TNO report

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E-Learning Sudan – Pilot II
Descriptive analysis of the baseline study

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Contents

1   Introduction

E-Learning Sudan (ELS) is a custom built tablet game that provides alternative learning opportunities to Sudanese children who are excluded from education. Through the use of tablet-based learning, solar power and community facilitators the project aims to overcome the limitations of inadequate resources and traditional schooling opportunities. The long-term aim is to enable vulnerable children to develop the necessary skills and knowledge to acquire a Certificate of Primary Education. For pragmatic reasons we have started with the mathematics curriculum.

1.1   Pilot I

In a six-week pilot with 60 children in three remote villages, during the period November 2012 – January 2013, results showed a significant increase: children's scores on an oral mathematics test doubled from 19.4/60 on the pre-test to 38.4/60 on the post-test. Children in the control group, a fourth community, did not increase their scores in the same period.

Having thus proved that children can learn mathematics by playing the game, the project aims to generate a body of research that will help to understand the social impact, contribute to the knowledge on e-learning, and pave the way for scaling-up of the project.

1.2   Pilot II

Pilot II aims to repeat the learning results with a larger group of children (approximately 600), in more states and communities, over a longer period of time (six months). In addition to the educational research, demographic and geographic information, and psychosocial research is included to explore and establish the effects of learning and technology on the children and the communities in which they live.

1.3   Descriptive analysis of baseline study

This report summarises the results of the descriptive analysis of the baseline study of pilot II. The research method, and the reliability of results will be described concisely. Then the results will be presented and discussed. Finally the next steps will be described.

1.4   Partners

E-Learning Sudan is conceived through a collaboration between the Ministry of Education of Sudan, Ahfad University for Women in Khartoum and War Child Holland. It is funded through the Ministry of Foreign Affairs of The Netherlands, with additional funding from UNICEF Sudan. Curriculum and game development is provided by TNO. The game was produced by Flavour with support from creative partners in Sudan.

2 Method

For pilot II we aim to include 600 children from three different states. Within the states we will involve approximately 20 communities, aiming at equal numbers of children per state. The children will play the mathematics game for six months, five times a week, in learning sessions of 45 minutes a day. Facilitators will supervise the learning sessions.

Facilitators supervise the children while they are playing the game and can solve small technical problems. They do not teach mathematics. All facilitators have finished a training on child-friendly approaches, educational background of the game, and technical aspects of the game and the tablet. The training consisted of a combination of face-to-face meetings and distance learning; including discussions and assignments. During the week, facilitators live in the villages. In the weekends they can go home.

2.1 Geographic information

The following geographic information will be collected: name of state, locality and community, GPS location of communities, characteristics of community, distance to nearest primary school, and distance to nearest secondary school.

2.2 Demographic information

Demographic information from the participating children will be collected using a questionnaire. The information asked for is: age, gender, family situation (parents, education of parents and number of siblings).

2.3 Educational research

To assess progress of children with respect to mathematics, the children will take four oral mathematics tests during the pilot period. Each test consists of 30 items. A good answer receives 2 points; a good answer when asked a second time receives 1 point; a wrong answer receives no points. Children can score a maximum of 60 points on each test.
All tests will be taken as a pre-test and a post-test. The tests were developed on the basis of EGMA, an Early Grade Mathematics Assessment (USAID, 2009). The focus of this tool is on the early years of mathematics learning; that is, mathematics learning with an emphasis on numbers and operations and on geometry through second grade or, in developing countries, perhaps through third grade. The tests related to the subjects the children can learn by playing the game: numbers up to 20, addition up to 20, subtraction up to 10, and shapes. The most important difference with EGMA is that there is no time-limit in the tests used in this pilot. All tests have been approved by the National Council of Mathematics in Khartoum. In this baseline study only test A was used (see Appendix A).

2.4   **Psychosocial research**

To explore and establish psychosocial impact of learning and ICT on the children and the communities they live in, the children will answer an oral psychosocial questionnaire three times. In addition, there will be focus group meetings for children and for parents to gather more qualitative data about psychosocial effects. The constructs used are: Self-esteem, Self-efficacy, Motivation to learn, Social support, Future orientation, and Identity orientation. These construct were chosen as they are known to interact with learning outcomes. The questionnaire was developed on the basis of validated questionnaires and in cooperation with the School of Psychology in Khartoum (see Appendix B). Before actual use it was tested with 20 children in Khartoum to asses if children can answer the questions and to train the researchers in the use of the questionnaire.

Self-esteem is measured using four pictures of a tree (see Figure 1). The first tree was bare, the second tree had a few leaves, the third tree had quite some leaves and the fourth tree had many leaves as well as flowers. These trees relate to the 'tree of life' that is used for psychosocial research in Sudan. Children are asked to draw a tree that reflects how they feel about themselves. The drawings are then used to assess the level of Self-esteem.
This is in fact a four-point Likert scale. Children were asked to point at the tree that showed how they felt about themselves.

Figure 1   Pictures of trees, 4-point Likert scale for Self-esteem.

The other constructs in the psychosocial questionnaire are measured with five cups, ranging from an empty cup to a completely filled cup (see Figure 2, below). This is a five-point Likert scale. Children are asked to respond to statements. They point at the cup that suits their situation best.

Figure 2   Picture of cups, 5-point Likert scale for psychosocial questionnaire.

Table 1, below shows an overview of how the tests and questionnaire are used during the pilot. T stands for the time in weeks. T=0 means before the pilot starts. We will use a staggered approach: the communities will not start on the same date. Testing will be done according to the number of weeks the children have been learning with the game.

Table 1   Overview of tests and questionnaires during Pilot II.

	T=0	T=6	T=9	T=12	T=16	T=18	T=25
Mathematics test	A-PRE	A-POST B-PRE		B-POST C-PRE		C-POST D-PRE	D-POST EGMA
Psychosocial questionnaire	X		X				X
Psychosocial Focus groups					X		

2.5   Researchers

Local researchers will be trained to gather the data using the mathematics tests and the questionnaire. They are trained in child-friendly approaches, in the background of the psychosocial questionnaire and in the way in which the tests and questionnaire should be taken. By using neutral, trained researchers we make sure that there is no bias when administering the tests and questionnaires and that the tests and questionnaire are taken in similar ways with all the children.

2.6   Ethics

- The ethics committee of the Ahfad University for Women has approved these pilot studies.
- Agreements have been signed by all States and all villages.
- Parents have signed consent forms for their children to take part in the pilot studies and to be photographed.
- All data are collected individually and related to a child-specific number (anonymous). This is done for privacy reasons, as well as for pragmatic reasons (Arabic names are spelt in different ways in English).

3 Results

In this chapter the results of the baseline study (T=0) will be presented. This is a description of the participants and the participating villages, and their scores on the mathematics test and the psychosocial questionnaire. As this baseline took place at the start of the pilot, any differences between participants or villages are the result of the situation in the villages and not of the use of the game.

3.1 Geographic information

Three states participate in Pilot II: North Kordofan (7 communities), White Nile (7 communities) and Gedaref (5 communities). Figure 3 below shows the communities per state, and the number of children per community.
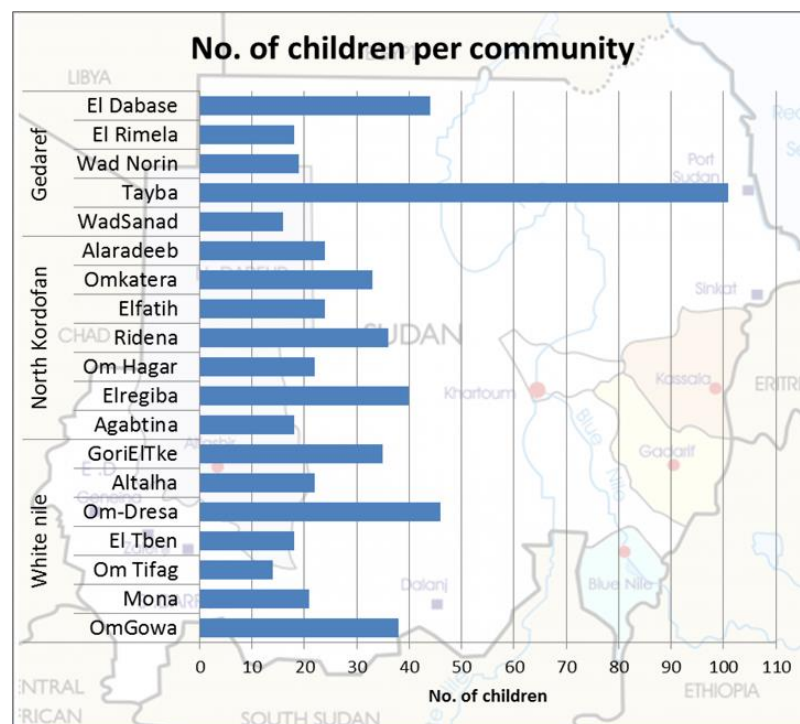

Figure 3   Number of children per community, per state.

