

Wellbeing at the 21st century innovative learning environment called learning ground

21st century
innovative
learning
environment

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Abstract

Purpose – Schools have a significant role in ensuring children’s wellbeing as children spend a lot of time at school. Students need to have an active role in their learning and an opportunity to participate in issues concerning wellbeing and studying. This research examines students’ wellbeing in an innovative learning environment. The classroom is built with professionals, teachers and students (aged 9). The authors call it Learning Ground.

Design/methodology/approach – Students’ wellbeing was measured with smart device application for a six-week period. Students answered the questionnaire with a Likert scale of five (very poor – excellent) responses. Two weeks during the six weeks research period, students were able to use digital study aids, EEG-biosensor headsets, to observe the effectiveness of their learning, defined by NeurSky app. The EEG-biosensors enabled students to use a tool to recognise their own learning factors during the lessons. The effectiveness was available to students via tablets all the time.

Findings – The students at the Learning Ground are satisfied with wellbeing and the environment support for students’ wellbeing experience is notable. They have “good vibes” before and after the school day. When wearing EEG-headsets “study aids”, which enabled them to observe their learning via tablets at lessons, the wellbeing experience in the mornings even increased.

Originality/value – Schools need to be visionaries concerning 21st century learning and children’s wellbeing. Building flexible learning environments and bringing innovative technologies into schools to provide active support for students will enable 21st century learning. Wellbeing of children should become first when developing the future schools.

Keywords Information and communication technology, Wellbeing, Innovative learning environments, Ownership of learning

Paper type Research paper

Introduction

Measuring health with various everyday equipment has become common during the last few years (Berg, 2017). Physical health is measured with smart watches, rings and smart phones with a wide range of applications. Some of the applications now also focus on mental health aspects by asking the user about their feelings, giving advice and offering solutions for a better life. Youngsters and children have these applications in their phones to observe their

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health and wellbeing. Also, schools have developed the use of smart devices such as phones or watches for learning or measuring health (Fjørtoft *et al.*, 2009; Garcia *et al.*, 2018; Mikkola *et al.*, 2011).

Measuring wellbeing, especially children's wellbeing, is a complicated field of research because of the range of definitions used to describe the term (Minkkinen, 2013; Statham and Chase, 2010). Reports from the OECD and UNICEF and the research field emphasise that the wellbeing of children needs to be considered better (Chapple and Richardson, 2009; UNICEF, 2020). This also concerns the schools, where the children spend most of their day (Ben-Arieh and Frønes, 2007; Ben-Arieh, 2010; Chapple and Richardson, 2009; Pollard and Lee, 2003; UNICEF, 2020). Learning has also changed due to new demands for a future in the workforce. Children need to learn an enormous number of skills, which are listed in the OECD's Learning compass (OECD Learning Compass, 2020; Finegold and Notabartolo, 2010).

The National Core Curriculum for Basic Education (NCC, 2016) in Finland highlights the student's own role as an expert in their own learning (Finnish National Agency for Education, 2016). Would it be possible to help our students to study 21st century skills, be the experts in their own learning and still consider the aspects of their wellbeing?

This research was implemented in an innovative learning environment, which was built with professionals, teachers and students (aged 9). The classroom enables the 21st century pedagogical solutions and student-centred learning. The place is called the Learning Ground. We ask, how does the Learning Ground support students' wellbeing? According to the NCC 2016, research, as well as reports, the participation, teachers' support and individual learning paths explain the wellbeing experience (de Róiste *et al.*, 2012; Finnish National Agency for Education, 2016; González *et al.*, 2021; Konu, 2002; Powell *et al.*, 2018; UNICEF, 2020),

We also ask how the use of the portable digital study aids EEG biosensor headsets affects students' wellbeing. The EEG-sensor is a portable device which measures the effectiveness of learning. During the lessons students can see their learning effectiveness via tablets all the time with colour and numeric indications. It helps them to recognise the difference in their learning during the lesson. The idea is to support their own learning with the student-centred pedagogy so, that they can switch the place, company or tasks during the lessons when observing how and when their learning is successful. Different tasks in a classroom demand a different level of concentration, for example when studying something new alone or discussing a topic with others, writing an essay or learning mathematics with active, exercising methods. (For more details concerning the EEG-sensor, see the research section of the article).

