY

mBot

KOKOA EDUCATION STANDARD - FINLAND

2018

According to Kokoa Standard evaluation, mBot represents high educational quality and is proven to promote learning efficiently.

Learning Goals

Matching the learning goals

The evaluator maps the product's learning goals against a specific curriculum/curriculums.

All supported skills are listed and classified as *didactic (A-level)* or *facilitative (B-level)* goals.

The Kokoa Tool has several hundred skills listed from various national curriculums on several subjects (Languages, STEM, Arts etc.)
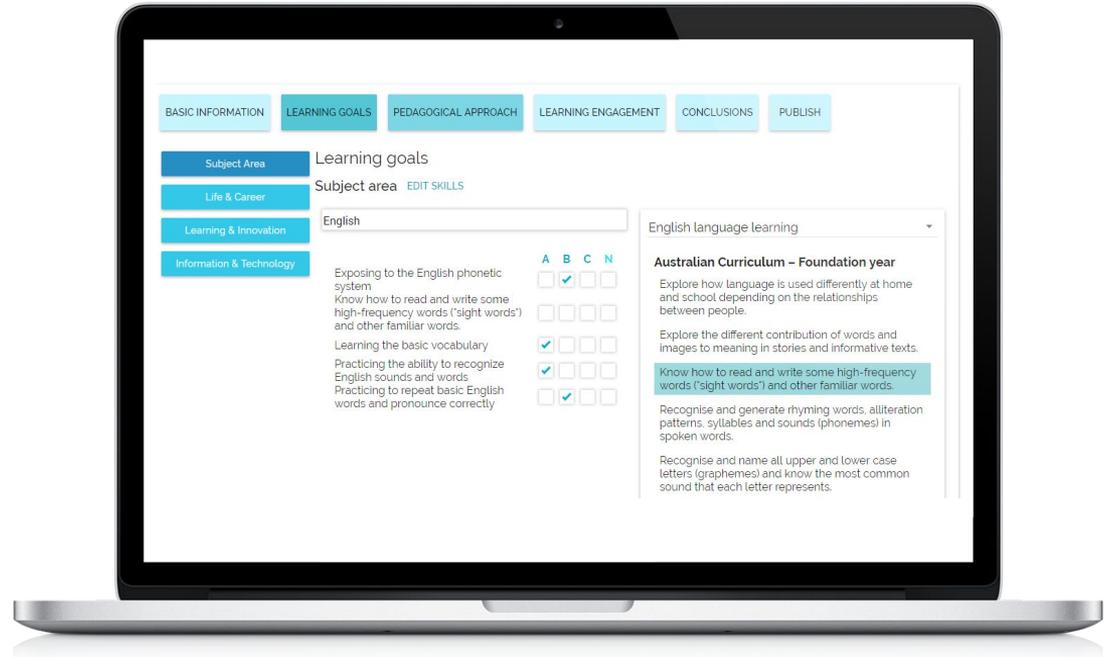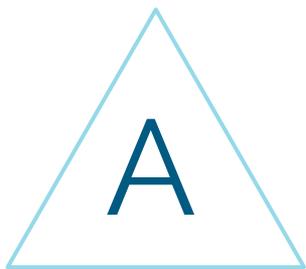
A

Primary Goals

Content is instructional and didactic: Learning of these skills is constantly present in the core usage and supported through didactic method.
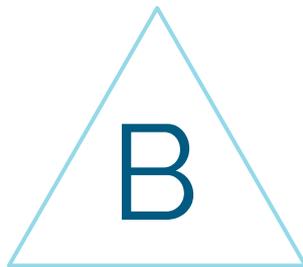
B

Secondary Goals

Content is partly instructional, partly facilitative: Learning of these skills is present in the core usage, but not essentially and constantly stressed.

N

Non-Existing

Content does not exist: Learning these skills would be a meaningful part of the use of the solution, but they are missing.

Subject Area

Programming

Computing & Technology

Programming

1. Understand simple Boolean logic [for example, AND, OR and NOT] and some of its uses in circuits and programming; understand how numbers can be represented in binary, and be able to carry out simple operations on binary numbers. **A**

2. Use sequence, selection, and repetition in programs; work with variables and various forms of input and output. **A**

3. Design, write and debug programs that accomplish specific goals, including controlling or simulating physical systems; solve problems by decomposing them into smaller parts. **A**

4. Use logical reasoning to predict the behaviour of simple programs. **A**

5. Understand what algorithms are, how they are implemented as programs on digital devices, and that programs execute by following precise and unambiguous instructions. **A**

Strengths
mBot provides a comprehensive materials for learning the basic skills of programming. Robots can be modifyid so it brings endless possibilities for building.

A = Primary goal: content is didactic

B = Secondary goal: content is facilitative

Compared against: UK National Curriculum Programming - Key Stages 1-3

6. Create and debug simple programs. A

7. Understand the hardware and software components that make up computer systems, and how they communicate with one another and with other systems. A

8. Use logical reasoning to explain how some simple algorithms work and to detect and correct errors in algorithms and programs. A

A = Primary goal: content is didactic   B = Secondary goal: content is facilitative   **Compared against**: UK National Curriculum Programming - Key Stages 1-3

Subject area - Primary skills

Computing & Technology

1. Select from and use a wider range of tools and equipment to perform practical tasks accurately ... **A**

2. Apply computing and use electronics to embed intelligence in products that respond to inputs, and control outputs, using programmable components .... **A**

3. Understand and use mechanical systems in their products .... **A**

4. Understand and use electrical systems in their products .... **A**

A = Primary goal: content is didactic   **B** = Secondary goal: content is facilitative   **Compared against**: UK National Curriculum Technology & Computing - Key Stages 2 -3

Life & Career

Wellbeing and Sustainable Development / Cross-Disciplinary Thinking / Cross Cultural Skills and Global Awareness / Social Skills / Work life skills and Entrepreneurship /

Life & Career skills

Work life skills and Entrepreneurship

1. Practicing versatile ways of working .... **A**

2. Learning to plan and organize work processes .... **A**

3. Connecting subjects learned at school to skills needed at worklife .... **A**

4. Encouraging positive attitude towards work life .... **A**

Cross-Disciplinary Thinking

1. Learning to build information on top of previously learned .... **A**

2. Practicing to notice causal connections .... **A**

Strengths
Cross-disciplinary thinking skills are one of the most primary ones as learners need to use previous knowledge and combine information when building and programming the robots.

