Feasibility of a tablet-based program for training everyday planning in adolescents with intellectual disabilities

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Abstract

Background: Individuals with intellectual disabilities (ID) show difficulties with everyday planning. A tablet-based training program for everyday planning may be a suitable intervention, but its feasibility must be evaluated. This study evaluated how behaviour changes during training and if individuals with ID can use technology by themselves. **Method:** 33 adolescents with ID and 30 younger children with a typical development were recruited. The participants were instructed to train in school for a total of 300 minutes. After the intervention, the participants were matched on Mental Age (MA) **Results:** Only 16% of the participants trained for all 300 minutes. Participants in the MA group trained for a longer time than the ID group. Both groups made fewer errors per task in the end compared to the beginning. Individuals with ID started off making fewer attempts per task and increased their activity during the training. This pattern was not seen in the comparison group. **Conclusions:** Both groups used the program without adult supervision. However, for some individuals in the ID group, the program might not have been feasible as they did not use the program as long as they were intended to. The ID group increased their activity during the training which might mirror a strategy development of how to use the program. The change in behaviour in activity on task attempts can be interpreted as individuals with ID needing a longer time to get familiarised with the technology. Tablet-based training programs are feasible for individuals with ID but it is necessary to follow up on usage-time.

Keywords: Intellectual disability, everyday planning, executive functions, cognitive training, intervention.

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Introduction

Planning ability is essential in everyday life. Planning is defined as formulating a set of sub-goals to achieve a future goal (B. Hayes-Roth & Hayes-Roth, 1979; Scholnick & Friedman, 1993). It is employed in both short-term and long-term plans, such as planning the morning routine or the summer's holidays. Individuals with ID show planning difficulties (Danielsson, Henry, Messer, & Rönnerberg, 2012; Danielsson, Henry, Rönnerberg, & Nilsson, 2010; Van der Molen, Van Luit, & Jongmans, 2007). Cognitive training has been used in this group before, perhaps can planning ability be supported by providing a training program for training everyday planning (e.g. Lanfranchi, Pulina, Carretti, & Mammarella, 2017; Söderqvist, Nutley, Ottersen, Grill, & Klingberg, 2012). However, for an effective intervention, it has to be feasible. The participants need to be able to learn and employ the training program and adherence to training for the targeted group need to be studied. This study investigated the feasibility of a tablet-based, everyday planning training program and compared adolescents with ID to mental age-matched children with a typical development.

Research has found that planning abilities are affected in individuals with intellectual disabilities (ID). Individuals with ID perform lower than their peers matched on chronological age (Danielsson et al., 2012; Numminen, Lehto, & Ruoppila, 2001; Van der Molen et al., 2007), and in some studies lower than a mental age-matched comparison group (Danielsson et al., 2010). Individuals with ID may be missing a strategy for solving the planning tasks, which might explain the difficulties. Bray, Fletcher, and Turner (1997) and Poloczek et al. (2016) found that individuals with ID can learn and use strategies, but that they use fewer strategies than their chronological age-matched peers. Thus, introducing an intervention program aimed at training strategies for everyday planning might be beneficial for this population.

Effective intervention requires implementation in the intended population and setting, for example a school, and a feasibility study helps to find possible limitations in a proposed intervention (Bowen et al., 2009). The purpose of such a feasibility study is to assess the components of an intervention, including the implementation and adherence to training (Bowen et al., 2009). Feasibility of cognitive training programs is commonly assessed by only evaluating the improvement after the training (e.g. Boot, Owuor, Dinsmore, & MacLachlan, 2018; Lanfranchi et al., 2017; Söderqvist et al., 2012; Stephenson & Limbrick, 2015; Wehmeyer, Smith, Palmer, & Davies, 2004). This assessment limits the important objective of studying how the program is used and how the behaviour changes during the training. Perhaps the program is not

usable for the population with ID. Research evaluating the feasibility of assistive technology for cognition (ATC), found that ATCs are only being used with adult supervision (Palmqvist & Danielsson, 2019). The same barrier might be seen when implementing a more complex training program in an intervention study. To our knowledge, no study has yet investigated if this is the case.