Observing and measuring one's own health and wellbeing has become normal (Berg, 2017). The transversal goals of the NCC 2016, which are based on 21st century skills, highlight the role of learn-to-learn skills (Eronen *et al.*, 2019). Study trainers increase the knowledge of one's own learning and support the skills to understand and reflect the issues concerning their effectiveness during the lessons.

Children's wellbeing

According to UNICEF and the OECD, the wellbeing of children is a responsibility for whole society (Chapple and Richardson, 2009; UNICEF, 2020). Children need to be listened to carefully when considering aspects of their wellbeing (de Róiste *et al.*, 2012; Powell *et al.*, 2018; United Nations Human Rights, 1989).

In rich countries most of the children are reasonably satisfied with their lives. But there is still work to do, because the present state of the whole of society affects children's wellbeing. When improving the conditions experienced by society overall with sustainable development goals, the wellbeing of children is also improved (UNICEF, 2020). According to the UNICEF report (2020) and studies by Chapple and Richardson (2009) and Jourdan *et al.* (2021), the

children spend a lot of time at school and schools need to have an active role concerning the students' wellbeing.

Measuring the wellbeing of children

The wellbeing models concern mostly adults. Measuring children's wellbeing with those is quite challenging because the wellbeing of children includes a range of factors, such as help from adults to fulfil physical needs and provide care and guidance to grow to be a part of society and environment (Bharara *et al.*, 2019; Minkkinen, 2013). Also, their status in society is different. According to Statham and Chase (2010) some wellbeing factors are connected only with adults' or children's wellbeing, and the factors might mean different things to children and adults. There is no standard method for assessing the wellbeing of children.

In a review of the scholarly literature review, Amerijckx and Humblet (2014) introduced five structural theoretical axes for children's wellbeing research. With these five axes they suggest that the research of children's wellbeing should develop into a junction of positive, hedonic, subjective, spiritual and collective dimensions. Also, Minkkinen (2013) has taken these factors into account in her theoretical overview of wellbeing definition. Children's development supports wellbeing and vice versa. Seligman (2012) defines five factors which are crucial to human happiness. Those are positive emotions, engagement, relationships, meaning and accomplishments. Many of the latest happiness and wellbeing research is based on Seligman's model (Kern *et al.*, 2021; Kern *et al.*, 2015; Shoshani and Steinmetz, 2014).

One view to children's wellbeing is a developmentalist perspective which focusses on accumulation of human capital and social skills (Chapple and Richardson, 2009). According to Minkkinen (2013) the wellbeing of children is now also a significant factor for future wellbeing. Ben-Arieh (2010) discusses the total wellbeing of a child, which means the wellbeing now and the well becoming in the future. Also, in the OECD's report entitled "Doing better for children", the developmental view is defined by well becoming (Chapple and Richardson, 2009).

Schools' role in students' wellbeing

The OECD Learning Compass (2020) has already paid attention to 21st century opportunities and challenges for children's education. One of the views is children's emotional mental health, which is vital to health and everyday life (Pollard and Lee, 2003). In the OECD report, children named bullying and anxieties about school as the most stressful factors challenging their emotional mental health. One of the broadest and newest pieces of research, the UNICEF report "Worlds of Influence—Understanding What Shapes Child Well-being in Rich Countries" pays attention to children's mental wellbeing, physical health and skills for life (UNICEF, 2020). The results show that even in rich countries, there is still some work to do for children's wellbeing. Social relationships are a crucial part of children's lives. A supportive family, a school where there is no bullying, options to participate in decision making and good friends are important.