A = Primary goal: content is _didactic_   **B** = Secondary goal: content is _facilitative_

Learning & Innovation

Cognitive and thinking skills / Learning to Learn /
Creativity and Innovation / Critical Thinking & Problem Solving /

Learning & Innovation

Critical Thinking & Problem Solving

1. Practicing strategic thinking .... **A**

2. Developing problem solving skills .... **A**

3. Practicing to plan and execute studies, make observations and measurements .... **B**

4. Practicing to create questions and make justifiable arguments based on observations ...... **B**

Creativity and Innovation

1. Encouraging students to be innovative and express new ideas .... **A**

2. Practicing creative thinking .... **A**

Strengths
As robots can be build up in multiple ways, students can be creative around them.

Development areas
Students could be encourages to evaluate one's own learning progress through the applications.

A = Primary goal: content is didactic   **B** = Secondary goal: content is facilitative

Learning & Innovation

Learning to Learn

1. Practicing to evaluate one's own learning . . . . **B**

2. Practicing to find ways of working that are best for oneself . . . . **B**

3. Practicing to set one's own learning goals . . . . **B**

4. Practicing persistent working . . . . **B**

A = Primary goal: content is <u>didactic</u>   **B** = Secondary goal: content is <u>facilitative</u>

Information & Technology

Multimodal Literacy / Media and Information Literacy / ICT Literacy /

ICT Literacy - Primary skills

ICT Literacy

1. Practicing logical reasoning, algorithms and programming through making .... **A**

2. Understanding technological system operations through making .... **A**

3. Using technology resources for problem solving .... **A**

4. Using technology as a part of explorative process .... **A**

5. Building common knowledge of technological solutions and their meaning in everyday life .... **A**

Strengths
As the robot is build around ICT and programming, ICT skills is a core learning area.

A = Primary goal: content is didactic

B = Secondary goal: content is facilitative

Pedagogical Approach

Assessing the pedagogy

The evaluator answers a set of statements to assess the product's pedagogical approach.

The answers to the questions result to a numeric score on each parameter. The parameters are shown as contrary pair sliders.

The assessment is divided into four parameters:

1. Passive – Active

2. Rehearse – Construct

3. Linear – Non-linear

4. Individual – Collaborative

The set of questions and definitions, have been developed by researchers from the Helsinki University.

Criterion definition

Passive / **Active**

Passive: Learner in an observant role

Active: Learning by doing

Individual / **Collaborative**

Individual: Learner is learning by her- or himself

Collaborative: Requires collaboration with other learners

Linear / **Non-linear**

Linear: Proceeding linearly through repetitive tasks

Non-linear: Supports free exploration and finding solutions in variable ways.

Rehearse / **Construct**

Rehearse: Practicing earlierly learned

Construct: Learning and constructing new concepts

The Rating Scale

-80

Fair

There are crucial issues with the pedagogical approach. Improvements are necessary in order to achieve high educational quality.

80+

Good

The pedagogical approach is valid. However, many improvements could be made in order to improve this aspect of learning experience.
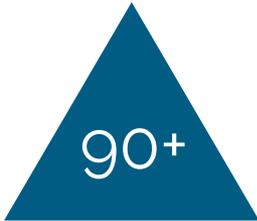
90+

Excellent

The pedagogical approach is innovative and meaningful. Some improvements could be made in order to improve this aspect of learning experience.
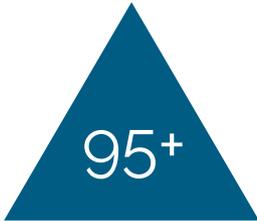
95+

Outstanding

Product is exceptionally innovative and provides high educational value. The content is delivered in an extremely meaningful and engaging way.

Passive - Active: 96/100 = Outstanding

Passive   96   Active

Strengths: Makeblock robots require active engagement to progress and user actions to extract information. After building the robot, users have multiple ways to learn to code and to solve problems with the robot. The product provides positive feedback to users and encourages them to engage in different kinds of activities.
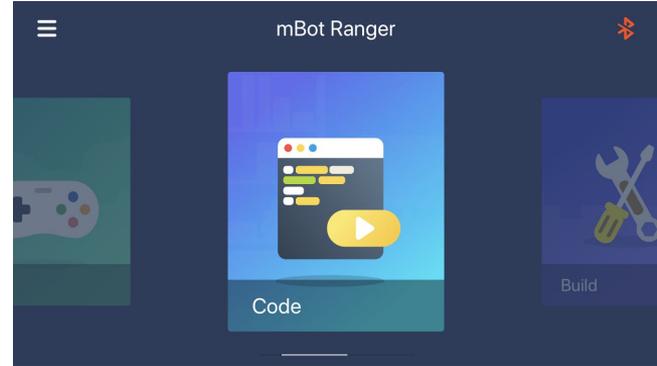
Development areas: Some of the activities don't have a meaningful goal. Would it be possible to guide the users to by giving examples of how to use it? For example, with the Avoid Obstacles there could be a tip to build an obstacle course to the robot, or with the Line Follow to draw own routes for the robot. Example on the right.
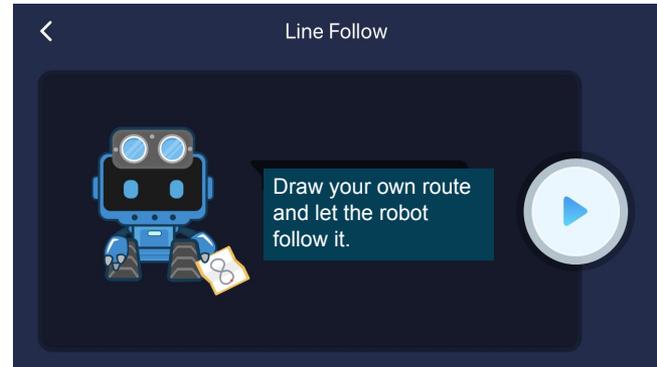
Rehearse ————————————99———————————— Construct

Strengths: The product provides the basic information about electronics and coding but after the beginning users are free to use the learned information however they want. With the extensions, it is possible to build nearly endlessly different kinds of robots.