Studies have investigated the effectiveness and feasibility of cognitive training programs in individuals with ID (e.g. working memory; WM; Danielsson, Zottarel, Palmqvist, & Lanfranchi, 2015). Söderqvist et al. (2012) studied the feasibility of cognitive training for WM and non-verbal reasoning in children with ID. The authors found that the training was feasible for the group as the participants fulfilled the criteria for sessions trained and were able to improve their cognitive performance. Lanfranchi et al. (2017), examined the feasibility of a tablet-based spatial-simultaneous WM training program for individuals with Down Syndrome. The study found significant positive effects on the tasks that were similar to what was being trained, but not in the tasks aimed at finding a generalised transfer effect to untrained tasks. A result that many studies on cognitive training struggle with, namely finding effects beyond what was being trained (e.g. Melby-Lervåg & Hulme, 2013; Rapport, Orban, Kofler, & Friedman, 2013). An effective training program should aim at training the specific components involved in a task where the improvement is desired.

The current study trained everyday planning using a strategy that can be applied in a real-world situation. The planner first identifies sub-goals of the plan, then orders the sub-goals in the appropriate temporal order (according to the theory of planning by B. Hayes-Roth & Hayes-Roth, 1979). Moreover, the study investigated how behaviour changes during training and if individuals with ID can use technology without an intermediary user.

The research questions were:

1. Can a tablet-based training program be used without adult supervision for individuals with ID and is there a difference compared to a group with a typical development?
2. Is there a difference between a group with ID compared to a group with a typical development, on how well they learn the training program and planning tasks?
3. Is there a difference between a group with ID compared to a group with a typical development, on how the participants use the training program to try to solve planning tasks?

Methods

Participants

Participants were recruited from schools in southern Sweden. Participation was voluntary. The participants were recruited after the consent of the school's principal. All caregivers signed an informed consent, regarding the confidentiality of data and group-level analysis. All participants gave oral consent at the beginning of the test session. The study follows the Ethical principles for medical research involving human subjects from the WMA Declaration of Helsinki (World Medical Association, 2013). The study was reviewed and approved by the Regional Ethical Review Board (city and country removed for blind review) (2015/119-31). Parts of the data used in this study have been reported in another paper (citation removed for blind review).

The participants in the ID group attended upper secondary schools for children with special needs. In Sweden, enrolment criterion for special schools is having a mild to moderate ID diagnosis.¹ The comparison group comprised children with a typical development attending primary schools. The recruitment process resulted in 63 participants ($n_{ID} = 33$, $n_{TD} = 30$).

The participants' MA were calculated based on Raven's coloured progressive matrices (RCPM; Raven, 2003). Raw scores were used as suggested by Mervis and Klein-Tasman (2004). A minimum mental age of six years was set as an inclusion criterion as it was considered a minimum mental age for the participants to plan for themselves.

One participant from the ID group was excluded based on having a mental age below six years. Additionally, one participant from the ID group was excluded due to technical problems with the tablet. A high percentage of the participants did not train for the instructed 300 minutes, thus cut-off levels for minimum played-time and played-tasks were added as new inclusion criteria to not lose too much data (and thereby decrease reliability of the analyses). To be included, the participant had to have played at least 10 tasks on each level (see below for details). Analysis of time trained revealed that 81% of the participants trained for at least 180 minutes (12 sessions). Hence, 180 minutes was decided as a cut-off and data from participants playing shorter was excluded. In addition, for the participants to have the time to meet the played-task criteria, we stopped analysing data collected after 200 minutes (rather than 180 minutes). Twelve participants (ID = 11, comparison group = 1) trained for less than 180 minutes and were excluded. Three participants in the ID group did not meet the played-task criterion.