Developing children's social and emotional skills during their early years is important for their future. Positive mental health includes feelings of happiness, self-esteem and balanced emotions (Korkeila *et al.*, 2003). Similarly, the academic opportunities from childcare to the options provided by having schoolbooks at home are important (UNICEF, 2020). Middle and late childhood children spend several hours a day at school, and they study and interact with others (Chapple and Richardson, 2009). The quality of the school experience and interaction with others are critical for the development of children's social skills and their ability to learn.

According to Konu (2002) and Konu and Rimpelä (2002), wellbeing at school consists of four sections, which are school conditions, social relationships, means of self-fulfilment and health. "School conditions" includes the physical environment aspects, that is, the school

building, learning space but also curriculum, schedules and school services. One of the school services in Finland is a healthy lunch, provided for free every day.

The second part of the wellbeing model includes various social relationships, the school atmosphere and group cohesion. Relationships between schoolmates and students and teachers are key factors for wellbeing at school.

The third part of the model is self-fulfilment which would be part of the ownership of learning, positive feedback, and experiences of meaningful learning. This also includes the breaks during the day. In Finland, children spend the break outside in the schoolyard which is full of activities they can choose from. The fourth part is student's health, which consists of psychosomatic symptoms, illnesses, diseases and common colds.

Wellbeing at school in Finland

[Konu's \(2002\)](#) Wellbeing at school model is used in Finland when measuring students' wellbeing through the school's wellbeing profile. E-Service was maintained by the Finnish National Agency for Education in years 2004–2018 and it gives a broad view of school wellbeing in Finland. The aim is to bring the data of students' wellbeing for school decision makers. The results are available in real time.

In the latest research ([Konu and Lintonen, 2019](#)) reviewed the data on wellbeing at school from 2008–2009 to 2017–2018 to examine the changes in students' wellbeing through this 10-year period. The wellbeing in Finnish schools has improved compared to the results 10 years ago. The changes were mostly positive; for example, in the self-fulfilment sector, the children reported being more listened to and encouraged. The children felt that they had better opportunities to participate, and they were listened to. Also, the physical learning environment, chairs and tables, had developed to be more satisfying.

The lack of clarity regarding the definition of wellbeing, especially in the school context challenges the systemic planning, implementing and evaluating the effective wellbeing agendas at school. Even though it is important to apply the potential of children's views of wellbeing when considering the wellbeing at school ([Powell et al., 2018](#)) The same was also being argued in 1989 in the context of the [United Nations Human Rights \(1989\)](#) which highlights the child-centred approach for wellbeing through which the children are heard in the matters that affect them.

Learning ground as a support for 21st century wellbeing and learning

According to the literature, the 21st century skills in primary education concentrate on technology and ICT, globalisation, innovations and a need for students to develop relevant skills and competence ([Chalkiadaki, 2018](#)). The changing requirements of the workforce and society means that different skills are demanded compared to those required in previous decades ([Larson and Miller, 2011](#); [Silva, 2009](#)). The 21st century skills are crucial to future work, as most of the new jobs are in the information or service sector (that is, in the service sector) the analytical and interactive tasks are taking over the manual routine tasks ([Finegold and Notabartolo, 2010](#); [Spitz-Oener, 2006](#)). The surrounding world places the opportunities and challenges for children to become future citizens and the schools have a significant role in this evolution.

The schools play a key role of taking care of the children ([Jourdan et al., 2021](#)). According to the UNICEF report ([UNICEF, 2020](#)) the children spend most of their time at school or on their way to school. The schools in Finland have already broadened their role by developing the physical environments and pedagogical solutions. According to [Konu and Lintonen \(2019\)](#) children are more satisfied with their involvement and learning environments than they were 10 years ago. Also, the NCC 2016 pays attention to learning environments and

future skills by highlighting 21st century skills, student-active pedagogy, wellbeing and development of learning environments. Students' participation and active role in school life supports their wellbeing at school but also in the future (González *et al.*, 2021; Jourdan *et al.*, 2021).