Development areas: Would it be possible to provide users a possibility to evaluate own learning experience? Especially in the school context, it would be valuable if students could somehow reflect what they've learned and what they would like to learn next.
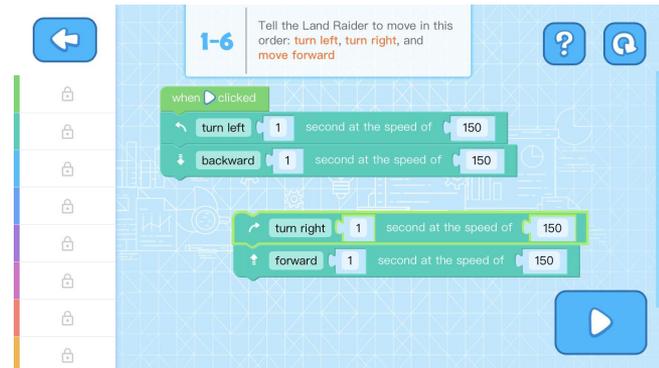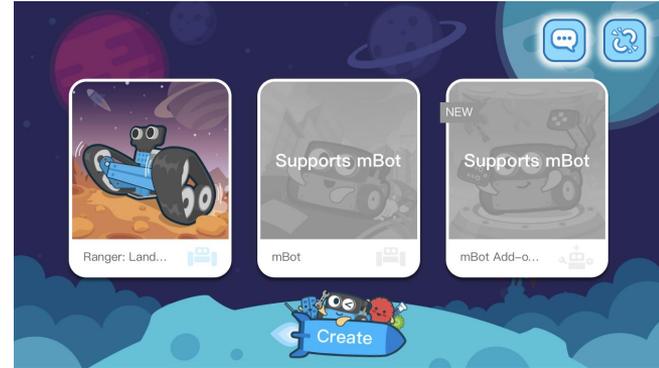
Linear - Non-linear: 100/100 = Outstanding

Linear ──────────────────── 100 ──────── Non-linear

Strengths: Building the robot -phase is well instructed and it is possible to start the usage with a linear game where the user can learn the basic concepts and command of coding. After that, the product provides an unlimited learning process and endless possibilities to program the robot.

Development areas: Would it be possible to instruct some of the play -features so they would be more goal oriented? If there would be at first a few linear steps that could make it easier for the user to come up with their own ways of using the features.
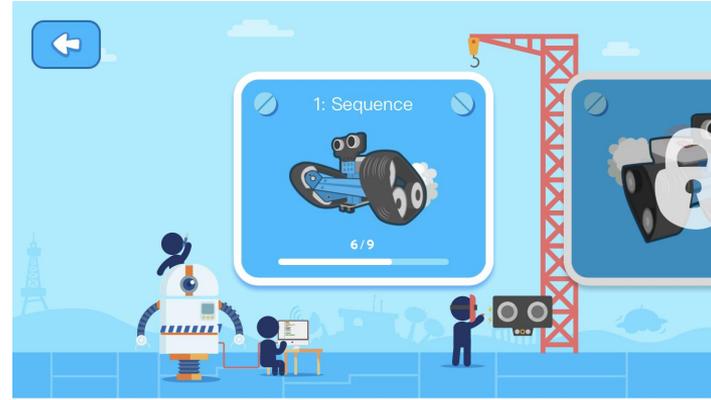
Individual ———————— 97 ———————— Collaborative

Strengths: Makeblock allows the learner to make all the decisions individually, but provides some materials with collaborative activities that can be carried out for example in a classroom context. As the robots provide open-ended learning possibilities it is possible to work either independently or compete and collaborate with other users.

Development areas: Additional education materials could provide support for student's constructive collaboration. In a classroom context, it is probably more likely that group of students use one robot together. At the moment there was only one collaborative task at the education platform. Also, there could be tips for students on how to make sure that everyone can participate and work with the robot equally.

Infrared communication
By:Yisong Xu, Si Xu
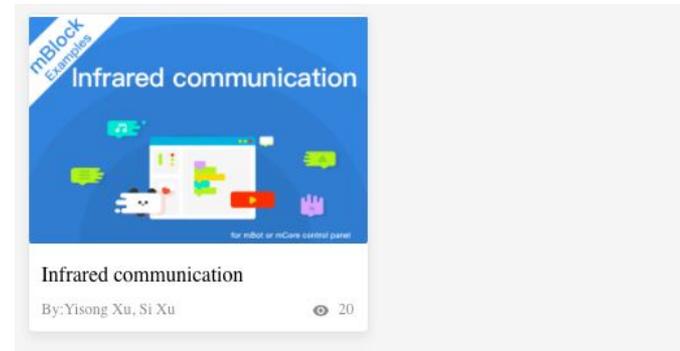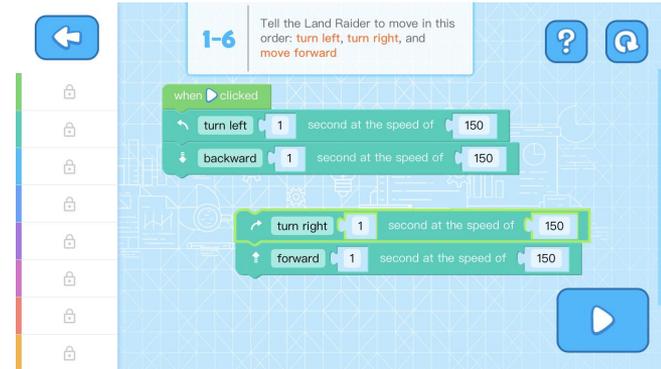
Learning Goals

- Subject Area: **12 Skills**

- Life & Career: **4 Skills**

- Learning & Innovation: **4 skills**

- ICT Literacy: **5 skills**

Pedagogical Approach

Approach	Percentage
Passive-Active	96 %
Rehearse-Construct	99 %
Linear-Non-linear	100 %
Individual-Collaborative	97 %