¹ In Sweden, the diagnosis of Intellectual Disability is made after a thorough assessment by a licensed psychologist according to criteria from the DSM-V (American Psychiatric Association, 2013).

After excluding participants based on the time trained and tasks played criteria, the groups were matched for mental age (MA). Facon, Magis, and Belmont (2011) proposed groups be equated on both mean and variance, with an α -level of $p > 0.50$. The comparison group had a higher mental age than the ID group, therefore, eight participants from the comparison group with the highest RCPM-score were excluded.

After the matching process, the groups did not differ in $t(36) = 0.56, p = .581$, nor variance, $F(1,36) = 0.04, p = .839$ on the RCPM. The groups consisted of 38 participants ($ID_n = 17$; 71% girls, $MA_n = 21$; 57% girls). The ID group had a mean chronological age of 17.91 ($SD = 1.50$) years and a mean mental age of 8.29 ($SD = 1.14$) years. The comparison group had a mean chronological age of 7.65 ($SD = 0.74$) years and a mean mental age of 8.49 ($SD = 1.01$) years. See Figure 1 for a flow chart of the exclusion process.

Insert Figure 1 about here

Diagnoses

Data on diagnoses were collected by parental surveys. Diagnosis data were missing for three participants, all in the comparison group, but teachers reported that none of the students had special educational needs. No neurodevelopmental disorders were reported in the comparison group. The diagnoses in the ID group can be seen in Table 1.

Insert Table 1 about here

Materials: The tablet-based training program

A tablet-based training program, called *Plan Some More*, was used to train everyday planning. The narrative of the training program was to help an alien named Hensi to create everyday plans. The program was user-driven, meaning the user initiated the actions in the program (e.g. to receive a task, the user clicked on Hensi). The program consisted of a setting with a rocket and a house with four rooms (a bathroom, a bedroom, an entrance, and a kitchen) where everyday tasks were performed. During the training, the user received rewards that could be used to furnish the rocket. The first tasks introduced how to navigate in the program (no planning was required on this level and data from this level was excluded in this study). The planning tasks had three levels of increasing complexity. The more difficult levels were presented when the user had successfully solved six tasks on the easier level. Level 1 required two items (e.g. “Help me plan for drinking a glass of water”, required items: drinking vessel and water), Level 2 required three items (e.g. “Help me plan get dressed for school”, required items: underwear, top, and pants/skirt), and Level 3 required four to five items (e.g. “Help me plan to make a toast”, required items: bread, butter, and a knife for spreading the butter onto the toast) to complete the plan. When the user-

initiated a task at Level 1-3, the user was first asked to identify the different items needed for the plan (e.g. for the plan "Help me plan to make a toast", the user had to collect a toaster, bread, butter, and a knife for spreading the butter onto the toast). When the user thought s/he got the correct items s/he pressed the play button. If the wrong items were collected or, one or several items were missing, the user was informed by Hensi giving general negative feedback. When the user had collected the correct items, the user was forwarded to the second part of the task. There, the user was asked to identify the temporal order of the items (e.g. 1. toast, 2. toaster, 3. knife, and 4. butter). Due to the nature of the tasks, different orders could be correct.

The program was installed on a Lenovo TAB 2 A10-30F ZA0C with OS Android 5.1. Data from the participants were logged and included: 1) time spent using the program, 2) number of tasks the user played, 3) whether the participant passed or failed the task, 4) the level of the task, 5) number of times the user clicked on Hensi (to initiate or repeat the instructions of a task), 6) number of times the user clicked on a button to check if the answer was correct.

Procedure

The training took place in the participants' school. The teachers were instructed to allow the students to train for 300 minutes (20 sessions for 15 min, five days a week for four weeks). The teachers were asked to let the participants train by themselves and not assisting in solving the tasks for the children. No verbal or written instructions were given to the participants. A research group member attended the first training session to instruct how to operate the tablet and program.

Computed variables

The variables *usage-time*, *activity-level*, and *improvement-rate* were computed from the logged data.

