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Development of Self-Help, Language, and Academic Skills in Persons With Down Syndrome

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Abstract

Using visual analysis by means of scatterplots, correlational analysis, and linear regressions, the authors explored the skills of individuals with Down syndrome in the areas of self-help, language, academics, and computer skills. By combining data of several Dutch studies, they obtained 1,252 different observations made by parents on 862 individuals, aged <1–35 years. Research shows advancement in language skills up to the age of 12, with plateauing afterward. In contrast, self-help skills still increase in adolescence and young adulthood. Academics and computer skills improve up to the age of 14. However, less developed academic skills (and computer skills) of adolescents and young adults appear to be a generational difference, rather than a loss of acquired skills. In their analysis, the authors differentiated between students with a primarily regular school career vs. those with a primarily special school career. In addition, in both groups, the studies were differentiated between students with an IQ >50 vs. an IQ between 35 and 50. The comparison between the various subgroups revealed that children with special education backgrounds in the higher IQ range demonstrated less advanced academic skills than children with regular education backgrounds in the lower IQ range. This suggests that regular education is more stimulating for academic skill development. Using age, "school career," and IQ (<35; 35–50; 50–60; 60–70; >70) as predictors, regressions confirmed this conclusion. The authors conclude that their analyses show that the shift in the early 1990s in the Netherlands toward more inclusion in education for students with Down syndrome has led to better outcomes in academic skill development for these students.

Keywords: academic skills, Down syndrome, inclusive education, intellectual disability, language skills, self-help skills

Introduction

Before the mid-1980s, in the Netherlands, there were no early intervention services for families with a child with Down syndrome and almost no possibility for these children to enter regular education. This rapidly changed in the late 1980s and early 1990s, due to the lobbying of parent organizations, notably the Dutch Down Syndrome Foundation (Stichting Down Syndroom, SDS). In recent years, in the Netherlands, around 68% of the parents of young children with Down syndrome make use of an early intervention program, and around 60% of these parents receive professional support in working with such a program (de Graaf, de Graaf, & Borstlap, 2011). With respect to inclusion in education, in the late 1980s and early 1990s, the numbers of children with Down syndrome starting in a regular school were rising fast (de Graaf, van Hove, & Haveman, 2014). Since 1995, an estimated 56% of all children with Down syndrome in the Netherlands start their school career in regular education (de Graaf et al., 2014). Further, as special classrooms inside regular schools are very rare, education almost always involves placement in a regular classroom with a certain amount of extra support (de Graaf & van Hove, 2015).

With some differences in timing—in comparison with, for instance the UK, New Zealand, the United States, and Australia, the Netherlands was relatively late in offering early intervention services to families and in the inclusion of children with Down syndrome in regular schools—similar developments have been reported in other Western countries. In two studies, developmental differences between generations before and after this shift were systematically explored. Using parent questionnaires, Bochner and Pieterse (1996) studied the skills of 66 young Australians (13–20 years old) with Down syndrome born between 1971 and 1978 in New South Wales. Of the 66 participants in their study, 50% had started their education in a regular classroom in a regular school, and another 18% in a special classroom in a regular school. The researchers compared their results with data on achievement levels reported in earlier British and American studies of students with Down syndrome. In these earlier studies, almost no children with Down syndrome had been in a regular school. In comparison with the students from earlier studies, the New South Wales' students had similar personal and leisure skills; however, they had attained higher levels in academic areas, were more independent, required less supervision, and had more optimistic futures in terms of integrated employment and accommodation options. In 1999, using a self-designed parent

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questionnaire, the Vineland Adaptive Behaviour Scale and the Conners Rating Scales, Buckley and colleagues (reported in Buckley, Bird, & Sacks. 2006; Buckley, Bird, Sacks, & Archer, 2000a, 2000b, 2006) studied the development of 46 UK teenagers with Down syndrome, 28 in special schools and 18 in inclusive schools. As school placement had not been determined by child characteristics but by differences in educational policy in different geographical areas, this study can be considered to be a natural experiment. The comparison between the specially and regularly placed teenagers revealed no differences in overall outcomes for daily living skills or socialization; however, regularly placed students had much higher scores on speech, language, and academic skills than their special-placed counterparts. In 1987, the authors had used the same self-designed parent questionnaire for investigating the development of a group of 90 teenagers with Down syndrome. The teenagers of this earlier generation were in special schools. In comparison with the 1987 group, the 1999 group had higher scores on speech, language, and academic skills. It appeared that this generational difference could be fully explained by the higher level of these skills of the students with Down syndrome in regular educational settings in the more recent cohort.

In a study in Italy conducted in 2006, Bertoli et al. (2011) using questionnaires for people with Down syndrome and their family members, collected information on quality of life of 518 individuals with Down syndrome living in Rome, ranging in age from <1 to 64 years. In Italy, inclusion in mainstream schools has been in effect since 1971. Special classes were abolished by law in 1977 (Bertoli et al., 2011). The authors found that among the 5-year age groups between 14 and 40 years (all entering school after 1971), there were no strong or systematic differences between the reading abilities by age group. In these age groups, between 34% and 52% could read easily, and between 6% and 24% could not read at all. Above 40 years of age (entering school before 1971), the percentages that could read easily appeared to be lower (11%–29% for the different age groups above 40 years), and the percentages that could not read at all seemed to be higher (24%–61%). Of course, above the age of 40, effects of aging can play a role. However, the consistency in reading abilities in the age groups between 14 and 40 years of age suggests that in Italy, as a result of educational inclusion, the shift to more favorable educational outcomes for students with Down syndrome indeed was made already in the 1970s. However, explicitly embracing the inclusive educational approach, the authors state that the data presented in their article also suggest an urgency to focus on the lack of social and health support for adults with Down syndrome. The authors report that after 20 years of age, only 30-40% of people with Down syndrome were found to be involved in some work or educational activity.