Axis: 10 20 30 40 50 60 70 80 90 100 %
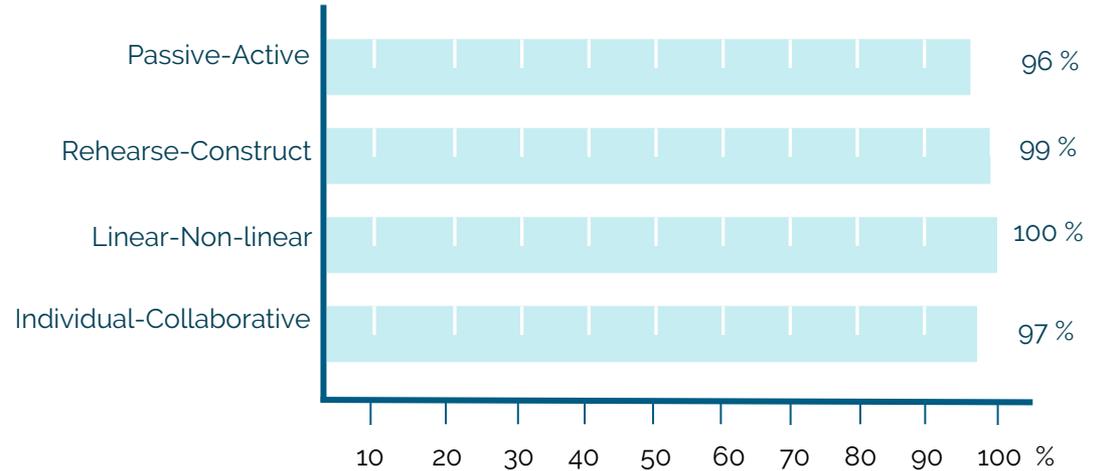
Learning Engagement

Overview

	Autonomy	5	Competence	3	Relatedness	4	Respect	3	Stimulation	5	Safety	3
Strengths	The robots are very versatile and offer plenty of chances for customizing, personalizing and creation.		The assembly instructions are great and the robots are designed in a way that it is easy to fix errors in the assembly.		MakeBlock robots feel like small lively creatures and personal companions. Apps have clear and friendly look and feel.		The robots responded to the commands made with the app well, and feedbacks were clear and encouraging		The Makeblock robots are very versatile and scale from simple and fun play to very goal oriented creation		The robots are robust and won't break easily. The kits include some spare parts.	
Development areas			The tutorials and example projects should be more easily available on MakeBlock website.		It would be nice, if some videos of projects other learners have done would be available more easily.		The apps had some issues, which made them frustrating to use				The mBlock 3 desktop app caused some security alerts for Windows 10 and Mac.	

The user's actions in the product are based on their own decisions rather than feeling there is external pressure to choose a certain action.

Makeblock is a maker of robotics kits. There are several different kinds of small robots, and Makeblock also offer additional parts which can be purchased to create new kinds of designs. Makeblock also has apps which can be used with the robots.

The set which was evaluated included: Mbot robot and Mbot extra parts kit, and Mbot Ranger kit. Mbot was programmed with mBlock app, and both Mbot and Mbot Ranger were controlled with Makeblock app. Also mBlock 3 Scratch editor was tested with Mbot.

The slogan for Makeblock is "one robot per child", and indeed Makeblock robots feel very personal. The robots are very versatile and offer plenty of chances for customizing, personalizing and creation, so they are best used individually, or potentially on pairs of students.

The apps offer both light entertainment and fun (driving, playing music etc), and changes for complex creation and learning. All in all, mBot robots let the learner do anything they can think about, and the extension packs give even more ideas and possibilities.

Feeling that you are very capable and effective in your actions rather than feeling incompetent or ineffective

The MakeBlock robots teach a variety of skills. The first challenge is assembling the robots, which requires following instructions and recognizing and using the robot parts and various tools. The construction manuals which come with the box are very clear and easy to read, and they require very little reading - the robots are possible to assemble by looking at the images. The structure of the tested robots was also very good for learning - if some part was set up wrong, it was often quite easy to fix without disassembling several parts.
MakeBlock app also offers the building instructions in interactive form. The small animations and help to understand the process well. However, the interactive manuals had some confusing and misleading parts, since the manual didn't always match the parts which came in the box (see the next slides for examples)

The apps offer both light entertainment and fun (driving, playing music etc), and changes for complex creation.
The mBlock app offers a set of programming problems, which teach the how to program with Scratch. The problems are fun to do and work well with the bot. The "Create" part allows free programming,
 mBot has some features, which are bt

The main drawback in MakeBlock product family is that it is hard to find out, which programs, apps and robot kits work together, and what should be used. The Makeblock website has lot of content, and some of it is organized in a way that is hard to find. For example, the Education section has all the tutorials and instruction under "Resources". The resource videos are great, but it would be good if at least some of the "Getting started" videos would be prompted better, so the users would find them without filtering. Especially the mBlock 3 desktop app could have the tutorials available more easily. (For example, link them directly here: http://www.makeblock.com/software/mblock3/) where it says: "Rich instruction materials".)

For the evaluation, the mBot Ranger was assembled with the paper manual.

MBot was assembled with the interactive manual in Makeblock app. The interactive manual didn't notify about assembling the Bluetooth chip to the core, so when the robot was ready, it didn't connect to the apps, because the chip was left out. It took some time to figure out, what was wrong, since the small chip was easy to ignore.

In the product there is meaningful contact with people who care about your actions rather than feeling that the contact is one-sided or meaningless. The user can feel connection with fictional characters and events in the product.

Makeblock robots and apps have nice and friendly look and feel. The apps have small robot characters, which add to the feeling of mBot and mBot Ranger as your personal robots. The robots themselves are quite mechanical - there's no covers or other decoration - but that doesn't make them unfriendly. They are of nice blue color and they feel like small lively creatures - they even seem to have eyes. The whole design makes mBots feel personal and relatable. The mBlock 3 desktop app for programming is visually different from the apps. It is more technical and adult. This is not a problem, and it is good that more complex products look more functional.

The mBot product series doesn't support sharing your creations with other students digitally. However, if used in class, it is easy to organize group work, contests or presentations around the robots. The mBlock app included tasks and a link to coding contest, which encouraged the students to share their creations on mBlock facebook page. This kind of light social features give some feeling of community.

Note: There is a community page http://openlab.makeblock.com/ However, it is not easy to find. It would be nice, if some videos of projects other learners have done would be available directly from the apps. The apps could have also some embedded videos or then at least the direct link to the Openlab community page.

Feeling that the product takes the user into account as a capable and desired actor rather than feeling that the user's opinions and experiences are neglected.

There are several factors which add to the respect for the user: The clarity of all materials, the feedback the user gets from their actions, general reliability of the apps and accessibility in all materials.

As for accessibility, assembling Makeblock robots requires some motoric skills. There are plenty of small parts and they need to be set precisely. The robots are designed in a way that the assembly is as easy as possible, and the instructions are clear and follow a good logic. All buttons and ports are easy to reach, except the mBot Ranger power switch button, which was bit deep in the core and required pressing with a tool.