The demands of the future society and workforce are challenging for schools and most importantly the students. Schools must also take a proactive role in building the future and pay attention to students' wellbeing (Awartani *et al.*, 2008; González *et al.*, 2021). The OECD's *Learning Compass (2020)*, calls for learners to "be able to navigate in time and social space, to manage their lives in meaningful and responsible ways by influencing their living and working conditions". It aims to improve the individual and collective wellbeing. To this end, the schools and educators have a critical role, such as in the coaching of future skills.

Wellbeing at the learning ground

From a social point of view, schools need to assist children to grow to become future citizens. In Finland this is also written in the NCC 2016 by adding there the transversal goals which emerge from the 21st century skills (Eronen *et al.*, 2019). The transversal goals are defined as follows: 'that cross the boundaries of and link different fields of knowledge and skills' (Finnish National Agency for Education, 2016). The key transversal competence areas cover aspects of learning, culture, interaction, taking care of oneself, daily life, multiliteracy, ICT, entrepreneurship, participation and sustainability (Lonka *et al.*, 2018). Integrative instructions and multidisciplinary learning modules are ways to support students to see the relationships and interdependencies of the phenomena to be studied (Finnish National Agency for Education, 2016).

The NCC 2016 pays attention as well to learning environments which need to support students' and community's growth, learning and interaction. According to Kariippanon *et al.* (2018), flexible learning spaces and student-centred pedagogy support student's motivation, engagement and interaction. The information and tasks are justified to different learners, not too demanding but still challenging. That will engage the interest of the students for learning (Acharya *et al.*, 2019). Learning is more personalised than in traditional learning space. According to research, there is a connection between psychological and physical learning environments and wellbeing (Awartani *et al.*, 2008).

To teach according to pedagogical goals of the NCC 2016 and especially the 21st century skills, requires innovative pedagogy and flexible learning spaces. The learning environment needs to support the desired actions and pedagogy and offer versatile affordances for learning (Young *et al.*, 2020). In 2018, at the University of Eastern Finland, University school of Joensuu this new, flexible learning environment was built with professionals, teachers and students (aged 9).

The students were a notable part of the building process; they were listened to and participated in the planning. According to UNICEF (UNICEF, 2020) participation is one of the wellbeing factors for children. The place is called Learning Ground as it enables the student's active role as a learner and offers many opportunities for students to develop their learning. It might be thought as a learning playground inside of the school.

Learning at the learning ground

The learning environment also consists of materials, tools and services which are used to support studying. The Learning Ground is 250 square metres, includes many spaces for learning and extra attention is given to acoustics and aesthetics. During the designing of the Learning Ground the attention was paid to individual and shared learning, student-centred pedagogy and wellbeing as mentioned in the curriculum (Finnish National Agency for Education, 2016). The pedagogy was at the centre of the planning all the time. The physical

space has an impact for students learning, but also the pedagogy and teachers' actions are important (Mahat and Imms, 2020), so that all the affordances for learning are in use for the students. The Learning Ground is a home classroom for 60 students and three teachers. It includes various kinds of spaces which are all flexible and possible to transform for pedagogical purposes. Learning should be organised so that students are encouraged to interact, ask questions, and talk freely with each other and teachers (Mazurkiewicz, 2013).

The Learning Ground is designed by keeping in mind this idea of a safe and respectful atmosphere for everybody to be able to communicate and bring their ideas to the classroom. The space itself responds to the requirements of 21st century learning by providing an opportunity for student-centred pedagogical solutions. For example, the students can choose different places, furniture and technological solutions to study in. During the school days the students can also follow their own learning as individuals and choose the places best suited for them to study. The tools, such as headsets for music or soundscapes, adjustable lightning in different spaces and smart lights for energising or relaxing are available in the Learning Ground. All the students have their own study books and a laptop. In the Learning Ground there are many other tools to support learning, such as VR glasses, robots, body add-ons, games and physical activities.