Specific Aims

In this study, we explored the skills of individuals with Down syndrome in the areas of self-help, language, and academics. Specifically, explored were differences in development by age and school placement, especially focusing on the effects of regular vs. special education. Consequently, our research yielded detailed information on the concrete skills of persons with Down syndrome at different ages, currently in the Netherlands. This level of detail allowed for comparisons with data from other studies. In this article, we use the term "regular school placement" to refer to the situation in which a child with Down syndrome goes to the same school and is in the same classroom as age peers without disabilities. There may be some individual instruction outside the regular classroom, but for most of the day the child is with his or her peers without disabilities. However, learning goals are individualized, if necessary.

Method

Sample

By combining the data of two Dutch studies with parent questionnaires, a study starting in 2006 with measurements in 2006, 2007, and 2010 and a cross-sectional study in 2009, we obtained 1,252 different observations made by parents on 862 persons with Down syndrome in the age range <1–35 years. In both studies, participants were approached by the Dutch Down Syndrome Foundation. From 1986 onward, the database of the Dutch Down Syndrome Foundation is highly nationwide representative of all children with Down syndrome. For instance, in 2006, approximately 80% of all children with Down syndrome in the age range 5–12 years were represented in this database (de Graaf et al., 2014).

In the 2006-study, 259 parents with children from the years of birth 1993–2000 and 92 parents with children from the years of birth 1987–88, taken out at random from the database of the Foundation, were contacted by telephone and asked to complete a short questionnaire with questions on their child's school history and reading abilities. This yielded a response of respectively 98% and 100%. From the first group, a smaller random sample (stratified for age and sex) of 160 parents of children with Down syndrome (all attending a school; children in special day care center were excluded from this sample) was requested to complete a more extensive questionnaire with questions about their child's writing and mathematics skills, self-help skills, and language abilities, the parents' educational level, and the extent to which they worked at home on academics (according to their own perception on a 5-point scale). The response rate was 75%. All of these 160 parents were requested to participate in a follow-up in 2007 and in 2010 (in 2007 with questions about school history, language, self-help, and reading abilities; in 2010 with questions about school history and reading abilities). In 2010, 142 of these respondents were still in the study (of which 115 had completed the extensive questionnaire in 2006).

The 2009 study was an online questionnaire with more than 800 questions, including the questions from the extensive 2006 questionnaire about academic, self-help, and language skills. Of the 835 parents who started filling in this questionnaire, 56% completed all questions. There were no systematic differences between parents who completed all questions and parents who only completed a part of the questionnaire. Parents of children of all ages were invited to fill in the questionnaire. However, as very few parents with children above 35 years participated, the analyses were limited to persons age 35 and younger.

TABLE 1
Number of data in the pooled studies

Area	Number of data	Number of persons
Reading	1252	862
Writing	640	640
Mathematics	645	645
Self-help	804	677
Language	807	680
Computer skills[a]	508	508

[a]Only in the 2009 study.

Instruments

The decision was made to use a questionnaire, instead of directly measuring development with tests. The choice for a questionnaire made it easier to study a relative large sample, and it heightened the chance for a greater response, and, as a result, to achieve a highly representative sample. Direct testing is very time consuming for the researcher and can be expected that more parents will not want to have their child in the study.

With respect to the disadvantage of using this approach, an important methodological issue was whether the data concerning the child's development derived from questionnaires could be interpreted as more than only subjective perceptions of parents. However, in an earlier pilot study in a sample of 18 cases parents' and teachers' questionnaires were obtained. Parents' and teachers' overall scores for the relevant different developmental areas (reading, writing, mathematics, self-help, and language) had a high correlation (0.85–0.96), so these overall scores may be interpreted as an index for development. It was decided that the process chosen over-rode any potential problems.

We measured the skills in reading, writing, mathematics, and language (and in the 2009 study computer skills as well) of the persons with Down syndrome using a questionnaire with questions about well-defined concrete skills ("*Is your child able to do it or not?*"), arranged from easy skills to more advanced. An overall score was derived by counting up the "yes" scores (no = 0 and yes = 3). Self-help skills were measured using 4-point scales, with answer categories reaching from cannot do it at all (score = 0), only with a lot of help (score = 1), with some little help (score = 2), or totally independent (score = 3). For the pooled data, the homogeneity measure of Cronbach's alpha is between 0.89 (language and computer skills) and 0.97 (mathematics).

Pooling the Data

By combining all data on reading skills 1,252 different observations made by parents were obtained on 862 persons with Down syndrome in the age range <1–35 years. Because not all respondents were participating in the 2006 extensive questionnaire and because in the follow-ups not all areas of development were represented, we had less data on the other developmental areas; however, the data were from considerably sized samples, as shown in Table 1. In addition, data on IQ were available on 403 persons, of which 343 parents also filled in questions on development in at least one of the skill areas under observation. This group is relatively small, because many younger children had never been tested. In Table 2, demographic data are given on the persons in the pooled studies; all data from the 2009 cross-sectional study are included. However, for the longitudinal study starting in 2006, if more than one data point per person was available, the most recent data point was selected and the earlier data points were excluded so each person is represented only once.

Why were data pooled from two different studies? First, it made the numbers of observations per age group much larger, so there would be less random variation. Second, it could be argued that the samples are taken from the same original group, that is, children with Down syndrome in the database of the Dutch Down Syndrome Foundation. It was expected that these samples would yield the same results, thus making it acceptable to pool the data. The assumption that the samples were not principally different, but could be treated as deriving from one group, was checked by linear regressions (using "sample" as covariate).

Analyzing by Type of School Placement

Next, students with a mainly regular school career vs. students with a mainly special school career were differentiated and the data analyzed. Students in the first group were still in regular school or had been in regular school for 5 or more years before being transferred to special education. Students in the second group were in a special school. If they had been in a regular school before special placement, their regular career was for fewer than 5 years. An important question is: do children with Down syndrome acquire more skills in academics in regular education because the children with more potential have a higher chance to be in regular education? Or, do they learn more academics because regular education is more stimulating and effective? To answer these questions, the development of children with a mainly regular vs. a mainly special school career by IQ group is described, differentiating between an IQ above 50 and an IQ between 35 and 50.