Usage-time Usage-time was considered a measure of adherence to training and was calculated as the minutes spent training using the program.

Activity-level The clicks the participants used for initiating a new task and checking if a task was correct was used to measure activity in the program. Activity-level was defined as the mean number of clicks per minute and data from the first session (referred to as the beginning) was compared to the last training session (referred to as the end).

Improvement-rate

To investigate improvement on the planning tasks in the end compared to the beginning, the first and last 25% of the completed tasks were extracted from the logged data². Thereafter, the total number of errors per task in the beginning were subtracted from errors per task in the end. This difference was called improvement-rate. A positive number reflects fewer errors per task in the end compared to the beginning.

Data analysis

To compare the usage-time of the two groups, different *t*-tests were used. For group comparisons with equal variance, student's *t*-tests were used, and Welch's *t*-tests were used when the assumptions were violated. To compare the improvement-rate and activity-level of the groups (ID and MA), mixed-ANOVAs with Type II Sums of Squares were performed. The dependent variable for the ANOVA investigating improvement was the total number of errors made. The within factors were difficulty, with three levels (level 1, level 2, level 3), and time (beginning and end). The between factor was group (ID and MA). The dependent variable for the ANOVA investigating activity was the total number of clicks (as defined in activity-level). The within factor was time (beginning and end) and the between factor was group (ID and MA). The recommended generalized eta squared (η^2_G) was used as effect size (Bakeman, 2005). Bakeman (2005) suggested a result of .02 be considered as a small, .13 as a medium, and .26 as a large effect. For the within-subject tests, the Greenhouse-Geisser correction was used to correct for violations of sphericity. Post hoc tests were performed using estimated marginal means with a multivariate model and the Tukey's HSD method was used to correct for multiple comparisons. The α -value was set to 0.05.

All statistical analyses were performed using R version 3.5.1, in R Studio version 1.1.463 (R Core Team, 2018). The r-packages: dplyr (Wickham, François, Henry, & Müller, 2018), afex (Singmann, Bolker, Westfall, & Aust, 2019), car (Fox & Weisberg, 2011), emmeans (Lenth, 2019) and psych (Revelle, 2018) were used. The plots were made in ggplot2 (Wickham, 2016) and beeswarm (Eklund, 2016). The manuscript was written in Rmarkdown using papaja (Aust & Barth, 2018) and citr (Aust, 2019) for formatting and references.

Results

The descriptive statistics for all variables can be seen in Table 2.

Insert Table 2 about here

² The choice to use per cent of completed tasks rather than using the first and last sessions was to ensure that the same number of tasks were performed in the beginning and the end.

Usage-time and adherence to treatment

The participants were instructed to train for 300 minutes (20 sessions in 15 minutes, five days a week for four-week), but only 16% (ID = 8%, MA = 8%) of the participants trained for all 20 sessions. The cumulative distribution of the participant's time spent on training can be seen in Figure 2. There was a significant group difference on how long time the groups had trained for ($t(50.81) = 2.53, p = .014$, Cohen's $d = 0.63$). The ID group ($M_{ID} = 219.00, SD_{ID} = 76.07, range_{ID} [68.75 \text{ and } 327.13]$) trained for a shorter time than the MA group ($M_{MA} = 258.90, SD_{MA} = 44.89, range_{MA} [130.56 \text{ and } 328.76]$). There were more participants in the ID group than the MA group that trained for less than the 180 minutes (ID = 11, MA = 1). A correlation between the participants' mental age and time played revealed a significant correlation in the comparison group ($r = .404, p = .027$), but not in the ID group ($r = .038, p = .841$).