Because the community Tayba, in Gedaref, has more than 100 children, only five communities in Gedaref were involved. The aim was to include about 600 children, divided over the three states. The other communities have approximately 20-40 children each.

Of the 19 communities, 12 are rural villages, one is an IDP village, two are IDP/rural villages and four are voyager/rural villages. The distance to the nearest primary school is 3-14 kilometres.

Figure 4   Rural community in White Nile.

3.2   Demographic information

A total of 589 children participate in this baseline study of Pilot II. At a later point in time, more children have taken these tests. Because we cannot be certain that they had not started using the game already, their data was not included in this baseline report. 51% of the participating children are girls, 49% of them are boys (see Figure 5). The participating children are between 7-9 years old (see Figure 6). Most of them (47%) are seven years old. 29% is eight years old and 24% is nine years old.
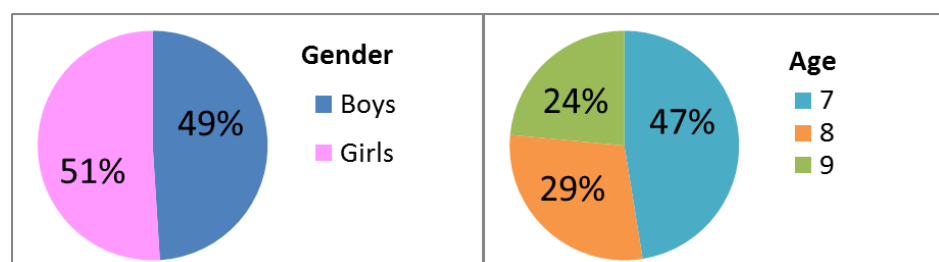

Figure 5   Percentage of children per gender. Figure 6   Percentage of children per age.

The average age of the participating children is 7.8 years. Children in North Kordofan are slightly younger (average is 7.4 years), compared to the children in Gedaref (average is 8.0 years) and White Nile (average is 7.9 years).

Figure 7, below, shows the family structure per state. Children were asked if they had both their parents, one parent or no parents at all. Most children reported they had both their parents.
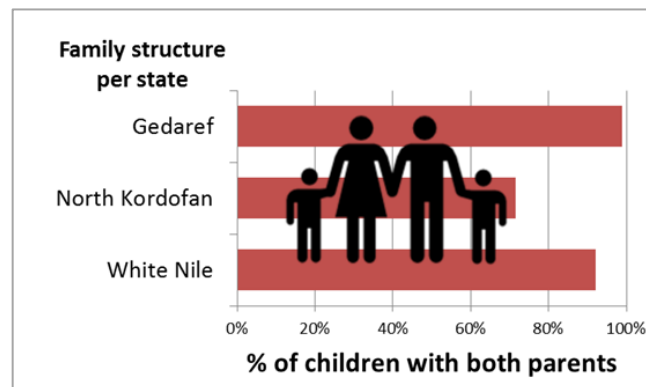
Figure 7   Percentage of children with both parents, per state.

Children from North Kordofan report more often that they only have a mother (24%) or have no parents at all (1%).

On average, children report to have 5.3 siblings. In North Kordofan this is less (4,8), whereas children from Gedaref report 5.8 siblings per child on average.
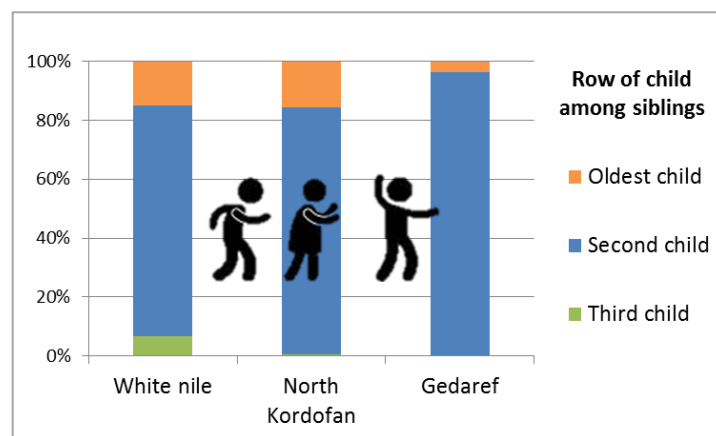

Figure 8   Place of child in the row of children.

Figure 8, above, shows that most children that participate in Pilot II are the second child in the row of children. They have only one older brother or sister.

Children report that 80% of their parents have not finished primary education. 20% has finished primary education, of which only a few have finished secondary education as well. There is no significant difference between fathers and mothers reported (see Figure 9 below).
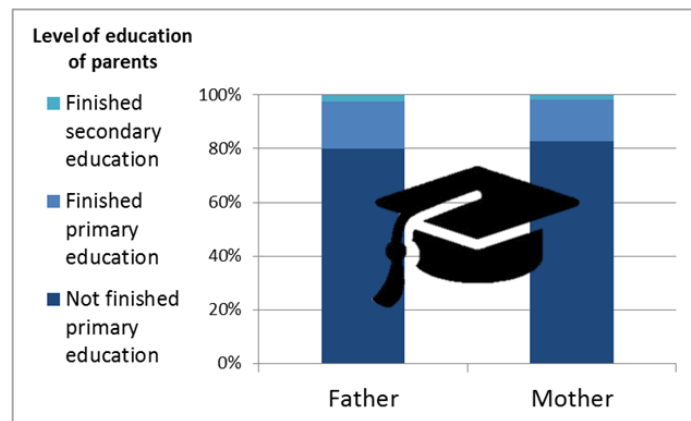
Figure 9   Level of education of parents.

3.3   **Psychosocial questionnaire**

The constructs used in the psychosocial questionnaire are: (1) Self-esteem: global self-esteem is typically defined as one's overall sense of worthiness as a person (Schmitt & Allik, 2005); (2) Self-efficacy: one's belief in one's ability to succeed in specific situations (Bandura, 1977); (3) Learning motivation: intrinsic motivation to learn, learning for its inherent satisfaction rather than for some separable consequence (Ryan & Deci, 2000); (4) Social support: the support children feel they receive from their parents, family and community (Fleuren, Paulussen, van Dommelen & van Buuren, 2012). (5) Future orientation: the ability to recognize potential in the form of future possibilities and alternative choices (Adams & Marshall 1996), and (6) Identity orientation: people derive their sense of self (identity) largely from the social categories to which they belong, this is unique per person (Adams & Marshall, 1996). Table 2, below, shows how these a-priori scales related to the results. Using a factor analysis, all scales were found in the data. This is a very positive finding, as it supports construct validity; the constructs and their operationalization prove to be valid. Some of the scales proved to be divided in sub-scales, though. This can be explained by the type of questions asked. Therefore, the sub-scales were used for further analysis. One item was excluded from further analysis, because it did not fit in any of the scales.

Table 2   Relation between a-priori scales and scales found in data, including reliability.