Visual Analysis and Regressions

A visual analysis employing scatterplots was used to explore the relations between skill development, age, school career, and IQ. The findings from this visual analysis were checked by additional correlational analysis and linear regressions. In all analyses, if there were more observations on one individual (in the 2006 study, self-help skills, language, and reading were followed up), the most recent data point was used for these persons and the earlier data points were excluded. Only in constructing Figures 3 and 4, alternatively, was the decision made to include all data points (so some children are more than once represented in these Figures) to have as many observations as possible per age group.

TABLE 2
Number of persons by age, school career[a], and IQ for the different skill areas[b]

	Reading	Writing	Mathematics	Self-help	Language	Computer
Total number of persons (and observations)	862 (1252)	640 (640)	645 (645)	677 (804)	680 (807)	508 (508)
Age group						
<5	234	241	243	245	247	232
5–10	141	198	199	198	198	109
10–15	250	93	93	121	121	59
15–20	184	53	54	57	57	53
20–25	37	38	39	39	40	38
>25	16	17	17	17	17	17
School career						
Mainly special	338	188	190	199	199	126
Mainly regular	288	218	220	226	226	148
Not in school	236	234	235	252	255	234
IQ						
<35	42	34	34	35	35	24
35–50	131	121	124	128	129	77
50–60	127	124	124	127	127	87
60–70	29	29	29	32	32	21
>70	14	12	12	14	14	9
Not known	519	320	322	341	343	290

[a]Students with a mainly regular school career were still in regular school or had been in regular school for 5 or more years before being transferred to special education. Students with a mainly special school career were in special school, or, if older than 18, had been in a special school up to age 18. If they had been in regular school before special placement, their regular career was for fewer than 5 years. Not in school are children who have not yet started their school career.
[b]All data from the 2009-cross-sectional study are included. However, for the longitudinal study starting in 2006, if more than one data point per child was available, we selected the most recent data point, and excluded the earlier.

Comparison with Other Studies

Regarding concrete skills, for some questions which were highly similar in content, a comparison was undertaken between our results and the results of the study by Buckley and colleagues (2002a, 2002b; Buckley, Bird, & Sacks, 2006; Buckley, Bird, Sacks, & Archer, 2006).

Findings

Results by Age and School Placement

In Figure 1 (using a SPSS nonlinear regression function to construct the lines), the skills by age are presented for the total group and for individuals with a mainly regular vs. a mainly special school history. With regard to self-help skills, the line for the total group, as well as the lines for both subgroups, continuously keeps rising with age. This suggests that persons with Down syndrome might still be acquiring more independency in self-help skills during adolescence and young adulthood. Looking at the relation between age and self-help skills, there is a strong positive correlation (Pearson correlation of 0.74; $p < .001$ between these variables in the preschool years (<1–5 years of age) and in the primary school years (0.47; $p < .001$ 5–14 years of age).[1] Above 14 years of age this correlation is statistically insignificant. The data show advances in language skills, as measured in the questionnaires, up to the age of 12, then reaching a more or less constant level. This plateauing is confirmed by the correlations between age and skill, positive in the preschool years (0.70; $p < .001$) and primary school years (0.25; $p < .001$), but slightly negative and not statistically significant—above 14 years of age.

The three academic areas, and computer skills as well, show a different picture over the age range. For the total group development continues up until 14 years of age and then appears to be declining. This decline is confirmed by correlational analysis. In the preschool years, there is a positive correlation between age and skills for reading (0.30; $p < .001$, writing (0.39; $p < .001$), mathematics (0.30; $p < .001$), and computer skills (0.27; $p < .001$). In the primary school years, these correlations appear stronger, for reading (0.52; $p < .001$), writing (0.64; $p < .001$), mathematics (0.63; $p < .001$), and computer skills (0.64; $p < .001$). Above 14 years of age, these correlations are negative for reading (−0.13; $p < .03$),

[1]In the Netherlands, children with Down syndrome often go to primary school up to age 14.