The capacities of contemporary ICT provide the environment required for today's flexible learning. They enable students to follow individual school paths and to collaborate with other student (Finnish National Agency for Education, 2016). In 21st century classrooms the teachers and students work together, and the individual expertise is shared in this broader community (Larson and Miller, 2011).

ICT is not the only solution in 21st century learning environments which supports student learning. In our Learning Ground, there is an opportunity to choose the place to study, the materials depending on the tasks, and the completion order of these tasks. The pedagogy is based on phenomenon-based learning, and the transversal goals and 21st century skills are a part of everyday class life.

For more about the Learning Ground, visit <https://www.thinglink.com/mediacard/1508050352040050690>.

This kind of 21st century Learning Ground offers many opportunities for learning individually but can also be challenging because of the many options. These *f* learning environments enable students' personalised working arrangements and autonomy, but also responsibility (Yeoman and Wilson, 2019). Students need to stay committed to shared goals, to reflect on their learning and to recognise challenges in their learning process. Niemi (2021) points out that the environment itself does not guarantee productive learning; this depends on multiple issues such as guidance from teachers and the regulation of learning. These are all considered when planning the pedagogy for the Learning Ground.

Application of wellbeing and digital study aids to support learning and wellbeing

Measuring wellbeing is part of everyday life nowadays. People wear smart watches, activity-monitoring rings, and use a range of equipment and apps to recognise the factors which affect their physical wellbeing. According to research, physical activity leads to a better quality of life and health, and regularly exercise leads to better mental health (Biddle *et al.*, 2015; Penedo and Dahn, 2005).

Similarly, at school physical activity has been measured during the school day with activity-measuring watches. According to Mikkola *et al.* (2011), the activity-monitoring watches and a virtual aquarium environment increased children's physical activity. Fjørtoft *et al.* (2009) used the smart watches to monitor the heart rate in the school yard and GPS to record children's movement patterns.

Portable smart devices, like watches, have also been used for learning by studying science reflections, as well as portable cameras for measuring the school trip (Garcia *et al.*, 2018; Kelly *et al.*, 2012).

Today body add-ons, like smart watches and rings enable even broader views about wellbeing. The rings or watches use an application to interpret what is happening in people's lives, bodies and minds (Berg, 2017). There is (Berg, 2017) a significant number of wellbeing applications and the branch is developing all the time. An automated solution like the SchoolDay application can help to discover the negative phenomena early in classrooms and improve awareness of wellbeing (Kylväjä *et al.*, 2019).

Digital study aids, tools to observe one's own learning are the EEG biosensor headsets, which were available from our Learning Ground in spring 2019 for a two-week period. This MindWave EEG biosensor was made by NeuroSky. The sensors produce data through three phases. First the active channel on the forehead picks up the (noisy) EEG data and transmits it to a ThinkGear sensor that, in the second phase, executes noise filtering and signal amplification. Finally, in the third phase, the amplified signal is sent to a platform which interprets the raw brainwave data to calculate real-time mental state interpretation which is called the effectiveness of learning. Algorithm of effectiveness is defined by NeuroSky and includes e.g., attention, meditation and mental effort (Adapted from Ruşanu *et al.*, 2018). The data are then available in an application called Effective Learner, for students to observe during the lessons via tablets. The students were able to see their own learning effectiveness with colours and numbers.

Research questions, the data and analysis

This research was carried out at the University School of Joensuu, University of Eastern Finland. The Learning Ground and pedagogical solutions were described earlier in this article with the main concepts. The research was completed in spring 2018. Students' wellbeing at the Learning Ground was measured during the six week-period beginning in April 2018. Students answered the questions with a Likert scale of five (very poor – excellent) responses. There were six questions in the morning (see Table 1) and nine in the afternoon (see Tables 2 and 3).