A-priori scales	**Scales found in results**	**Reliability (Crohnbach's Alpha)**
Self-efficacy	Self-efficacy beliefs	α = .54
	Self-efficacy expectations	α = .58
Learning motivation	Learning motivation	α = .60
Social support	Learning Support	α = .60
	Parental/Family support	Only 1 item
	Social belonging	α = .59
	Social participation	α = .56
Future orientation	Future orientation	α = .53
Identity orientation	Identity orientation	No scale assumed

To validate a new questionnaire in European and American settings, a reliability of 0.7 is used. In comparison with that, the reliabilities found in this baseline are rather low. On the other hand, questionnaires with young children, and especially in a developing context, usually have a lower reliability. The children in this study had

never been to school and had never answered a questionnaire before. Probably, they had never been asked to think about themselves in this way. In this light, the reliability found is something we can accept. The questionnaire will be taken two more times. It is very well possible that the reliabilities will increase with use, as children learn to think about these issues.

Below, the results will be described per construct.

Figure 10   Children are drawing in Agabtine, North Kordofan, while the psychosocial questionnaire is taken individually.

3.3.1   Self-esteem

The average Self-Esteem score of all children participating in the study is 1.9 (1 = low; 4 = high) (see Figure 11). There are no differences with respect to Self-esteem between boys and girls. Self-esteem seems to decrease with age, though. On average, children in North Kordofan have a higher self-esteem compared to children from the other two states. This can partly, but not completely, be explained by age: Children in North Kordofan are slightly younger than in the other states.

Children in rural or rural/IDP regions report higher self-esteem (2.04 and 2.29 respectively) compared to children in IDP or voyager regions (1.37 and 1.54 respectively).
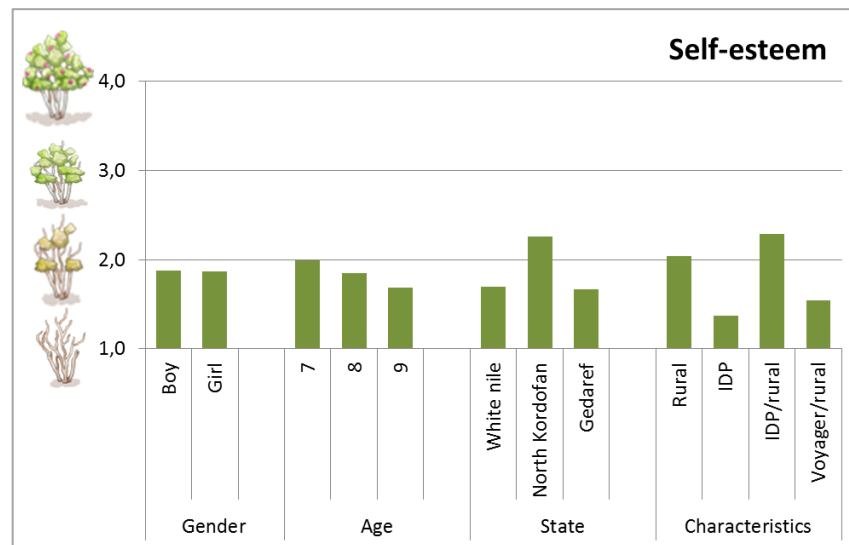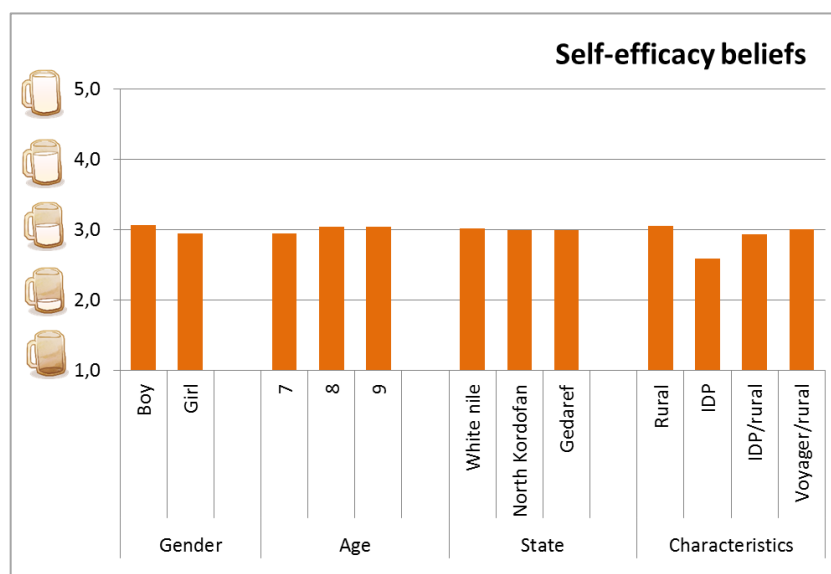

Figure 11   Self-esteem per gender, age, state and characteristics.

3.3.2   *Self-efficacy*

The average Self-efficacy score of all children participating in the study is 2.8 (1 = low; 5 = high). Children in rural regions report higher than average self-efficacy (3.0), whereas children in IDP/rural or voyager regions score blow average (2.4 and 2.6 respectively). There are no significant differences with respect to gender, age or state.

This scale proved to have two subscales: Self-efficacy beliefs and Self-efficacy expectations, where the second is more concrete than the first.

Children in IDP regions report lower Self-efficacy beliefs (2.6) compared to other regions (average 3.0) (see Figure 12). There are no significant differences with respect to gender, age or state.

* I am certain I can accomplish my goals.
* I can handle whatever comes my way.
* I stay confident even when things are difficult.

Figure 12   Scores on Self-efficacy beliefs, per gender, age, state and characteristics.

Boys report higher Self-efficacy expectations compared to girls (see Figure 13). There are no significant differences with respect to age. Children from Gedaref report lower self-efficacy expectations (2.5) compared to average (2.75). Children from rural and IDP regions report Self-efficacy expectations above average (2.85 and 3.2). Children from voyager regions report expectation below average (2.5).
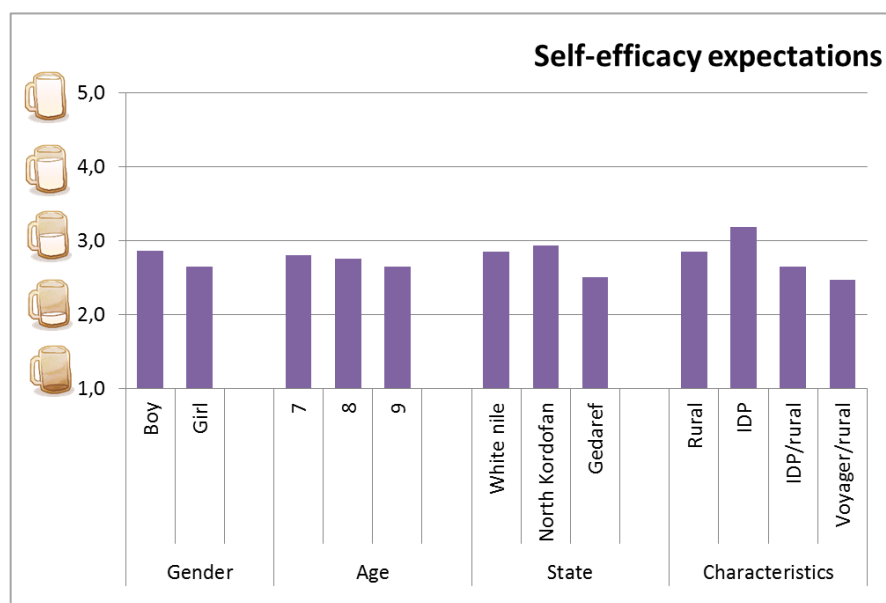
* I can do most things as well as my friends
* I expect to do well in my learning

Figure 13   Scores on Self-efficacy expectations, per gender, age, state and characteristics.