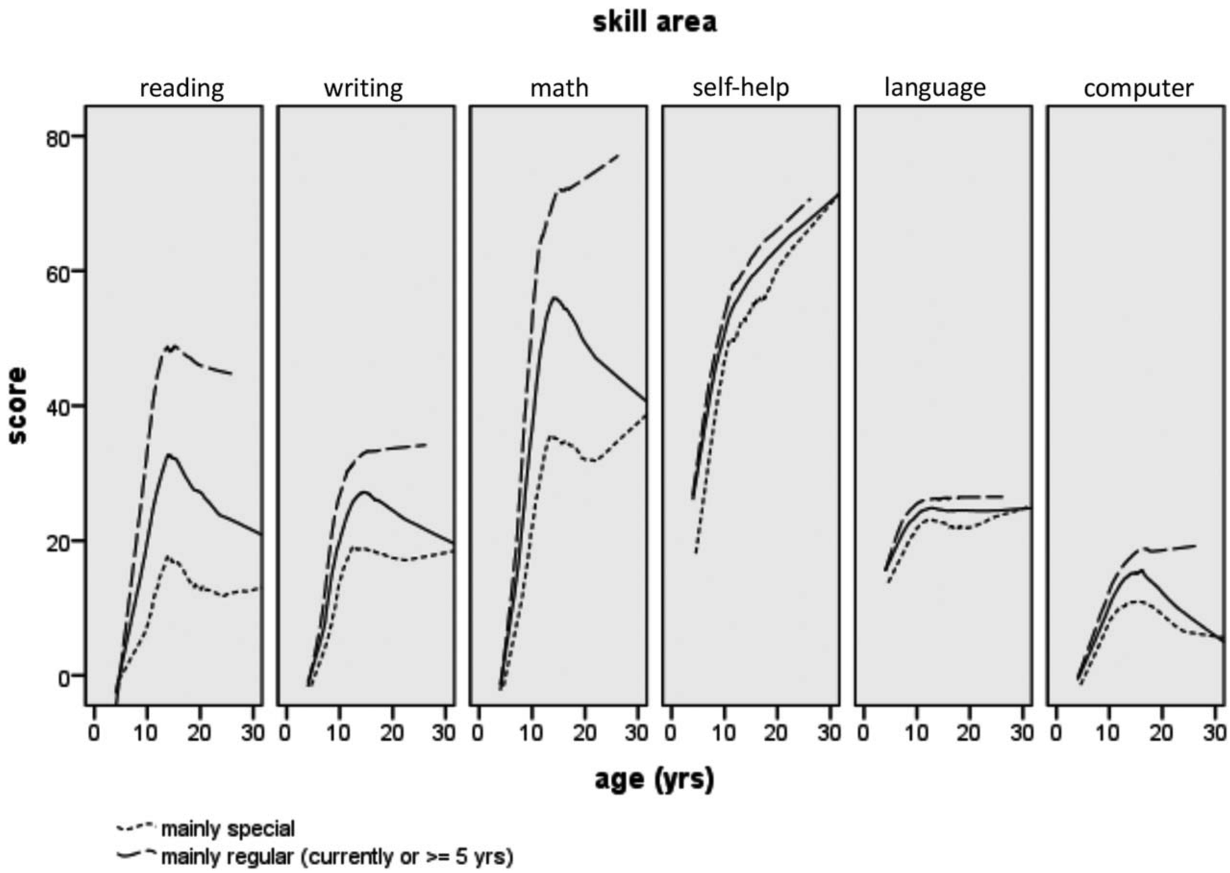

FIGURE 1

Skills by age. Comparison between students with a different school history.

writing (-0.19; $p < .04$), mathematics (-0.16; $p < .07$; however, statistically not significant), and computer skills (-0.31; $p < .000$). It seems likely that this differential decline may have one major cause. Older persons with Down syndrome were much more often in special schools in their primary years than among those in the more recent generation. As shown in Figure 1, students with primarily a regular school history do better in academic and computer skills. A second possibility might be that within the same category of "school career," the academic and computer skills of some students might decline after 14 years of age, as Figure 1 seems to suggest for reading and computer skills. However, this hypothesis was not confirmed by a correlational analysis. Above 14 years of age, if analyzed separately for people with a mainly regular school career and people with a mainly special school career, there were no significant correlations of age with reading, writing, mathematics, or computer skills.

Results by Age, School Placement, and IQ Group

We observed that the children under study who had primarily a regular school career more often had an IQ over 50 than did children with primarily a special school career. Among children of 9 years of age and older with primarily a regular school history, 69% had an IQ over 50, whereas of their same-aged counterparts with a mainly special school history, 40% had an IQ over 50. This suggests a selection process in which children who have more learning potential have more chance to be allowed to enter and to stay longer in regular education.

However, when we compared children with an IQ over 50 with primarily a special school history with children with an IQ 35–50 with primarily a regular school history, a strange phenomenon was observed. As shown in Figure 2, the group with an IQ 35–50 and a regular school history was doing better on academic skills, and to a lesser extent on language and computer skills as well, than the group with an IQ over 50 and primarily a special school history. As these differences cannot be accounted for by differences in learning potential (i.e., IQ), this suggests that regular education is more stimulating, in particular for academic skill development.

To verify the results as represented in Figure 2 in a more formal statistical way, regressions were run with predicted skills in each area with age, "school career," IQ (represented as the five IQ-categories as presented in Table 2) and "sample" (sample