Insert Figure 2 about here

Improvement-rate in the beginning compared to the end between the ID and MA group

The ANOVA on improvement-rate for group*time*level showed no significant main effects between the groups, ID and MA, ($F[1,36] = 0.02, MSE = 4.25, p = .891, \hat{\eta}_G^2 = .000$). The main effect of time was significant ($F[1,36] = 51.19, MSE = 1.43, p < .001, \hat{\eta}_G^2 = .131$). Participants made significantly less errors per task in the beginning compared to the end ($\Delta M = 1.13, 95\% \text{ CI } [0.81, 1.45], t(36) = 7.08, p < .001$). There was also a significant main effect of level ($F[1.33,47.99] = 56.30, MSE = 3.91, p < .001, \hat{\eta}_G^2 = .376$). The participants improved significantly on all three levels (Level 1 = $\Delta M = 1.30, 95\% \text{ CI } [0.91, 1.69], t(36) = 6.78, p < .001$, Level 2 = $\Delta M = 1.38, 95\% \text{ CI } [0.88, 1.89], t(36) = 5.56, p < .001$, Level 3 = $\Delta M = 0.71, 95\% \text{ CI } [0.02, 1.40], t(36) = 2.08, p = .045$). Improvement significantly decreased for the more difficult: levels 1 to 2 ($\Delta M = -1.79, 95\% \text{ CI } [-2.18, -1.40], t(36) = -11.21, p < .001$), level 1 to 3 ($\Delta M = -2.74, 95\% \text{ CI } [-3.55, -1.93], t(36) = -8.25, p < .001$), and level 2 to 3 ($\Delta M = -0.95, 95\% \text{ CI } [-1.61, -0.29], t(36) = -3.54, p = .003$). There were no interaction effects between group*time ($F[1,36] = 0.10, MSE = 1.43, p = .756, \hat{\eta}_G^2 = .000$), group*level ($F[1.33,47.99] = 0.05, MSE = 3.91, p = .893, \hat{\eta}_G^2 = .000$), time*level ($F[1.82,65.64] = 2.08, MSE = 1.43, p = .137, \hat{\eta}_G^2 = .011$) or group*time*level ($F[1.82,65.64] = 0.61, MSE = 1.43, p = .531, \hat{\eta}_G^2 = .003$). The average of errors per task in the beginning compared to end is presented in Figure 3.

Insert Figure 3 about here

Activity-level in the beginning compared to the end between the ID group and MA group

The ANOVA on activity-level for group*time showed no significant main effect of group, ($F[1,36] = 1.69, MSE = 7.04, p = .202, \hat{\eta}_G^2 = .029$). The main effect of time was significant ($F[1,36] = 12.70, MSE = 3.90, p = .001, \hat{\eta}_G^2 = .112$). Multiple comparisons showed a lower activity-level in the beginning compared to the end ($\Delta M = -1.76, 95\% \text{ CI } [-2.69, -0.84], t(36) = -3.87, p < .001$). Results also showed a significant interaction effect between time and group ($F[1,36] = 9.57, MSE = 3.90, p = .004, \hat{\eta}_G^2 = .087$). The ID group had a lower activity-level in the beginning compared to the end, ($\Delta M = -3.17, 95\% \text{ CI } [-4.55, -1.80], t(36) = -4.68, p < .001$). However, the MA group did not differ over time ($\Delta M = -0.35, 95\% \text{ CI } [-1.59, 0.88], t(36) = -0.58, p = .565$). No other comparisons were significant ($p > .10$). Activity-level throughout the training can be seen in Figure 4. The interaction effect between groups and activity-level can be seen in Figure 5.

Insert Figure 4 about here

Insert Figure 5 about here

Discussion

We have presented an everyday planning tablet-based training program and investigated the feasibility of the program for individuals with ID compared to individuals with a typical development matched on MA. The analyses revealed several interesting findings. By analysing data from using the training program, we found that the training program was feasible, but only for a sub-group of individuals with ID. There were more individuals with ID who were excluded due to not training above the cut-off level, this could not be explained by investigating the correlation between usage-time and MA. Furthermore, we did not see a change in the activity-level in the MA group, whereas the ID group increased their activity in the end compared to the beginning. This suggests that the ID group needed a longer time to be familiarised with the training program, but that they caught up during the training. However, the difference in activity-level between the groups did not show in improvement-rate across levels, where both groups improved their performance equally.