In Figure 14, below, the scores on the two sub-scales of Self-efficacy are presented in one graph. Scores on Beliefs are higher than scores on expectations. This is interesting because it means that children are more convinced that they can learn, but when it comes to the actual learning, their expectations are lower. There is one exception to this: Children in IDP communities report a higher score on Expectations than on Beliefs.
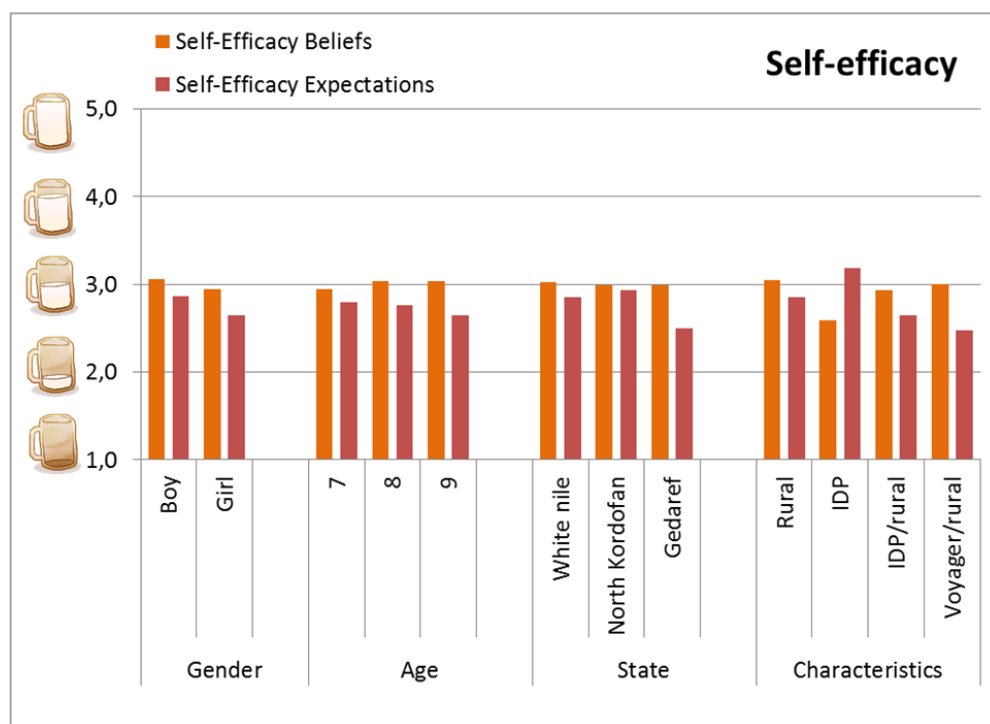

Figure 14   Comparison scores Self-efficacy beliefs and Self-efficacy expectations.

3.3.3   *Learning motivation*
There are no differences with respect to Learning motivation between boys and girls
or children with a different age (see Figure 15). Children in Gedaref have, on average,
lower scores on Learning motivations compared to children from the other two
states. Children in rural communities report higher scores on Learning motivation
than average. Children in IDP/rural communities report a lower score than average.
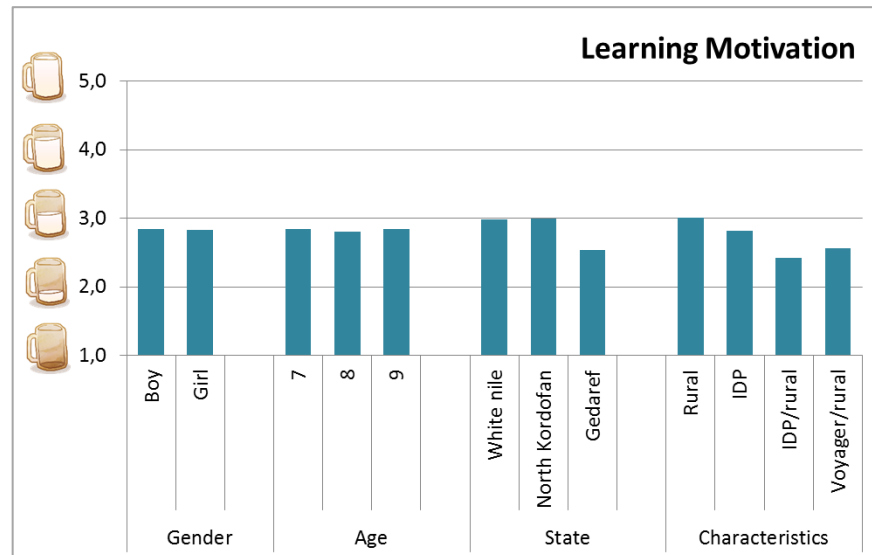
* I think learning new things is important.
* I like learning new things.
* I am doing my best to learn new things.

Figure 15   Scores on Learning Motivation per gender, age, state and characteristics.

3.3.4   *Social support*
The scale Social support proved to consist of four sub-scales: Learning support,
Parental/family support, Social belonging and Social participation. Although all
sub-scales refer to Social support, factor analysis showed that this was not a strong
overall scale.

Learning support refers to the support children they receive with respect to learning.
There are no significant differences for Learning support for gender, age, state or
regional characteristics (see Figure 16).
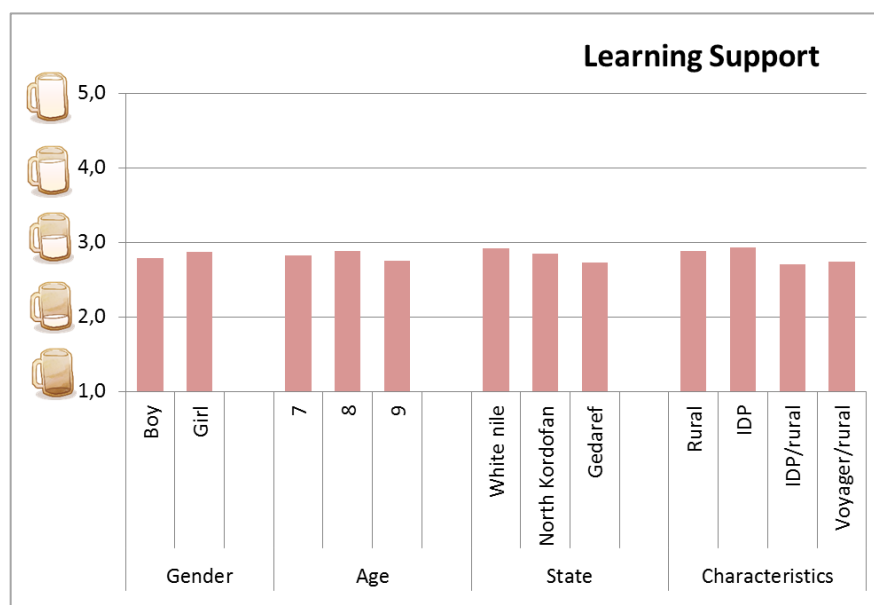
* I feel supported to learn by my parents or family
* I feel supported to learn by others in my community

Figure 16   Scores on Learning support per gender, age, state and characteristics.