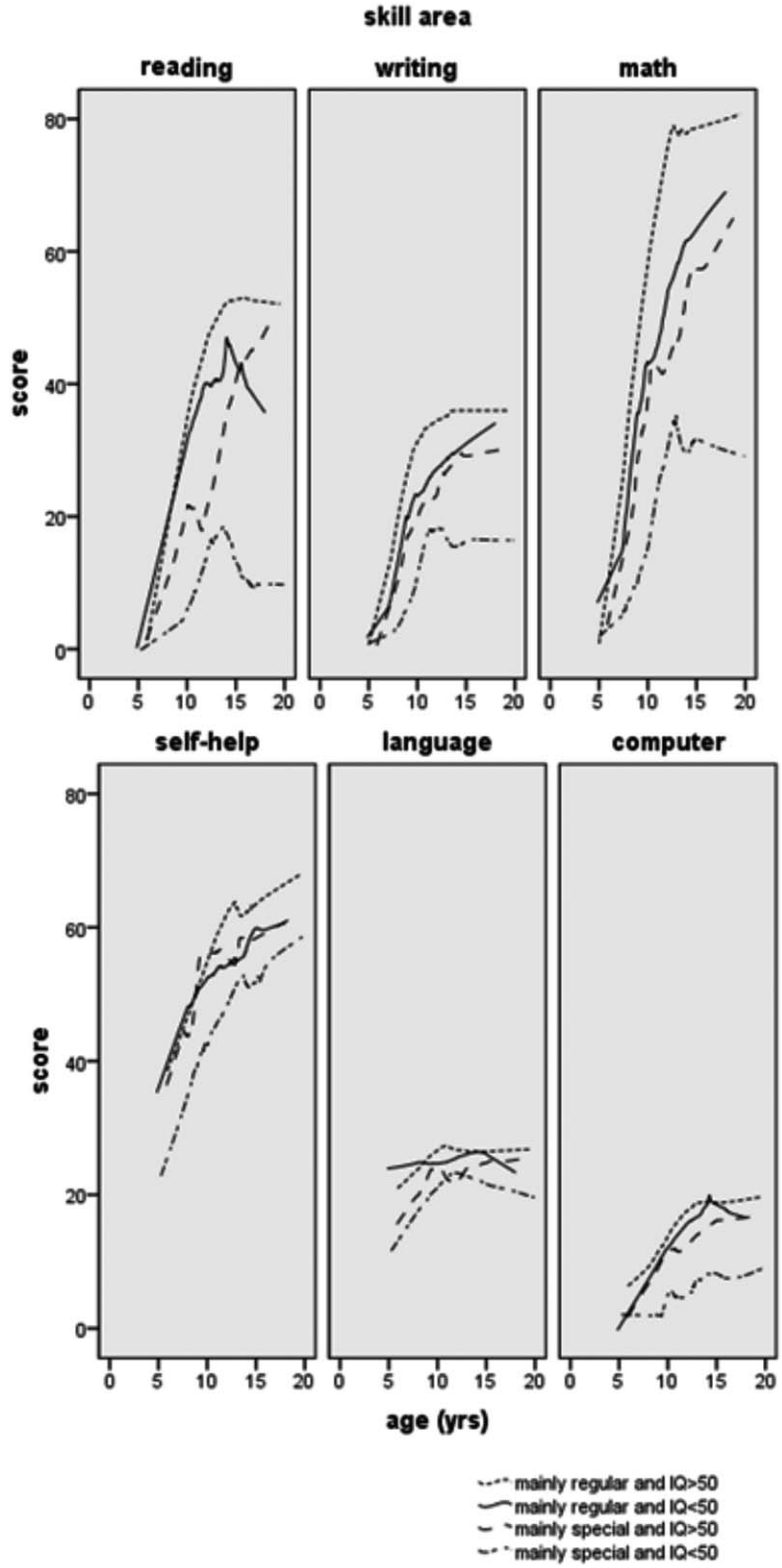

FIGURE 2

Skills by age. Comparison of groups differentiated by IQ and school history.

TABLE 3
Regressions predicting skills, with age, IQ, "school career"[a] and "sample"[b] as predictors, in the age group under 14 years

Area:	**Reading**	**Writing**	**Mathematics**	**Self-help**
Sample:	2009 + 2006[a]	2009 + 2006	2009 + 2006	2009 + 2006
R-square	0.66	0.65	0.66	0.50
d.f.	162	196	197	204
F	76.0	88.3	92.9	50.8
$p <$	.001	.001	.001	.001
Independents	Beta ($p <$)	Beta ($p <$)	Beta ($p <$)	Beta ($p <$)
Age	0.61 (0.000)	0.68 (0.000)	0.67 (0.000)	0.57 (0.000)
IQ	0.23 (0.000)	0.30 (0.000)	0.30 (0.000)	0.34 (0.000)
"School career"	0.44 (0.000)	0.28 (0.000)	0.27 (0.000)	0.19 (0.000)
"Sample"	0.09 (0.10)	−0.02 (0.6)	0.04 (0.3)	−0.02 (0.7)
Area:	**Language**	**Language**	**Language**	**Computer**
Sample:	2009 + 2006	2006	2009	2009
R-square	0.42	0.36	0.42	0.56
d.f.	204	107	96	94
F	35.8	19.9	22.7	39.3
p	.000	.000	.000	.000
Independents	Beta (p)	Beta (p)	Beta (p)	Beta (p)
Age	0.34 (0.000)	0.40 (0.000)	0.31 (0.000)	0.61 (0.000)
IQ	0.32 (0.000)	0.31 (0.000)	0.33 (0.000)	0.23 (0.003)
"School career"	0.32 (0.000)	0.31 (0.000)	0.34 (0.000)	0.27 (0.000)
"Sample"	−0.24 (0.000)	-	-	-

[a]Students with a mainly regular school career were still in regular school or had been in regular school for five or more years before being transferred to special education. Students with a mainly special school career were in special school, or, if older than 18, had been in a special school up to age 18. If they had been in regular school before special placement, their regular career was for less than five years. Not in school are children who have not yet started their school career.
[b]All data from the 2009-cross-sectional study are included. However, for the longitudinal study starting in 2006, if more than one data-point per child was available, we selected the most recent data point, and excluded the earlier.

from first or second study) used as predictors. "Sample" was added as a predictor as an extra check for the similarity of the samples in the two studies. As most of the skills seem to level off in adolescence and young adulthood, regressions were run separately for two age groups, that is, children up to 14 years, and adolescents and adults of 14 years of age and older.

Looking at the regressions for the age group up to 14 years, "sample" was not significant in most of these equations. However, one exception is the regression predicting language (beta coefficient for "sample": −0.24; $p < .001$). As, in relation to language skills, perhaps the samples of both studies could not be treated as one sample, additional regressions were run predicting language separately for the 2006 study and the 2009 online sample.

Table 3 presents the results of all the relevant regressions for the age group up to 14 years. The most important finding is that age, IQ and "school career" are highly significant predictors ($p < .001$) in all regressions, confirming the results of the visual analysis in Figure 2. Beta coefficients for IQ and "school career" are similar in most of the regressions, highlighting the role of both cognitive capacities and school type in skill development. In the predictions of reading, the beta coefficient for "school career" clearly exceeds the beta for IQ, signifying that reading is the skill area most strongly related to going to a regular school. In contrast, in the regressions predicting self-help skills, the beta coefficient for IQ exceeds the beta for school career, suggesting that this skill area is less strongly connected with regular schooling. In the regression for the age group above 14 (not presented in a table), "sample" is not a significant variable in predicting reading scores. This check only applies to reading, as for the other areas, the 2006 study and follow-ups do not contain data of children above 14 years of age.

In none of the regressions, age is a significant predictor, with the exception of the regression predicting self-help skills. These results confirm the levelling off after 14 years of age in the development of language, academic skills and computer skills, whereas self-help skills appear to still increase in adolescence and young adulthood, as was suggested by Figures 1 and 2. In contrast, IQ is a highly significant predictor in all the regressions ($p < .001$). In the prediction of language, reading, writing, mathematics, and computer skills, "school career" is a significant predictor, too ($p < .001$). In relation to reading, mathematics, and computer skills, beta coefficients for "school career" (0.42–0.49) exceed those for IQ (0.34–0.41). For writing, these coefficients are highly similar (0.42–0.44). In contrast, for language, "school career" shows a lower beta of 0.30, in comparison to 0.49 for IQ. In predicting self-help skills, "school career" was not a significant predictor ($p < .06$).