The two research weeks for the EEG biosensor headsets were scheduled at the beginning of May 2018. With the "add-on" EEG band we enabled children to use a tool to recognise their own learning factors during the lessons.

School days for students ($N = 39$) were normal phenomena-based lessons, other subjects and pedagogical solutions, days according to schedule. The content of the phenomena for this period emerged from the Finnish curriculum and was named "Democracy and Economy". This included the contents of mathematics, Finnish, social sciences, technology and the arts.

The school day for students began at 8.00 or 9.45 a.m. When they arrived at school, they answered the SchoolDay application questionnaire (see Table 1) with their personal

($N = 1,372$)	1	2	3	4	5
1 My relationships with friends today were					
2 My vibes today	0.38**				
3 My motivation for studying today is	0.35**	0.62**			
4 The comfort of my learning environment today is	0.38**	0.61**	0.64**		
5 I ate breakfast today	0.37**	0.45**	0.49**	0.48**	
6 I feel fresh today	0.32**	0.62**	0.62**	0.57**	0.42**

Note(s): **Spearman correlations. The correlations are significant at the 0.01 level (2-tailed)

Table 1.
Students' feelings
about wellbeing before
school day. The
structure of WBBS

Chromebook (from school) or their own phones. The school day finished at 1 p.m. or 2.30 p.m.; and at that time they answered the afternoon questionnaire (see Tables 2 and 3). A total of 1,372 morning answers and 882 afternoon answers were gathered and from these data, the research questions were:

- (1) How do the students experience their wellbeing at the Learning Ground and how does it remain within and between school days?
- (2) How does the digital study aid (portable learning tool, EEG biosensor headset) affect students' wellbeing during and between school days?

Concerning ethical aspects, the research was completed by carefully following the guidelines of the Finnish National Board on Research Integrity. The data were anonymised and the identity of students did not emerge in any point. The variation of number of answers between mornings, afternoons and between the days is the result of student-instigated change, due to sickness, a holiday or just that they forgot to save the answers. The school days are also different in the mornings compared with the afternoons. Normally mornings are more teacher-centred when gathering together to talk about the coming day. In the afternoon, the students normally study more individually or in groups, so they are not so carefully guided by teachers.

SPSS 27 was used for the data analysis. Three sum variables were created from students' morning and afternoon SchoolDay questionnaire answers. Those were wellbeing before school day (WBBS), wellbeing after the school day (WBAS) and Learning Ground support (LEGSU). The Cronbach's alphas were defined for each sum variable and episodes of exceeding of internal agreement (0.70) were confirmed. Non parametrical tests were used because of the value of kurtosis was higher than 1.0 (Ellis, 2010). The interplay between sum variables was investigated using Spearman rank correlation coefficient. Related samples were subjected to the Wilcoxon signed rank test were used to defying changes in wellbeing during school days and the Independent Samples Kruskal–Wallis test was used to compare wellbeing experiences between schooldays. The influence of study aids was researched within and between school days, respectively. The effect size of test result the *r* was used with limitations 0.1 small, 0.3 moderate and 0.5 Large (Cohen *et al.*, 2013).

Table 2.
Students' feelings
about wellbeing after
school day. The
structure of WBAS

<i>N</i> = 887	1	2	3	4	5
1 My relationships with friends today were					
2 My vibes today	0.42**				
3 My motivation for studying today was	0.34**	0.65**			
4 The comfort of my learning environment today was	0.36**	0.61**	0.64**		
5 I ate lunch today	0.39**	0.47**	0.52**	0.51**	
6 I felt fresh today	0.35**	0.69**	0.67**	0.61**	0.45**

Note(s): **Spearman correlations. The correlations are significant at the 0.01 level (2-tailed)

Table 3.
Learning Ground
support for
wellbeing (LEGSU)

<i>N</i> = 882	7	8
7 I concentrated on studying today		
8 My learning environment supported my learning today	0.62**	
9 It was peaceful in our class today	0.57**	0.64**

Note(s): **Spearman correlations. The correlations are significant at the 0.01 level (2-tailed)

Results

Students' experience of their wellbeing

Wellbeing was measured in the mornings and afternoons. Tables 1, 2 and 3 show the Spearman correlations within each question. Students' experiences at the beginning of each school day were asked by six questions (see Table 1).