Parent/family support is based on one question only: do children feel they can talk to their parents or family when they have a problem. There are no significant differences with respect to gender (see Figure 17). Children with age 9 report a score on Parent/family support that is significantly lower than average. Children from White Nile report Parent/family support below average, whereas children in North Kordofan report Parent/family support above average. This is partly due to the lower average age of participating children in North Kordofan. There are no differences with respect to regional characteristics.
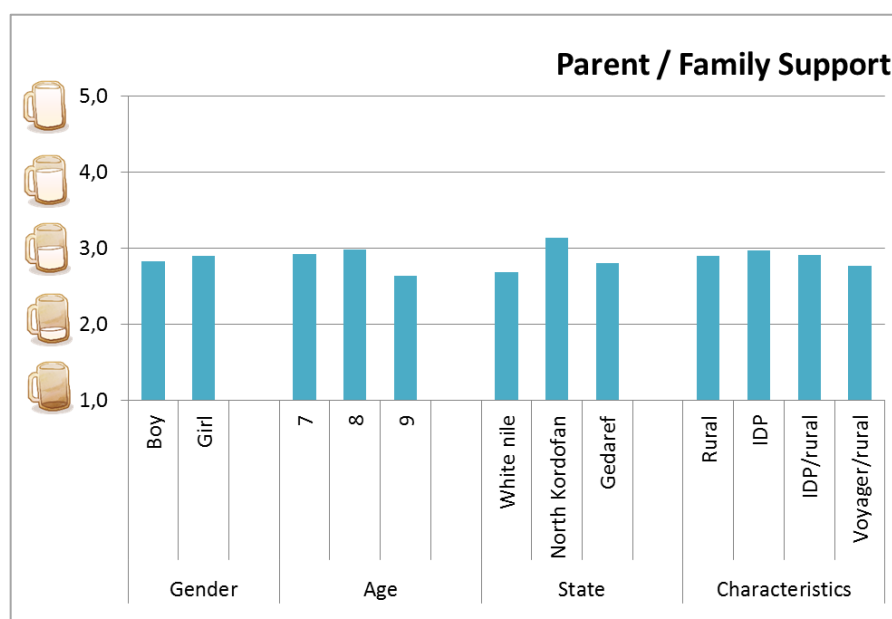

Figure 17   Scores on Parent/Family support per gender, age, state and characteristics.

Figure 18, below, shows the comparison between Learning support and Parental/family support per gender, age, state and characteristics. On average Parental/family support is scored higher than Learning support, with the exception of nine-year olds and White Nile state.
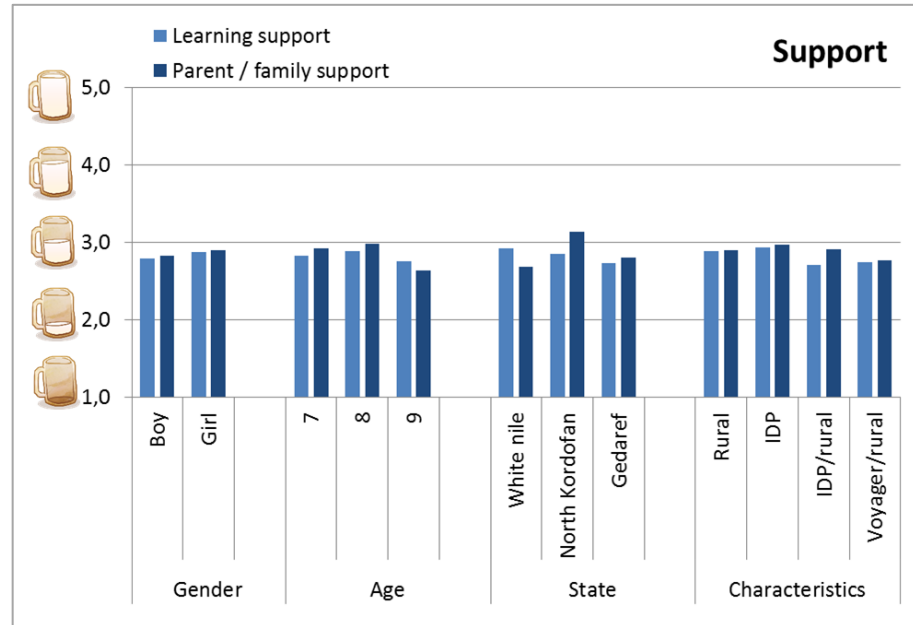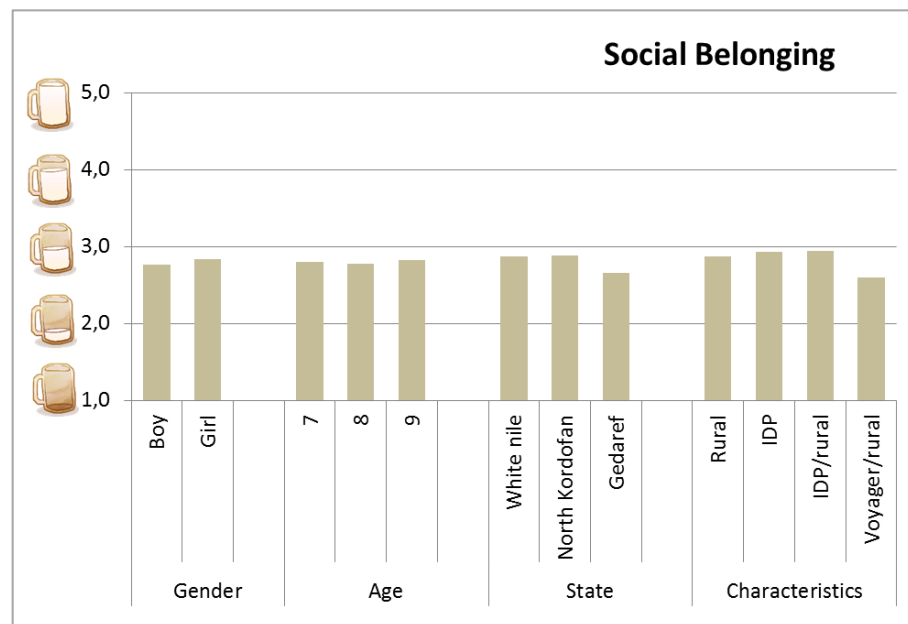

Figure 18   Comparison between scores on Learning support and Parent/family support.

The scores on Social belonging show no differences with respect to gender and age (see Figure 19). Children from Gedaref report score below average, and children from Voyager communities also report a below average score on Social belonging.


* I am accepted by my community
* I feel like I am part of the group

Figure 19   Scores on Social belonging per gender, age, state and characteristics.

For Social participation there are no differences with respect to gender and age (see Figure 20). Children from North Kordofan report above average Social participation. Children from IDP communities report social participation above average, whereas children from voyager communities report below average Social participation.
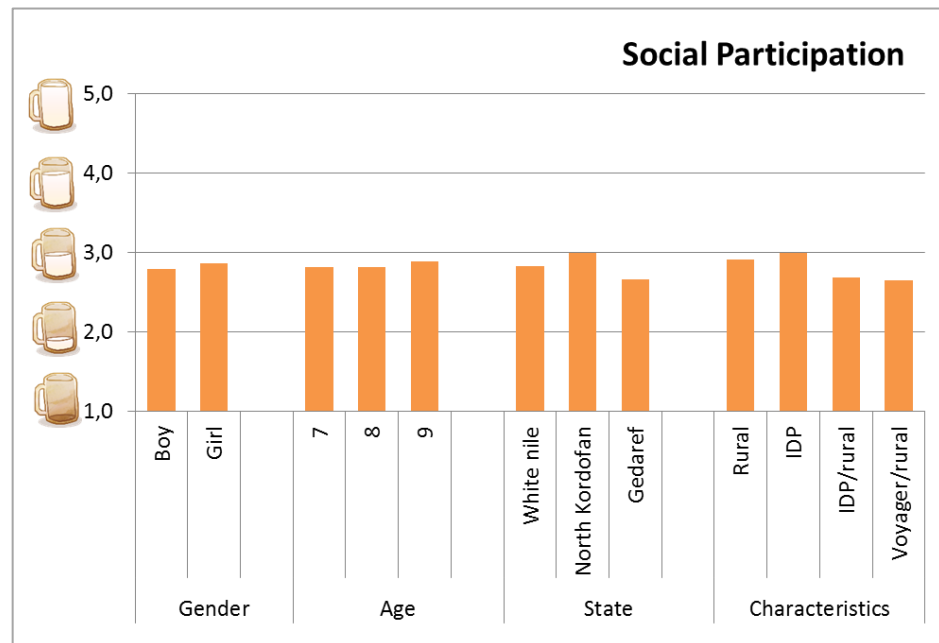

* I participate in activities in my community
* I feel I can trust others in my community.

Figure 20   Scores on Social participation per gender, age, state and characteristics.