Other Modifiers

Adding sex to the regressions for the subjects with Down syndrome and educational level of the father and the mother (low, middle, high, high university) as predictors, did not lead to "school career" (nor IQ) losing significance. In stepwise regressions, for the group up to 14 years, sex had a statistically significant impact on language, self-help skills, and computer skills, that is, after correcting for the other variables (IQ, "school career," age of the child, and educational level of the parents), girls scored higher on language and self-help skills, but boys scored higher on computer skills. A higher educational level of the mother was associated with better mathematics skills, a higher educational level of the father with higher scores on writing. However, the effects of sex and of parental educational level were relatively small, with beta coefficients between −0.15 and 0.14. In the age group above 14 years of age, after controlling for the other modifiers, sex was associated with reading (females had higher reading scores) and the educational level of the father had a positive and significant correlation with mathematics. However, the beta coefficients were relatively small, respectively, 0.15 and 0.17.

Correlations Between Skill Areas

Using the 2006 data from the first study, in combination with the 2009 online questionnaire data, and using age as the control variable, the correlations between the academic skill areas (reading, writing, and mathematics) turn out to be very high, around 0.9. Correlations of these skills with computer skills are high too, around 0.8. Correlations between the academic skills and the other skill areas (language and self-help skills) are in the range 0.6–0.7, and the correlation between language and self-help skills is around 0.8. The high correlation between the scores for the three academic skill areas suggests that these scores could be treated as one skill area. However, by looking separately at these three areas, it was possible to find out that, in comparison with writing and mathematics, reading seems to be more strongly related to school type.

Detailed Information

We have presented information on total scores in different areas of development. However, these scores are based on information about concrete and very useful skills. Our research actually yields detailed information on the concrete skills of persons with Down syndrome at different ages, currently extant in the Netherlands.

Figure 3 shows by illustration an overview of a few of the separate reading skills as these were investigated in the questionnaires, differentiated for persons with primarily a regular or special school career. The same pattern can be observed when comparing the total scores, but now these can be described in more tangible terms. So, if we say that students with Down syndrome in regular schools have a higher score on reading skills, we actually are talking about the kind of differences as illustrated in this figure. For instance, more than 90% of adolescents with a mainly regular school history are able to read at least short stories of a few sentences and around 60% are able to read longer stories. Of their counterparts with a mainly special school history only between 30% and 45% (depending on which age group we are looking at in particular) can read short stories and only about 15% longer stories. It can be argued that these huge differences have an impact on functioning in daily life.

Comparison with Other Studies

This level of detail allows for comparisons with data from other studies. In this regard, the study of Buckley and colleagues (2002a, 2002b; Buckley, Bird, & Sacks, 2006; Buckley, Bird, Sacks, & Archer, 2006) is of interest because these researchers also differentiate between students with a different school history. Moreover, some questions were highly similar in content, making a valid comparison possible. We acknowledge that Buckley et al.'s study has a relatively small sample size; however, their study is covering all students in a certain geographical area, and thus we would expect the sample to be fairly representative. For that reason, we think a comparison is relevant.

Figure 4 shows the results for 10 items relating to reading, writing, or language. In the figure, we compared the percentages of individuals having acquired that specific skill at the age 11–20 in our study with the results on highly similar items in Buckley et al.'s study of teenagers with Down syndrome in the UK in 1999. It is quite remarkable how much the results show the same pattern and magnitude of differences by school history.

Discussion

For language, at least for the way we have measured it with questions about length of utterances and active vocabulary, development continues up until 12 years of age and then remains constant. In contrast, the visual analysis suggests that self-help skills still increase in adolescence and young adulthood. Although, this could not be confirmed by the systematic correlational analysis (looking at the correlation between age and skill for the subgroup of 14 years and older), in the regressions with IQ, age and "school career" as predictors (for the same age group), age was indeed a significant positive predictor of self-help skills.

The three academic areas, and computer skills as well, show a different picture. For the total group, development continues up until 14 years of age and then appears to be declining. It is important to note that this decline is in a cross-sectional study, which implies that perhaps there is a generational difference instead of a real plateauing or even a loss of skills. In fact, the observed decline appears to be related to generation, that is, that older persons with Down syndrome were much more often in special schools in their primary years than those persons in more