The Makeblock apps had some issues, which made them frustrating to use (see the next slides for examples). However, these appeared in rarer use cases and didn't block the use. All in all, the robots responded to the commands made with the app well, and feedbacks the apps and robots gave were clear and encouraging.

The main issue with the robots was, that some of the features didn't work as expected. Line following and obstacle avoiding had issues with mBot Ranger, but the issues vanished when the Makeblock app was reinstalled and the robot was reset. With mBot, the user needed to set the robot to a different mode to access these features. This happened with a remote control which came with the box. The remote control felt unnecessary, and it would have been much nicer to be able to set the modes from the apps, but this wasn't possible.

Note: It was noted on the call, that the mode for mBot can be changed with a button in the robot. This should be noted on the manual.
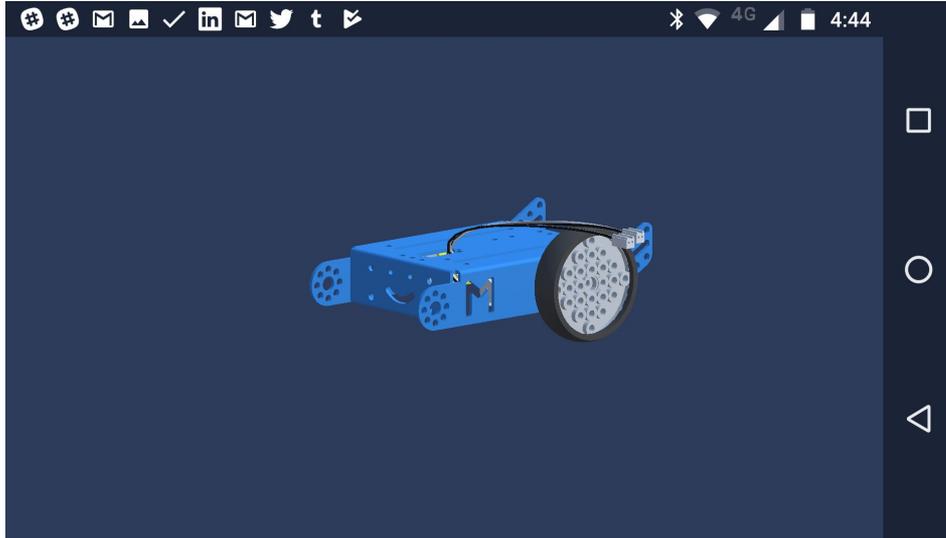
MBot was assembled with the interactive manual in MakeBlock app.

If the phone went to sleep during the assembly, after unlocking the screen all controls on the manual had disappeared. The app had do be killed and launched again to go back to the assembly manual. This was frustrating.

The app was used with Android 7.0
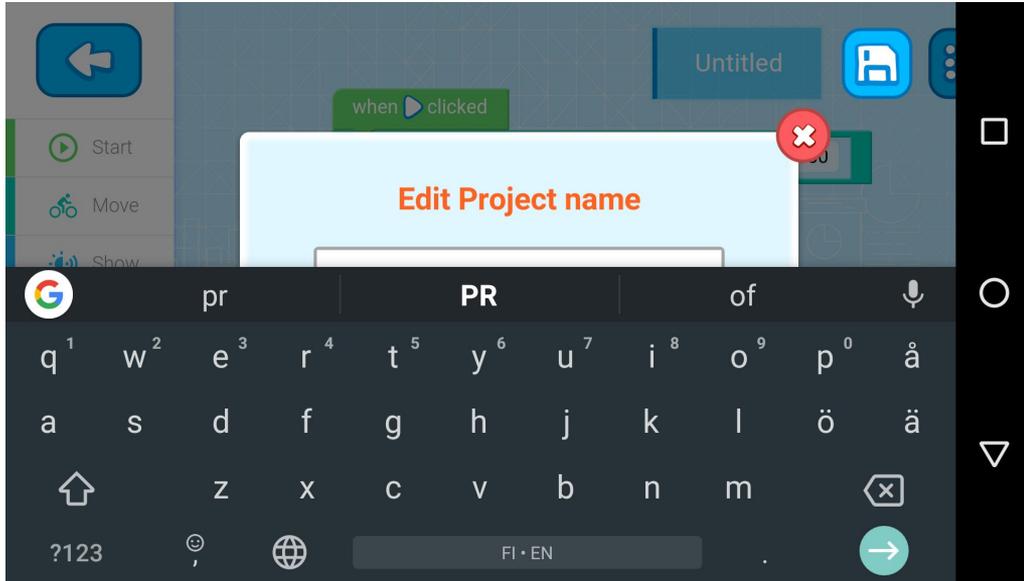
In mBot Create mode, the Project name is hard to set, since the keyboard goes over the text field.

Stimulation

Feeling that you get plenty of enjoyment and pleasure rather than feeling bored and understimulated by the product.

The Makeblock robots are very versatile and scale from simple and fun play to very goal oriented creation. For enthusiastic user the robots and related materials offer plenty to do. The apps are visually friendly and clear, and the small robot characters are a nice touch.
The mBlock 3 desktop app is visually more functional, but clear in layout and quite pleasant to use.

Feeling that the product is a safe environment for having fun and trying out things rather than feeling uncertain of the consequences or threatened by other users.

The Robots come with a well made box, which is easy to open. All parts are packed well, and there are some extra screws and nuts, so even if the user loses some during the assembly, there are parts available. The robots themselves are very robust and parts which might break are covered. The boxes also come with some spare parts.

There are no social features and no account creation required in the apps, so the usage is safe and doesn't compromise the user's privacy.