3.3.5   *Future orientation*

For Future orientation there are no differences with respect to gender and age (see Figure 21). Children from North Kordofan report above average scores on Future orientation. Children from Gedaref report below average scores on Future orientation. Children from rural or IDP communities report Future orientation above average, whereas children from IDP/rural and Voyager communities report scores on Future orientation below average.
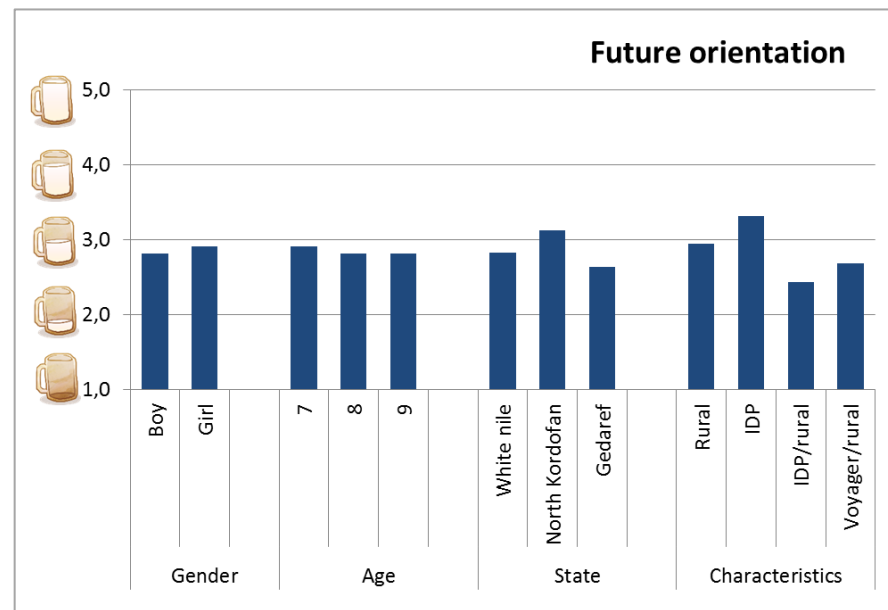
* I know what I want to become
* I know what I want to be

Figure 21   Scores on Future orientation per gender, age, state and characteristics.

3.3.6   *Identity orientation*

Identity orientation was not assumed to be a scale, the four different statements aim to capture different perspectives of Identity orientation (personal, social, relational and collective). Therefore, they will be discussed separately.

For Personal identity orientation, there are no differences with respect to gender or age (see Figure 22). Children from North Kordofan report an above average score of Personal identity orientation. There are no differences with respect to characteristics.
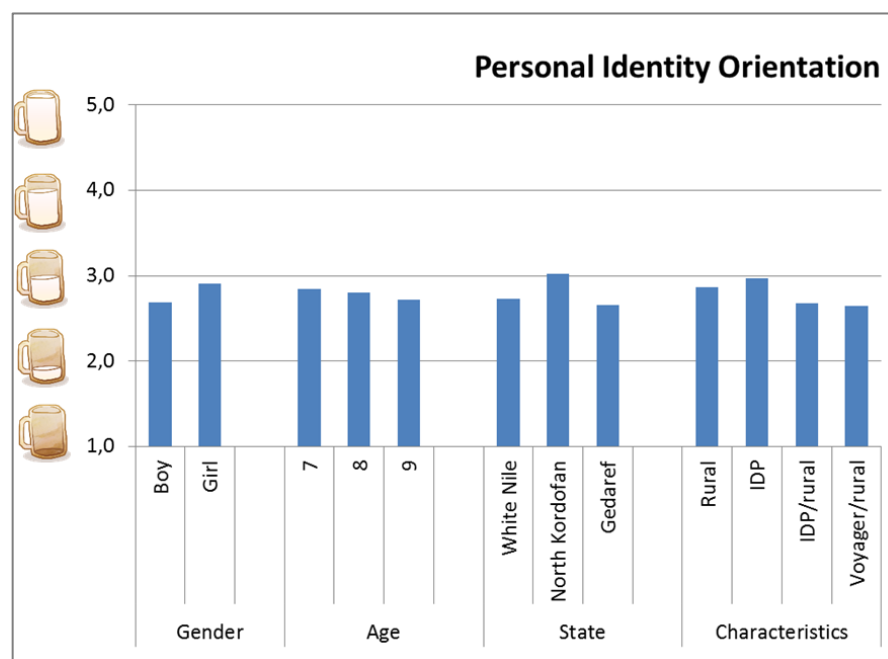
* My feeling of being a unique person, being distinct from others is important to me

Figure 22   Scores on Personal identity orientation per gender, age, state and characteristics.

For Relational identity orientation there are no differences with respect to gender or age (see Figure 23). Children from North Kordofan report above average score on Relational identity orientation, whereas children from Gedaref report below average scores. Children from rural communities report above average scores on Relational identity orientation, whereas children from voyagers / rural communities report below average scores.

* My reputation, what others think of me, is important to me

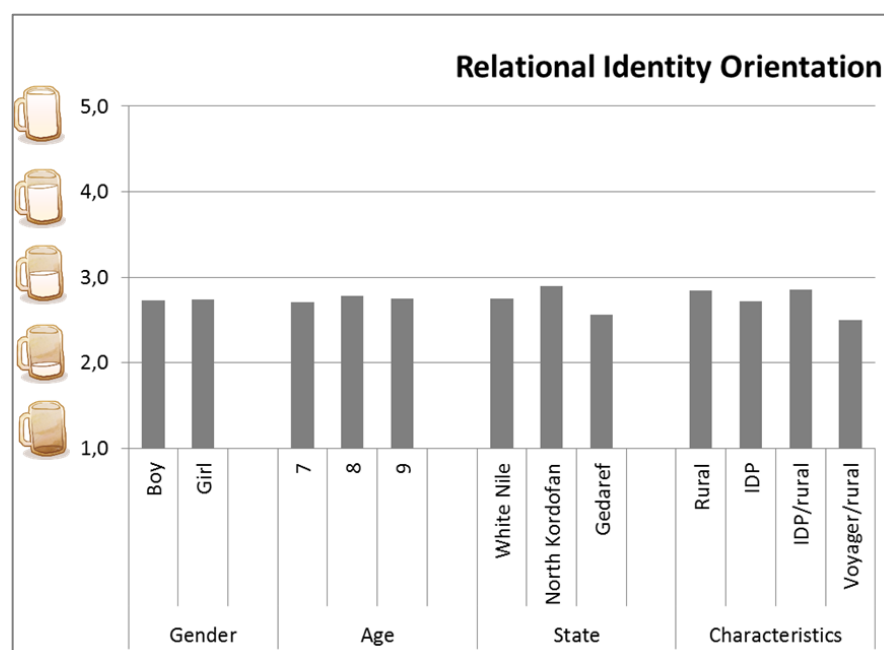Figure 23   Scores on Relational identity orientation per gender, age, state and characteristics.