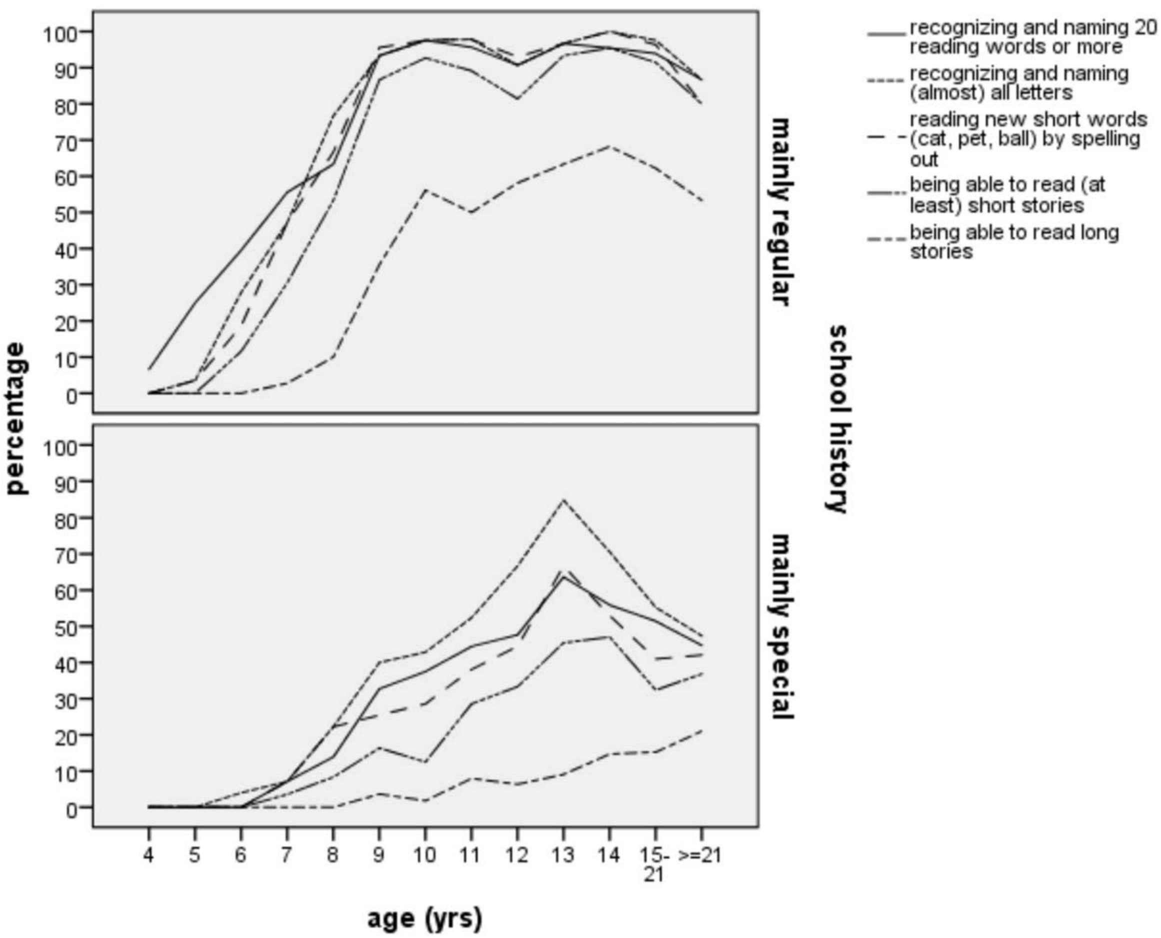

FIGURE 3

Some concrete reading skills by age. Comparison between students with a different school history.

recent generations. Students with primarily a regular school history do better in academic and computer skills. A second possibility might be that the academic and computer skills of the students within the same category of "school career" might decline after 14 years of age; however, in a systematic correlational analysis, this could not be confirmed. In addition, our 2010 longitudinal follow-up of the 2006 study (these students in 2010 being 9–17 years of age) showed that almost none of these students actually lost reading skills (other skills were not followed-up in 2010). In a UK-based study by Buckley et al. (2002a,b; Buckley, Bird, & Sacks, 2006; Buckley, Bird, Sacks, & Archer 2006), in regular and special schools alike, older teenagers tended to have higher scores on the Vineland subscales Daily Living Skills and Socialization Skills. Regularly placed teenagers tended to have higher scores with age on the subscale Communication (which includes reading skills) as well. This was not the case for specially placed teenagers. In this area, they seemed not to advance between 11 and 20 years of age. However, neither did their development decline. Our results and those reported by Buckley et al. suggest that losing skills is not a likely explanation for the difference between the younger adolescents vs. the older adolescents and adults in our study. The declining lines for academic skills and computer skills above 14 years of age appear to be due to a generational difference in educational stimulation in the primary school years, related to more possibilities for these children to enter regular education.

The differences between students with primarily a regular vs. primarily a special school history in academic skills, also after controlling for IQ, are in line with other recent studies, such as Buckley et al. (2002a,b; Buckley, Bird, & Sacks, 2006; Buckley, Bird, Sacks, & Archer, 2006), Turner, Alborz, and Gayle (2008), de Graaf, van Hove, and Haveman (2013), and de Graaf and van Hove (2015). It is important to note that in the study by Buckley et al., selective regular placement of more-able children did not occur, because in that particular historical context, school placement was not determined by child characteristics but by geographical area. Yet, in our study, in which selective placement played a role, very similar differences by placement were observed, also when focusing on specific skills. This corroborates the conclusion that in our study selective placement only partly accounts for the differences in academics by