The only issue was when downloading the mBlock 3 desktop app for Windows 10 and Mac. Mac refused to download the program, and on Windows some features were blocked by firewall and the user needs to allow access to them. If the error is due the fact that mBot 3 uses Bluetooth and communicating over local network, then this should be communicated clearly on the MakeBlock website before the user downloads the program, and possibly also tell how the access can be allowed. Not all teacher have the technical capabilities to understand, what is needed, and even if they do, giving the instructions before download will reassure them that the programs are safe to use.
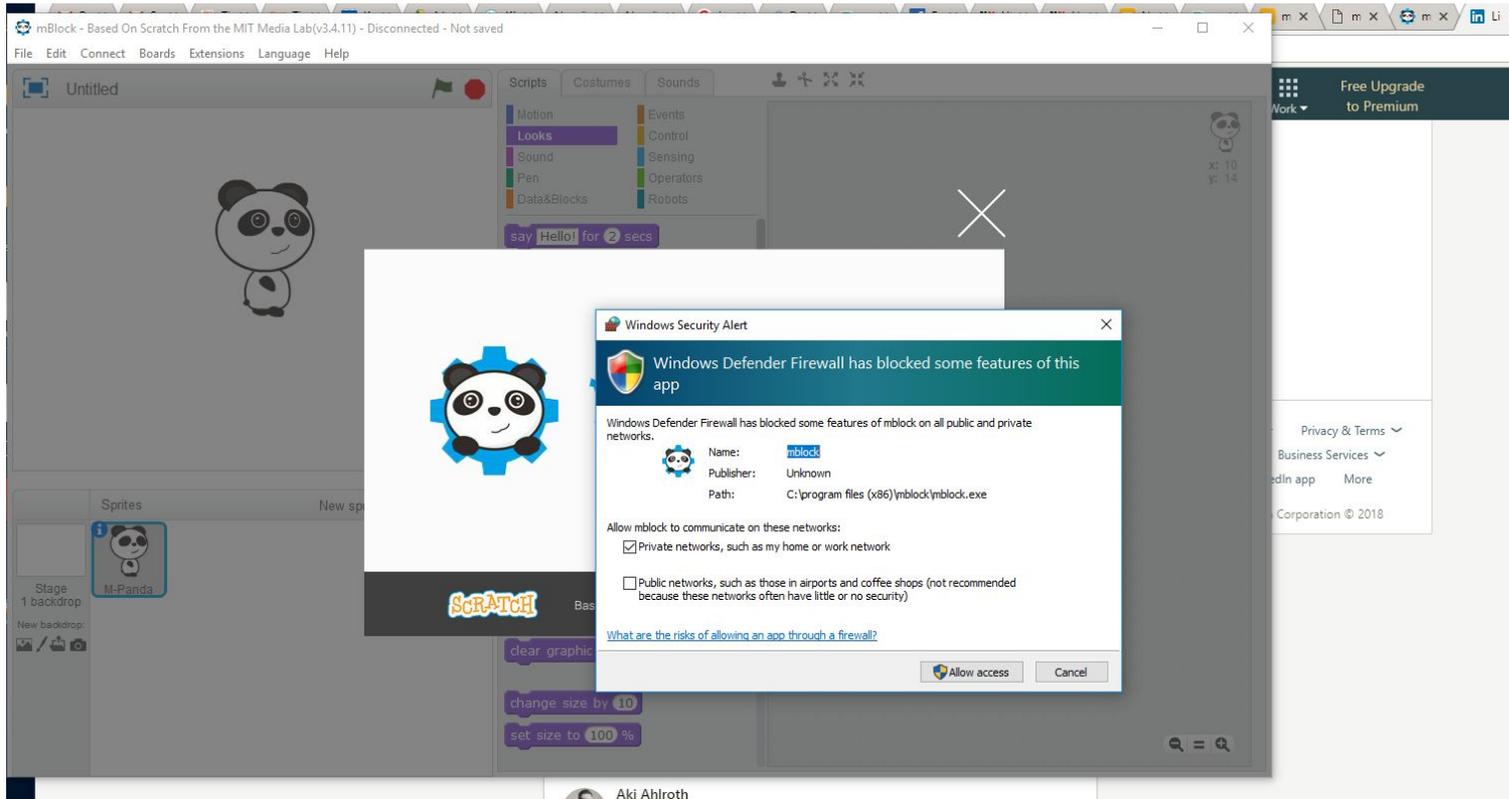
The Windows firewall gave the notification that it blocked some features in mBlock 3. Some users might have doubts, if the program is safe and working properly, if they don't know, why they got the notification.

Background

*Expert Evaluation of **what** the solution teaches and **how** it teaches?*

Standard

The standard for analysis is built around 21st century skills, Finnish pedagogy, and existing research related to the product.
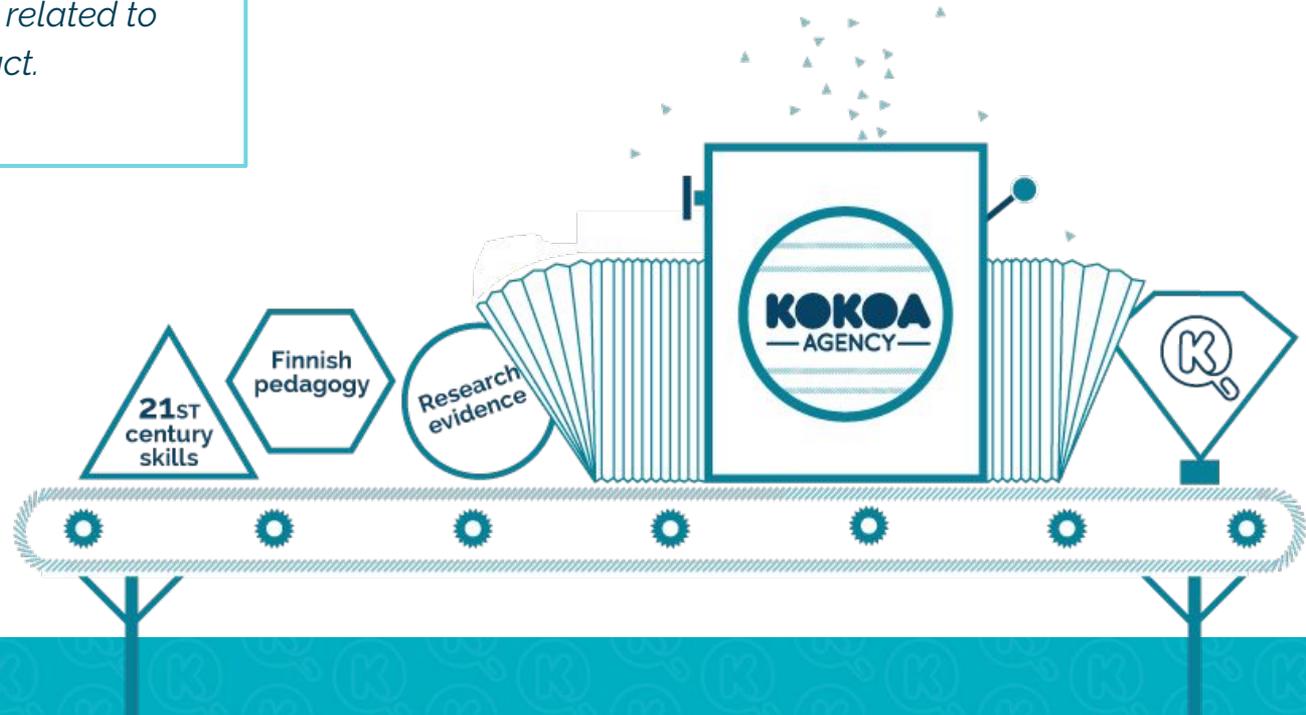
Expert Evaluation and Rating