For Social identity orientation there are no differences with respect to gender or age (see Figure 24). Children from North Kordofan report an above average score on Social identity orientation, whereas children from Gedaref report a below average score. Children from voyagers / rural communities report below average scores on Relational identity orientation.
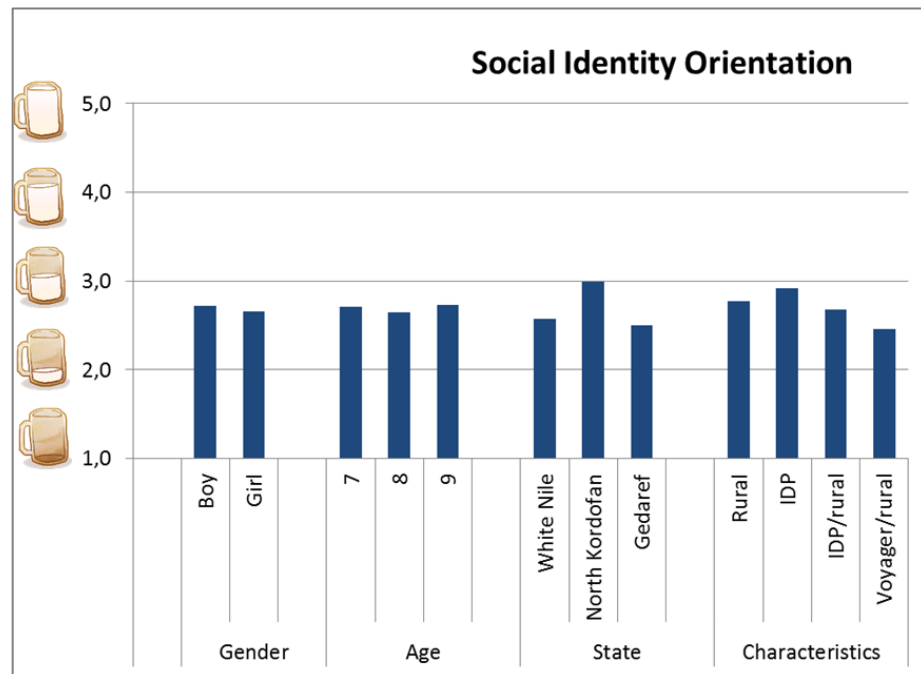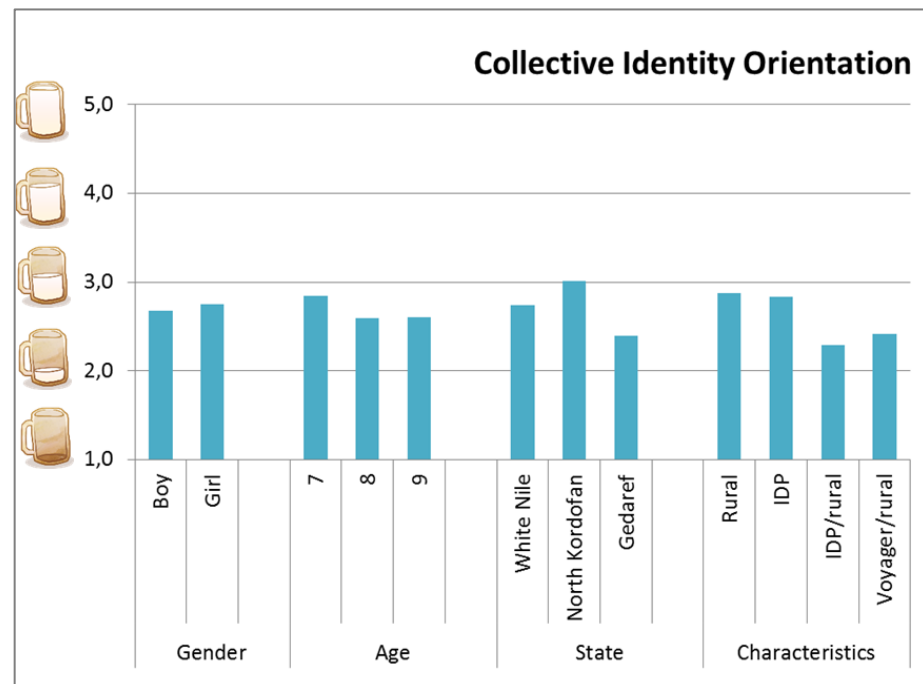

Figure 24   Scores on Social identity orientation per gender, age, state and characteristics.

For Collective identity orientation there are no differences with respect to gender (see Figure 25). Children with age 7 report above average scores on Collective identity orientation as well as children from North Kordofan. This can be partly explained by the fact that the average age in North Kordofan is lower than average. Children from Gedaref report below average scores on Collective identity orientation. This can also partly be explained by the above average age in Gedaref. Children from rural communities report above average scores on Collective identity orientation, whereas children from voyagers / rural communities report below average scores.

My feelings of belonging to my community is important to me

Figure 25   Scores on Collective identity orientation per gender, age, state and characteristics.

Overall, there are no significant differences between the different types of Identity orientation (see Figure 26).
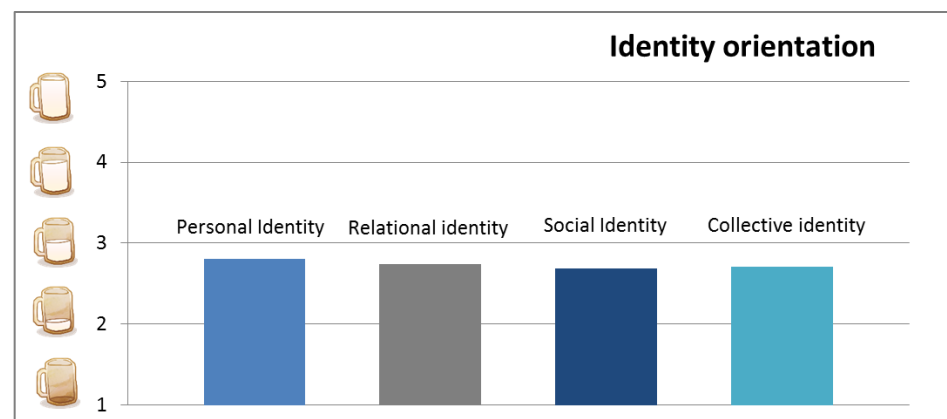

Figure 26   Comparison between averages on the different Identity orientation perspectives.

Based on earlier research in the One Laptop Per Child (OLPC) project in Ethiopia (Bos, Hansen, Kocsev, Pischetola & Annika Tovote, 2009), this is not what we expected. Results there showed that the average of Collective identity was higher than the average on Personal identity in the baseline study. During the project the scores on Personal identity increased, while scores on Collective identity stayed the same. There can be several reasons for this. In collective countries like Sudan, thinking about one's identity may be something people, and especially children, are not familiar with. The lack of differences between the Identity orientations may be due to the inability of children to evaluate and express their identity. This will be addressed in the focus group meeting. Over time, we may find changes in the scores of Identity orientation. These can be caused by an increasing ability to

express one's identity or by changes in the different Identity orientations. By using test-retest validity, we can determine if changes are due to an increasing ability to express identity.

3.4   Mathematics test

Figure 27   Taking the mathematics test in Omhagar, North Kordofan.

The average score on test A, pre-test was almost 20 points out of 60 (see Figure 28). The older the child the higher the score on the mathematics test: 9-year olds perform on average better than 7-year olds. There are no differences in scores between boys and girls. There is a significant difference in test scores between the States: on average White Nile performs better, and a difference between characteristics: on average IDP/rural performs better, where voyage/rural shows a lower Math-score.
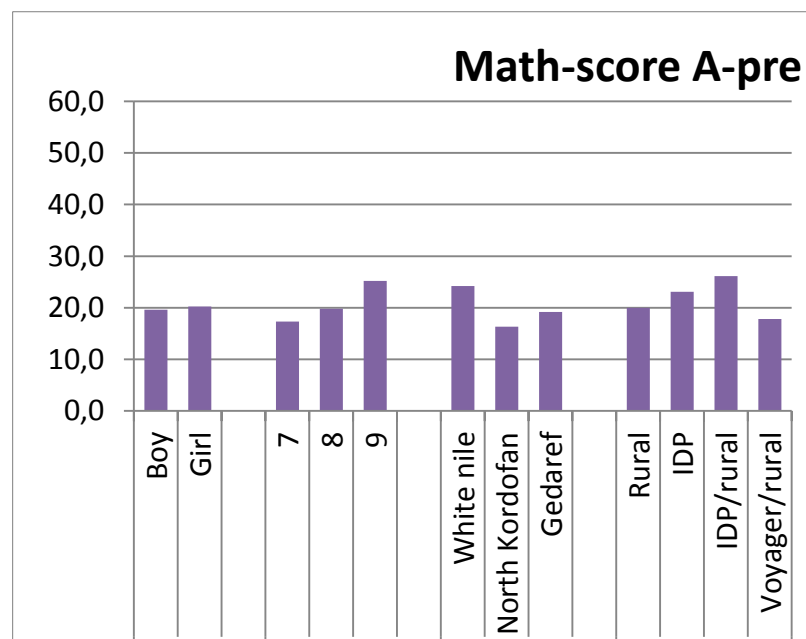

Figure 28   Average Maths-score on Test A, pre-test.