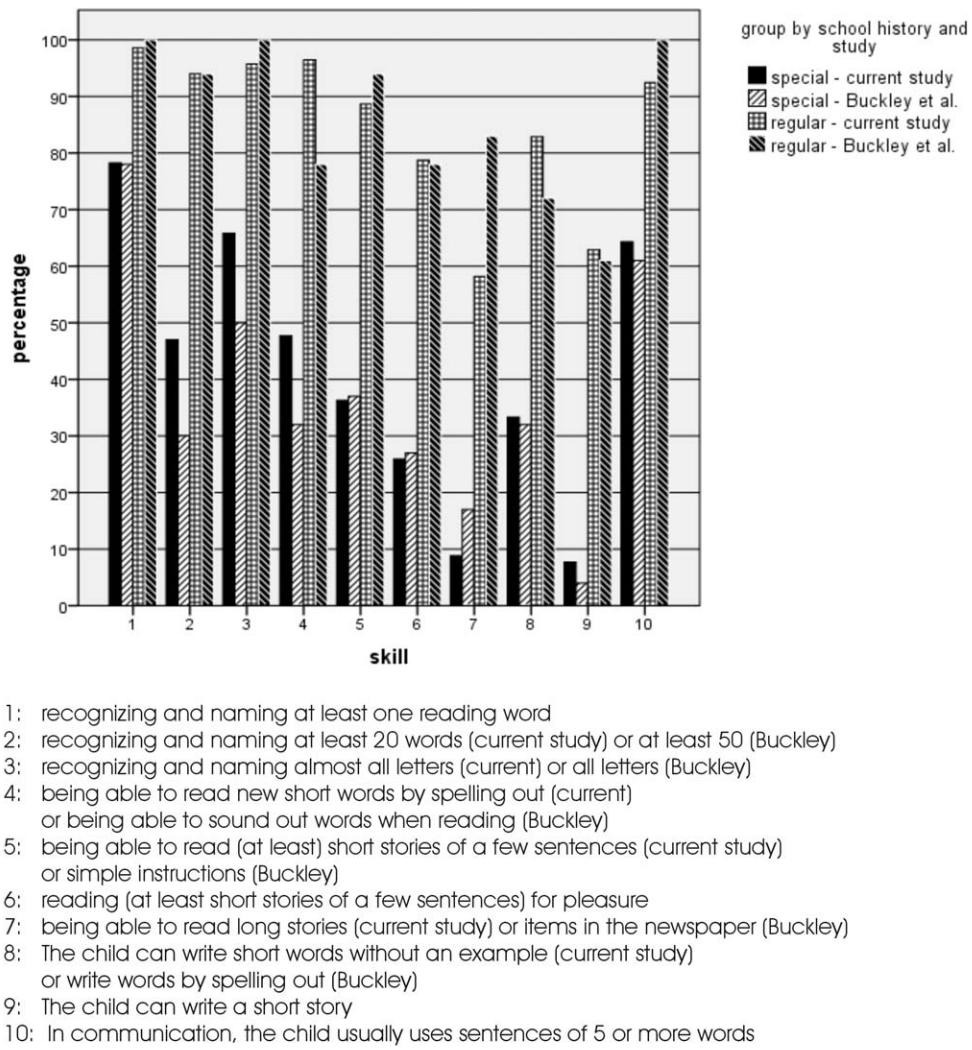

FIGURE 4

Some reading, writing and language skills. Comparison between teenagers with a different school history in the current study vs. teenagers in the study of Buckley et al. (2002a,b; Buckley, Bird, & Sacks, 2006; Buckley, Bird, Sacks, & Archer, 2006).

school history and that differential stimulation of skills in regular vs. special education plays a leading role.

A major methodological issue is whether the data on the child's development derived from questionnaires can be interpreted more reliably than subjective perceptions of parents. However, in an earlier pilot study, parents' and teachers' overall scores for the different developmental areas had a high correlation. Second, as de Graaf and van Hove (2015) note, studies where academic skills were not assessed by parent questionnaires alone, but instead or in addition, by either using teacher questionnaires (e.g., Lorenz, Sloper, & Cunningham, 1985; Philps, 1992; Sloper, Cunningham, Turner, & Knussen, 1990; Turner et al., 2008; Yadarola, 1996) or normative tests (e.g., Laws et al., 1995; Bochner, Outhred, & Pieterse, 2001; Casey, Jones, Kugler, & Watkins, 1988; Laws, Byrne, & Buckley, 2000) demonstrated similar advantages of regular placement for the academic skill development of students with Down syndrome. Nevertheless, it is recommended to undertake more studies in which development is measured in a more direct way, though finding tests that are valid for application to children with Down syndrome can be challenging, given their unstable performance and motivational problems during formal testing (Wishart, 1993; Wishart & Duffen, 1993).

In our study, we had a limited number of individuals above 25 years of age. However, we feel that these observations should be included, as there were no significant differences between the age group 20 and 25 and the age group above 25 in mean scores for the developmental areas studied. However, we would welcome studies in which more adults with Down syndrome are represented.

A limitation of our study is the way language was measured with only 10 items, relating either to expressive vocabulary size or to the length of utterances. This might be too undifferentiated to explore (expressive) language development, especially above 12 years of age. Thus, it is possible that there is some language development in the age range above 12 years which was missed in our study. We would like to see studies exploring language development, and the connection with school type, in a more differentiated way. Following the same line of argument, with regard to the measurement of self-help skills, we would recommend to use or develop instruments with more items that may capture development in adolescence and young adulthood in a more differentiated way.

Another limitation of our study is the fact that non-measured variables, which might differentiate regularly- and specially placed children, could perhaps also account for differences in development. We have explored this for sex of the person with Down syndrome, and for educational level of the father and the mother. Adding these modifiers to the regressions did not lead to "school career" (nor IQ) losing significance. However, in new studies other modifiers could be included, for instance health problems of the child, or the extent to which parents were involved in early intervention.

There is little research on the reasons why regular school placement is successful in stimulating the development in children with Down syndrome. More research is needed to shed light upon school, teacher, and parent characteristics that might play a role in successfully including children with Down syndrome in regular schools. Research into which elements contribute to good practice could benefit children with Down syndrome, in regular and special settings.

Our study supports the shift in the early 1990s in the Netherlands toward more inclusion in education for students with Down syndrome and supports the notion that this has led to better outcomes in academic skill development (and computer skills) for these students. As has been explained in the introduction, a similar shift, occurring in the 1970s in Australia and in the 1980s in the UK, led to the same developmental advantages for students with Down syndrome in these countries.

Furthermore, we argue that the huge differences in specific academic skills that were found between regularly and specially placed students, both in our study as in Buckley et al.'s, have an impact on functioning in daily life. In contemporary society, people are expected to acquire literacy and numeracy. In many everyday situations, people use their academic skills. Having mastered academic skills to a certain extent certainly helps people to participate. However, even limited academic skills can be of value. Just being able to write your own name or read a shopping list can increase opportunities for participation and independence. Not only regarding reading and writing, but also in relation to numeracy, we would argue too that even limited skills can contribute to participation and quality of life. In five case studies of adults with Down syndrome, Faragher and Brown (2005) demonstrate this point.

The advantages of regular school placement for academic skill development in people with Down syndrome are clear. In the light of the importance of academics in daily life, as a practical consequence, we should strive for placement in regular education, but with adequate support. Because in the current Dutch situation, regular placement for children with Down syndrome is rather selective, it is important to find out more about what type and amount of support at regular schools is adequate to make a regular career possible for more children with Down syndrome. The Italian educational system has shown that full inclusion in education for students with Down syndrome is a feasible goal. At the same time, the Italian study of Bertoli et al. (2011) emphasizes that inclusion during the school years is not enough. Thus, we should also focus on supporting adults with Down syndrome continue to participate in our society.

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