The analysis of how the product supports learning of different skills is done by using a contrary pair criterion. The evaluator uses contrary pairs to diagnose skills — specifically the pedagogical approach which the product represents. The diagnosis is done by using a slider between contrary pairs, setting the slider in a position that describes the product's approach. Evaluator uses the same slider to describe the best possible approach and gives a rating (0-100) on how adequate of an approach the product has.

All diagnoses and ratings are done by two expert-evaluators separately. After all skills are diagnosed through the criterion, evaluators discuss and form a concluding diagnosis of two separate evaluations.

The rating points out the strengths and development areas, mirroring them with the needs of the education field and product development possibilities. After pointing out the development areas, the analysis gathers suggestions on how to improve the product.

Outcomes

🔍 Defining **what** and **how** the product teaches

🔍 Analysis of features which **engage** the learners

🔍 Pointing out the strengths and development areas

🔍 Giving validation for building the marketing message

Pedagogical Approach

Subject area

Life & Career

Learning & innovation

Information & technology

Learning Engagement

Autonomy

Safety

Competence

Stimulation

Relatedness

Respect
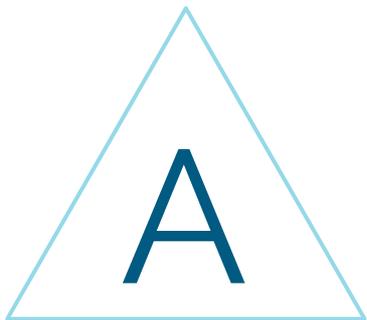
A

Primary Goals

Content is instructional and didactic: Learning of these skills is constantly present in the core usage.

B

Secondary Goals

Content is partly instructional, partly facilitative: Learning of these skills is present in the core usage, but not essentially and constantly stressed.

C
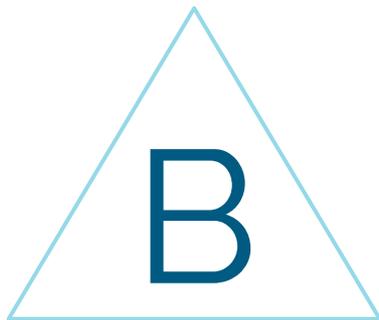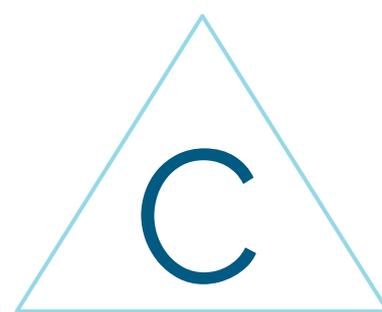
Tertiary Goals

Content is facilitative: These skills can be practiced by using the product, but it requires external guidance and instructions.

Pedagogical Model and Learner Perception

In the first phase of the analysis evaluators are forming product-related statements to define a variation of skill sets that the use of the product supports. The base of the statements is formed upon definitions of 21st century skills, Finnish pedagogics, and existing research evidence related to the product. The reason for using the mentioned influencers is that they represent the needs of the education field globally.

In the second phase the same influencers are used to develop the criterion for evaluation on how the product supports learning of different detected skills. Finnish new curriculum represents a learner perception based on the most advanced understanding of efficient pedagogical approach and therefore it can set the highest quality standards for education tools.

Criterion definition

Passive / **Active**

Passive: Learner in an observant role

Active: Learning by doing

Individual / **Collaborative**

Individual: Learner is learning by her- or himself

Collaborative: Requires collaboration with other learners

Linear - / **Non-linear**

Linear: Proceeding linearly through repetitive tasks

Non-linear: Supports free exploration and finding solutions in variable ways.

Rehearse / **Construct**

Rehearse: Practicing earlierly learned

Construct: Learning and constructing new concepts

Individual — 60 — Collaborative

The magnifier tells where the product currently positions the learner in this contrary pair pedagogical dimension.

The pin shows where the product should position the learner according to the pedagogical principles.
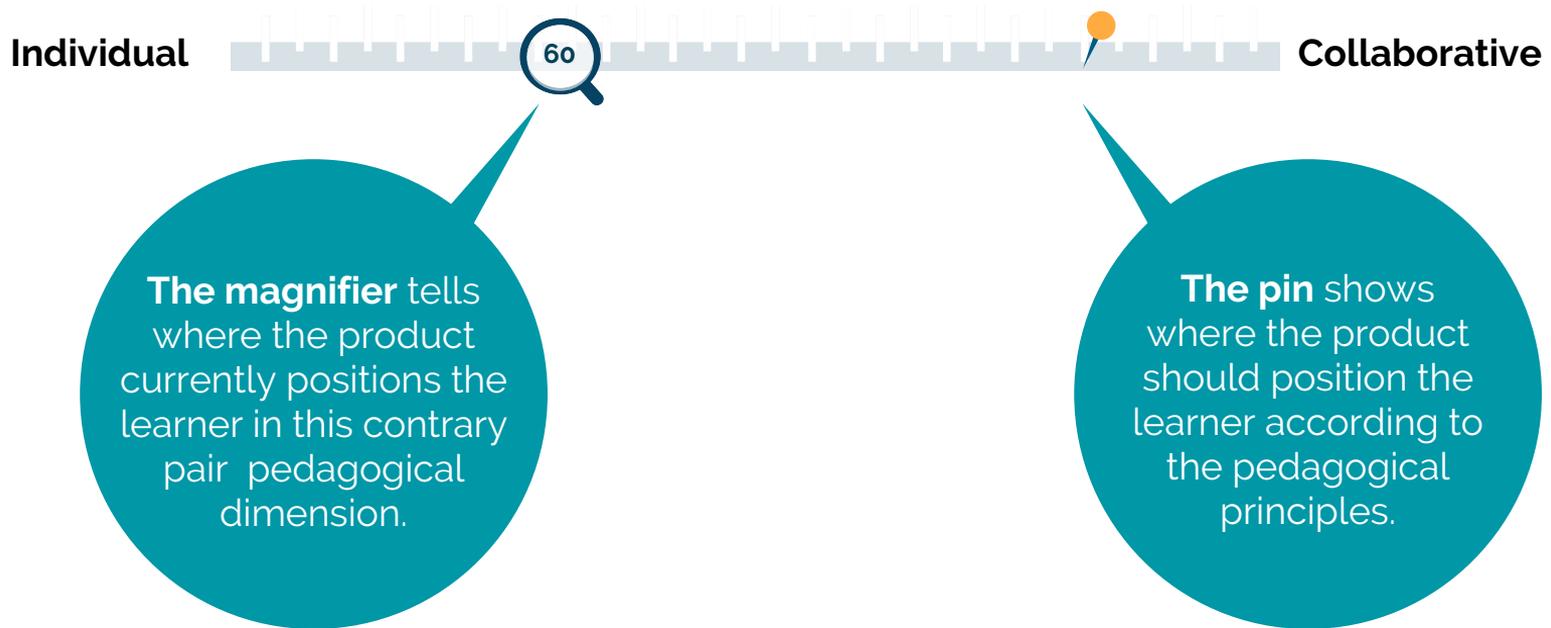
Regarding the role of the student, we characterize the learning solution as promoting learning that is situated somewhere on the scale between *passive* and *active*. As key components determining the characteristics of the solution on this scale we use *accountability, behavioral engagement, and emotional engagement.*