The differences between the states can partly be explained by age. The average age of children in North Kordofan is lower than average. But children in White Nile score highest, while the average age is highest in Gedaref. In addition, the differences per state exist for each age. This means that other factors influence this as well.

On average, there is no difference between boys and girls. Also, for the different ages there are no significant differences between boys and girls (see Figure 29).
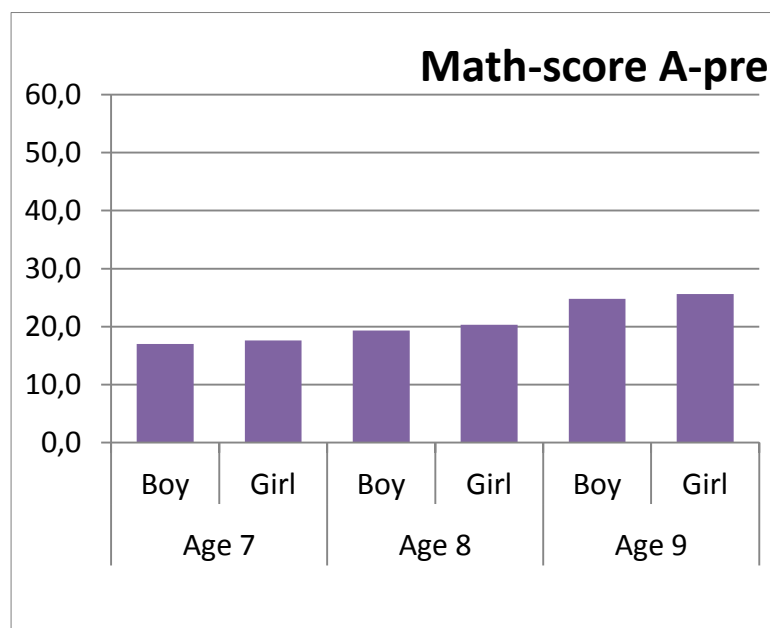

Figure 29   Scores on mathematics test A, pre-test, per age, per gender.

There were no significant differences between the mathematics scores of children with respect to family situation of education of parents.

4 Moving forward

As mentioned in the introduction of this report, this is just the baseline study of a six-month pilot. As the pilot continues, more data will be collected. This will provide insight in the progress children make with respect to their knowledge of mathematics, but also provide information on the psychosocial impact of learning and ICT on these children and the communities in which they live. These results will be described in effect studies.

It is the intention to involve a control group of 200 children from similar communities in the same states. These children attend formal out-of-school education, and follow the official curriculum for out-of-school children. Using a control group in a formal out-of-school setting makes it possible to compare the increase of scores on the mathematics test. The hypothesis is that children playing the game will learn as much or more than the children in the control group.
The children in the control group will take test A, as a pre-test and after six weeks, as a post-test. After six weeks, the curriculum in the pilot follows a different order; it teaches the concept to addition. In the formal curriculum, children continue learning their numbers until they have reached 1,000. Therefore, they will not be able to take test B. To compensate for that, the children in the experimental group will take EGMA at the end of the pilot. This allows for comparison with average scores on the same mathematics subjects of children in Grade 2, in Sudan, but also in other Sub Saharan countries.

4.1 Pre-post test El Fatih

When writing this report, one community, El Fatih in North Kordofan, had already completed the first six weeks of the pilot and taken the post-test of test A.
The results are very promising: on average the score on the pre-test was 17.3 points out of 60; the score on the post-test was 43.9. This is an increase of 26.7 point and means that the scores were more than doubled. There was no significant difference between the increase of scores of boys and girls (see Figure 30).
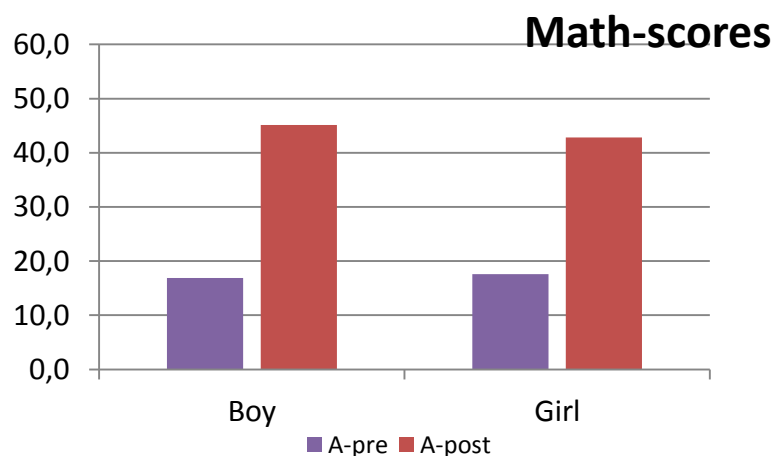
Figure 30   Scores on mathematics test A in El Fatih, pre-test and post-test.

This is just the first community, and the effect may be different in the other communities. On the other hand, this is very much in line with the findings in Pilot I (Stubbé, Badri, Telford & van der Hulst, in preparation): in six weeks children doubled their scores on a mathematics test as well, from 19 points out of 60 on the pre-test to 38 points out of 60 on the post-test.

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A   Mathematics test A

1. Can you count to 10?

2. Can you count on from 4?

3. Can you count on from 6?

4. Can you count back from 5?

5. Can you count back from 7?

6. Can you tell me how many tomatoes you see?

7. Can you tell me how many tomatoes you see?

8. Can you tell me how many tomatoes you see?

9. Can you point at the picture which has the most carrots

10. Can you point at the picture which has the most carrots

11. Can you say what this number is?
    3

12. Can you say what this number is?
    6

13. Can you say what this number is?
    2

14. Can you say what this number is?
    8

15. How many carrots do you see? Point at the right number.

1 3 5

How many tomatoes are this? Point at the right number.
1 2 6

16. Can you write down the number 3?

17. Can you write down the number 12?

18. Can you write down the number 9?

19. I have one tomato, and I buy two more. How many tomatoes do I have?

20. There are two people in the bus, and three more people get in the bus. How many people are there in the bus?

21. What number comes after the number 7?

22. What number comes before number 6?

23. Can you point at the highest number
    5 – 16 – 10

24. Can you point at the lowest number?
    11 – 17 – 9

25. Which number should be in the empty box?

9	10		12	13

26. Can you say the answer to this sum?
    3 + 1 =

27. Can you say the answer to this sum?
    2 + 1 =

28. Can you say the answer to this sum?
    1 + 4 =

29. Can you say the answer to this sum?
    3 + 2 =

30. Can you say the answer to this sum?
    1 + 1 =

B   Psychosocial questionnaire

Self-efficacy	1.	I am certain I can accomplish my goals
	2.	I can handle whatever comes my way
	3.	I stay confident, even when things are difficult
	4.	I can do most things as well as my friends
	5.	I expect to do well in my learning
Motivation	6.	I like learning new things
	7.	I think learning new things is important
	8.	I am doing my best to learn new things
Future orientation	9.	I know what I want to become
	10.	I know what I want to be
	11.	In the future, I will do as well as my friends or better
Social support	12.	When I have a problem, I can talk to my parents or family
	13.	I feel supported to learn by my parents or family
	14.	I feel supported to learn by others in my community
	15.	I am accepted by my community
	16.	I feel like I am part of the group
	17.	I participate in activities in my community
	18.	I feel I can trust others in my community
Identity orientation: - Personal Identity	19.	My feeling of being a unique person, being distinct from others is important to me
- Relational identity	20.	My reputation, what others think of me, is important to me
- Social identity	21.	My relationships with people I feel close to is important to me
- Collective identity	22.	My feelings of belonging to my community is important to me

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