Being able to use the training program and compliance

The reason for the large number of individuals in the ID group not meeting the inclusion cut-off is not known. Usage-time was not correlated with MA in the ID group, indicating that MA cannot account for the difference in usage-time in this group. The results imply that the training program for everyday planning is feasible for a sub-group of individuals with ID and that the intervention can be implemented in

this population, which is following earlier literature on WM training (e.g. Lanfranchi et al., 2017; Söderqvist et al., 2012). However, future research should investigate how to further increase compliance for all individuals with ID throughout the training. Usage-time correlated with MA in the comparison group, meaning that participants with a typical development and lower MA trained for a shorter period. This indicates that the feasibility for individuals with a typical development and lower MA is lower than for those with higher MA which was not the case for individuals with ID.

Even though the ID group had a higher number of participants not meeting the inclusion cut-off, a majority of the individuals in the ID were able to learn and use the program on their own. For those individuals that met the cut-off criteria, there were no group differences between the ID group and the MA group on how much they improved in the program, regardless the level of difficulty of the task. This suggests that individuals with ID were able to learn as much as their MA peers in a program aimed at training everyday planning. Thus, the training program does not appear to require another adult for supervision, which was a proposed reason for the intermediary-usage of ATC (Palmqvist & Danielsson, 2019). The reason for the larger drop-out in the ID group on usage-time could be due to external factors such as school absence, sickness, or the teachers forgetting to allow the participants to train every day. These variables were not measured in the study. Thus, the lower feasibility in the ID group might be reduced by more carefully following up on usage-time during (and not only after) the training.

The MA group did not show a change in activity during the training, they were using the same number of clicks in the beginning compared to the end of the period. The ID group, however, were increasing their activity and were faster at the end of the training. This implies that individuals with ID were using a more careful or perhaps exploratory approach at the beginning of the training. Maybe, the ID group needed more time to get to know the environment and to feel confident when exploring the program and thus needing a familiarisation period. Interestingly, this group-difference in behaviour did not result in a lower learning rate, as both groups improved to an equal extent. The lack of difference implies that the groups did not differ in planning ability, or at least not in their ability to improve in the training program. Rather, the participants might have used different strategies for solving the tasks. As Bray et al. (1997) and Poloczek et al. (2016) have suggested, individuals with ID do use and learn strategies for solving different types of cognitive tasks but use fewer and qualitatively different strategies compared to individuals without ID.

Theoretical implications of the difference between the groups

The results showed that individuals with ID improved as much as their peers matched on mental age, which is in line with the earlier literature stating that individuals with ID perform on par with groups matched on MA on planning tasks (e.g. Danielsson et al., 2010; Numminen et al., 2001; Van der Molen et

al., 2007). We could not find that individuals with ID perform at lower levels than their mentally age-matched peers, which Danielsson et al. (2012) found in their study.

This study investigated the activity-level during the use of the training program and was therefore able to compare if the groups differed in strategy-use when learning the program. It was found that the ID group needed a familiarisation period before they were as active as the participants in the MA group. We, therefore, hypothesize that individuals with ID are using different strategies compared to the MA group when solving the tasks in the beginning, but that they develop their strategies throughout the training. This behaviour was unique to the ID group and could not be observed in the MA group. The captured difference in familiarisation between the groups can be explained by the groups demonstrating both qualitative and quantitative differences in strategy use.

This way of analysing intervention data can provide new ways of testing cognitive theories of ID. The most common models of ID are the difference model and the developmental delay model of ID (Bennett-Gates & Zigler, 1998). The difference model of ID states that individuals with ID have specific deficits in cognitive functioning and atypical cognitive development. This model is contrasted by the developmental delay model which states that individuals with ID follow the same pattern of development as individuals with a typical development, but progress at a slower rate (Bennett-Gates & Zigler, 1998). The results from our study, suggest that even though the groups were matched on mental age, individuals with ID differ qualitatively from individuals with a typical development, a result in line with the difference model of ID (Bennett-Gates & Zigler, 1998).