Accountability	Behavioral engagement	Emotional engagement
Autonomy	*Guidance of actions*	*Activation of emotions*
Self-regulation	*Engagement requirements*	*Success feedback*
Goal orientation	*Interactivity*	*Challenge optimisation*

Passive   **Active**

Hietajärvi, Maksniemi (2017) / Engaging learning Ltd. (University of Helsinki)

Regarding the learning activities, we characterize the learning solution as promoting learning that is situated somewhere on the scale between rehearse and construct. As key components determining the characteristics of the solution on this scale we use sparking of interest, building of knowledge, and reflection among learners.

Interest	Knowledge building	Reflection
Prior knowledge	*Goals definition*	*Levels of difficulty*
Experience optimisation	*Applying existing knowledge*	*Decision making*
Autonomy	*Success factors: memorizing/understanding*	*Progression feedback*

Rehearse   **Construct**

Hietajärvi, Maksniemi (2017) / Engaging learning Ltd. (University of Helsinki)

Pedagogical approach - Individual / Collaborative

Regarding the learning activities, we characterize the learning solution as promoting learning that is situated somewhere on the scale between individual and collaborative. As key components determining the characteristics of the solution on this scale we use interaction, responsibility and regulation.

Interaction	Responsibility	Regulation
Social aspects in decision making	*Peer support*	*Self-/co-regulation*
Guidance of collaboration	*Information sharing*	*Individual/common goals*
Content sharing		*Community requirements*

Individual   **Collaborative**

Hietajärvi, Maksniemi (2017) / Engaging learning Ltd. (University of Helsinki)

Regarding the learning process, we characterize the learning solution as promoting learning that is situated somewhere on the scale between linear and non-linear. As key components determining the characteristics of the solution on this scale we use procession and predictability.

Procession	Predictability
User progression	*Outcome predictability*
UX optimisation	*UX limitations*
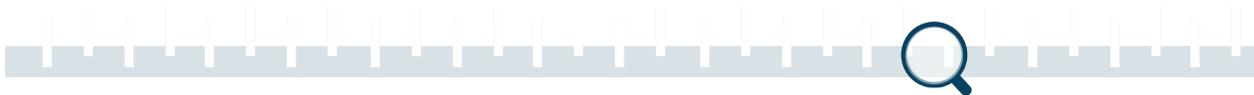
Linear   **Non-linear**

Assessing User Happiness

The user experience evaluation is done from the perspective of user happiness. The evaluation assesses how fun and engaging a product is to use and its suitability among entertainment games, learning games, and utility apps,.

The evaluation focuses on things the users are able to do in the product, and how these features make the users feel. It takes into account the general usability of the products, but looks behind issues which are not essential for the experience. Therefore, this type of evaluation is also suitable for proof-of-concept prototypes and ideas.

The evaluation report serves as a tool for the design and development team. It shows what are the features that support the user happiness the best, and how they do it. It will also point out things that hinder the happiness, and ways the experience could be improved.

Sources: The aspects of player happiness are from Hassenzalh, Marc et all: Designing Moments of Meaning and Pleasure. Experience Design and Happiness. International Journal of Design Vol. 7 No. 3 2013

The Six Aspects of Learning Engagement

Q **Autonomy**

Feeling that the user's actions in the product are based on their own decisions rather than feeling there is external pressure to choose a certain action.

Q **Competence**

The user can feel capable and effective in their actions rather than feeling incompetent or ineffective.

Q **Relatedness**

Feeling that in the product there is meaningful contact with people who care about you rather than feeling lonely and uncared for. You can also feel connection with fictional characters and events in the product.

Q **Respect**

Feeling that the product takes the user into account as a capable and desired actor rather than feeling that the user's opinions and experiences are neglected..

Q **Stimulation**

Feeling that the product offers plenty of enjoyment and pleasure rather than feeling bored and understimulated by the product.

Q **Safety**

Feeling that the product is a safe environment for having fun and trying out things rather than feeling uncertain of the consequences or threatened by other users.

The Rating Scale

5-4
Well Supported

There are several well executed features which support this aspect of learning engagement
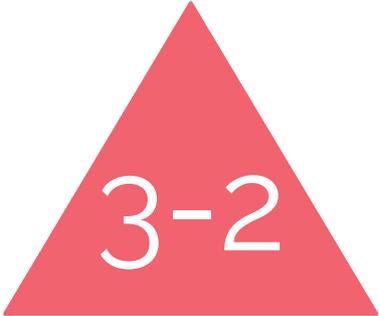
3-2
Supported

The product takes into account this aspect of learning engagement. Some improvements could be made in order to make the support better.

1
Not Supported

There are issues with the learning engagement in this area.

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