There is a statistically significant correlation with large effect size between answers 2 'My vibes today', to answers to questions numbers three to six. Vibes correlate strongly with satisfaction with Learning Ground, motivation for studying and the feeling of freshness. After the school day students answered these six questions again, and the sum variable Wellbeing after the school day (WBAS) was created (see Table 2).

After the school day the vibes remain statistical correlation between satisfaction to Learning Ground, motivation for studying and the feeling of freshness as strong as at mornings with large effect size.

The effect of Learning Ground for students' wellbeing was measured with three variables (see Table 3). The data gathered after the school days and used for the third sum variable Learning Ground support for wellbeing (LEGSU).

There was statistical correlation between every question with large effect size. In Table 4 it reveals that the Cronbach's alpha for WBBS, WBAS and LEGSU were all at a proficient level. Further the correlation between sum variables was significant with large effect size.

Comparing means and the percentiles from the variables WBBS and WBAS (see Table 4) show that the experience of students' wellbeing at the Learning Ground was at the good (4) or excellent (5) levels. In the mornings (WBBS), 75% of the students defined their wellbeing in these levels and in the afternoons (WBAS) the students were a little more satisfied, because the score for the 75% percentiles has decreased from 4.83 to 5.0, meaning that 25% of students defined their wellbeing at the level of excellent.

When comparing the differences within the days, the data consist of 882 cases when the student answered both mornings and afternoons. Within this cases, wellbeing of students improved statistically with a small effect size during the school day ($U = 85184.000$, $z = 8.634$, $p < 0.001$, $r = 0.22$). In 323 cases, the students reported better wellbeing experience at the end of the school day than in the morning. In 161 cases the wellbeing experiences decreased and in 281 cases it was the same. However, the independent samples Kruskal-Wallis test did not reveal differences in wellbeing experience between different school days in either WBBS ($H(29) = 23.263$, $p = 0.76$) or WBAS ($H(29) = 31.150$, $p = 0.36$). It appears the good vibes remain throughout the day and the effect of the Learning Ground on students' wellbeing was positive.

The effect of study aid for students' wellbeing

The level of wellbeing before the school day was higher on days with study aids ($M = 4.46$, $SD = 0.54$) compared to days without the study aids ($M = 4.24$, $SD = 0.63$). The difference was statistically significant ($U = 132756.5$, $p < 0.001$, $r = 0.12$) with a small effect size. Further

	<i>M</i>	<i>SD</i>	<i>Md</i>	<i>Q1</i>	<i>Q2</i>	Skewness	Kurtosis	Cronbach's Alpha	WBBS	WBAS
WBBS	4.27	0.62	4.33	4.00	4.83	-0.99	1.60	0.83	1	
WBAS	4.39	0.58	4.40	4.00	5.00	-0.97	1.16	0.85	<i>0.76</i>	1
LEGSU	4.31	0.63	4.33	4.00	5.00	-0.94	1.80	0.81	<i>0.65</i>	<i>0.7</i>

Note(s): *Italic values* represent Spearman correlation coefficient, all correlations significant at the $p < 0.01$ level. WBBS, wellbeing before school day; WBAS, wellbeing after school day; LEGSU, Learning Ground support

Table 4. Mean, standard deviations, medias, percentiles, Cronbach's Alphas, and correlations between measures of wellbeing before and after school days and Learning Ground support

the statistical difference remains ($U = 49311.500$, $z = 2.089$, $p = 0.037$ $r = 0.07$) after the school day WBAS between days with study aids ($M = 4.49$, $SD = 0.54$) and without study aids ($M = 4.37$, $SD = 0.58$). However, the difference was below the small effect size.