Conclusions

A tablet-based program offers a potentially feasible intervention for teaching everyday planning to adolescents with ID, but the time the training program is used should be monitored. The outcomes of this study suggest that a tablet-based training program can be beneficial for adolescents with ID and the intervention has the potential to be implemented as part of a daily program of instruction within a school setting. Furthermore, the study found that individuals with ID needed more time to get used to the program but were still able to learn as much as their MA peers. This shows that it is important to consider the length of time when assessing digital support for this group. Finally, the difference in behaviour in combination with a similar learning outcome provides evidence in favour of the difference model of ID when describing tablet-based planning training.

Future considerations

Even though many participants did not train as much as intended, both groups were able to display learning in the task and both groups were able to navigate in the program without the help of another adult or teacher. This result is promising with regards to using tablet-based training programs for interventions for individuals with ID, but also highlights the importance of monitoring that the training de facto is carried out. The next step is to investigate the potential to train the individuals' proficiency in everyday planning, to increase their independence and reduce the role of intermediary users.

The results emphasise the importance of bearing in mind the familiarisation period when assessing and evaluating the efficacy of a cognitive support and intervention programs, such that an ATC or intervention is not discarded before the individual has had enough time to get used it.

Declaration of interest

All authors declare that they have no conflicts of interest. The authors alone are responsible for the content and writing of this article. The study was funded by [text removed for blinding].

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Figure 1: A flow chart of the exclusion process

Table 1

Diagnoses in the ID group

Diagnoses	<i>n</i>
Mild intellectual disability only	9
Down Syndrome	1
William Syndrome	1
Mild intellectual disability and Attention deficit hyperactivity disorder	2
Mild intellectual disability and language disorder	2
More than one additional diagnosis	2
Total	17

Table 2

Descriptive statistics of included variables presented by group. Groups are compared using t-tests.

	Intellectual Disability			Mental Age-matched			<i>p</i>
	<i>M</i>	<i>SD</i>	(<i>Range</i>)	<i>M</i>	<i>SD</i>	(<i>Range</i>)	
Chronological age	17.91	1.501	(16, 21)	7.65	0.736	(7, 9)	<.001
Mental age	8.29	1.14	(6, 11)	8.49	1.01	(6, 10)	1.000
Usage-time	260	37.1	(191, 307)	253	38.2	(181, 311)	1.000
Activity-level beginning	4.57	1.33	(2, 7)	5.18	1.49	(2, 7)	.970
Activity-level end	7.74	3.97	(2, 18)	5.53	1.86	(3, 10)	.209
Improvement-rate Level 1	1.01	1.424	(-1, 5)	1.59	0.928	(0, 4)	.853
Improvement-rate Level 2	1.44	1.40	(-1, 3)	1.33	1.62	(-2, 4)	1.000
Improvement-rate Level 3	0.788	2.5	(-6, 4)	0.628	1.7	(-4, 3)	1.000

Note. Mental age and chronological age are presented in years. *p*-values are corrected for multiple comparison.

Figure 2: The cumulative distribution of the time spent training in the program. The y-axis equals the proportion of participants and the x-axis the time spent training in minutes. Data is divided into the two groups where the ID group is represented in red and the comparison group in blue. Note. The results are based on the groups before they were matched on mental age and before the usage-time cut-off.

Figure 3: Total number of errors per task separated on group and time for each level. The central tendency measure is represented with means, and error bars represent 95% confidence intervals. *Note.* ID = Intellectual Disability, MA = Mental age-matched

Figure 4: Graph showing clicks per every five minutes throughout the training. The number of clicks is presented on the y-axis. Time is presented on the x-axis.

Figure 5: Bee plot of activity-level separated by group. The central tendency measure is represented with means. Error bars represent 95% CI. *Note.* ID = Intellectual Disability, MA = Mentally age-matched.