A comparison of students' experiences of wellbeing and the change of these experiences reveals that on the days when EEG-based study aids was used, there was no difference in wellbeing experiences between WBBS ($M = 4.46$, $SD = 0.54$) and WBAS ($M = 4.49$, $SD = 0.54$). Instead, the days when students were not able to use study aids the change between wellbeing experiences can be found with a moderate effect size ($U = 71700.000$, $p < 0.001$, $r = 0.34$) being better after the school day ($M = 4.37$, $SD = 0.58$) than before the school day ($M = 4.24$, $SD = 0.63$). This difference can be explained because students' wellbeing experience was already better in the mornings when students were able to use study aids, and every student described their wellbeing as being at the level good (4), compared to days without study aid when some students' feelings were minimum at the level bad (2).

Discussion

Measuring wellbeing is always complex because of the nature of wellbeing as a concept. The experience of wellbeing is always individual and in this research all the students have their own perspectives when answering questions. The number of answers in this research is large enough to draw conclusions of this type. Wellbeing is always an experience and cannot be defined unequivocally. In this research the missing value consist of the students who did not answer the afternoon questionnaire, totally 490 of 1,372. However, Cronbach Alphas were above 0.8 which Nunnally's (1978) recommend for applied research and reflects good validity of sum variables based on Konu's (2002) model.

The results of this research show that students in the 21st century Learning Ground are feeling well. Their wellbeing is at a good level and the correlations between the various aspects of wellbeing were strong. The wellbeing was already at a good level in the mornings and the good vibes remained throughout the day and even improved in the afternoons. There were no differences between the days when comparing each day separately.

In recent years, the availability of wellbeing applications and portable wellbeing devices has increased and with other tools it has become easier for consumers to measure their own wellbeing daily. The experience of the activity-measuring watch and virtual aquarium (Mikkola *et al.*, 2011) increased the experience of activity amongst the students. The digital study aids were used for two weeks in this six-week research period. The results reveal when the comparison was measured between the days when students were able to use or not use study aids. On the days when students used study aids the wellbeing experience was better even before the school days compared to days without the study aids and wellbeing experience remains at high level after the school days. Therefore, it seems that the positive effects of study aids, when observing the effectiveness of learning, and connection to students' experience of wellbeing should be investigated more closely, perhaps by interviewing students.

However, the Learning Ground support for students' wellbeing experience is notable and can explain the positive change in a student's wellbeing experience during the day, especially on days when they were not able to use study aids. The Learning Ground is planned with students, and it enables student-centred pedagogy through which the students acquire 21st century skills, such as learn-to-learn skills and self-regulation. The Learning Ground and EEG study aids provided students with new opportunities to take responsibility for their learning. That is important for their wellbeing to have experiences of meaningful learning and involvement of issues concerning the learning (Finnish National Agency for Education, 2016; Konu, 2002; Konu and Lintonen, 2019; Powell *et al.*, 2018).

The wellbeing, ownership of learning and technology are all important parts of the school days according to transversal goals of NCC 2016. Alternative technological solutions at school for learning, such as measuring physical activity or applications helping students to concentrate are quite common at school, at least for teachers and students to try. The schools are participants in projects in which the newest technology is used, but the research-based documentation is missing, maybe because of the fast development of the branch. With portable study aids, like EEG sensors the technology could also be used to activate students to observe and understand their learning.

Technology and ICT are a significant part of future and according to Genuth (2015), EEG technology is getting closer to consumers all the time. The schools need to be able to try and learn innovative technologies and offer them to students as options. Bringing this 21st century technology to classrooms appears to be positive. Also, the confidence for the data the study aids produce and comparing different kind of study aids would be interesting. The benefits of add-on digital study aids at school demand additional research.

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