How ICT interventions in education contribute to better career perspectives
A research for Maxim Nyansa with case studies in Ghana and Sierra Leone

by
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ICT intervention in primary and secondary education
Case studies in Ghana and Sierra Leone

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On behalf of Maxim Nyansa IT Solutions

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Acknowledgement

I have written this thesis as student International Development of the Wageningen University & Research (WUR) and as volunteer of the PR-team of Maxim Nyansa. Since 2019, I am a volunteer for Maxim Nyansa and in the beginning of this year, I finished a 3-months feasibility study in Sierra Leone for Maxim Nyansa. I have been so enthusiastic that I wanted to continue with this and hence I have been writing this thesis.

During my thesis, I have been supervised by Harro Maat from the Communication, Philosophy and Technology (CPT) group of the WUR and Diana van der Stelt, co-founder of Maxim Nyansa. They have also supervised my previous research. I am grateful for this learning experience and want to thank both from the bottom of my heart. It has been great working with you for this thesis. Moreover, I thank Maarten Smulders for the Skype sessions. He is currently writing his Master thesis for Maxim Nyansa as well. Due to COVID-19, unfortunately we have not been able to meet, but the Skype sessions have been helpful. I have learned a lot from his structured way of researching and hardworking and I am sure that it will be of benefit for me when I will do my master thesis myself next year.

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Above all, I want to thank God for providing me this opportunity, for meeting all those beautiful people and keep me encouraged almost every day during the 8 weeks of writing this thesis!

Laura de Bruine,
Wilnis, 6 July 2020
Executive summary

During the research of Maxim Nyansa in 2016, success factors for ICT in Africa were identified. In my research, the main question is 'how do ICT interventions in education contribute to development in Ghana and Sierra Leone? The purpose is to give an up-to-date overview in Ghana and Sierra Leone how ICT interventions contribute to career perspectives and to improve the quality of the learning transformation of Maxim Nyansa. I have taken a constructivist perspective, advocating for interactive education and ICT implementation to promote a useful learning process towards better career perspectives. I have done a general literature research on the relation between ICT, education and development and two exploratory case studies, one for Ghana and one for Sierra Leone. I have complemented relevant government documents with literature. The case studies show that both countries have a poor learning environment that is barely interactive. I mapped the learning environment in 3 categories. Firstly, resources and tools are poorly available. Secondly, teaching and learning communities if existing do not function well. Thirdly, there is a traditional way of teaching and learning with low level interaction. Beside a poor learning environment, the education system is not closely linked to the job market and does not provide the required 21st century skills. ICT intervention provides the opportunities to improve the education system when conditions are met. Sufficient ICT devices should be available that are both accessible and relevant for the education. In addition, community support, school leadership and training that meets local demands is important for a meaningful ICT intervention. But to go one level beyond that by creating ownership and lifelong learning, intensive communication, information management, analytics and networking are needed. My recommendations for Maxim Nyansa are to create a Maxim Nyansa Teachers Family that paves the way for the desired bottom-up development, to further research training and open source material efficiency, and to equip teachers with personal laptops.
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<tbody>
<tr>
<td>ABFA</td>
<td>Annual Budget Funding Amount</td>
</tr>
<tr>
<td>BECE</td>
<td>Basic Education Certificate Examination</td>
</tr>
<tr>
<td>DSTI</td>
<td>Directorate of Science, Technology and Innovation (Sierra Leone)</td>
</tr>
<tr>
<td>ESA</td>
<td>Education Sector Analysis</td>
</tr>
<tr>
<td>ESP</td>
<td>Education Strategic Plan</td>
</tr>
<tr>
<td>ESMTDP</td>
<td>Education Sector Medium-Term Development Plan</td>
</tr>
<tr>
<td>ICT</td>
<td>Information and Communication Technology</td>
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<tr>
<td>JHS</td>
<td>Junior High School</td>
</tr>
<tr>
<td>GES</td>
<td>Ghana Education Service</td>
</tr>
<tr>
<td>GER</td>
<td>Gross Enrolment Rate*</td>
</tr>
<tr>
<td>GETfund</td>
<td>Ghana Education Trust Fund</td>
</tr>
<tr>
<td>KG</td>
<td>Kindergarten</td>
</tr>
<tr>
<td>MEST</td>
<td>Ministry of Education, Science and Technology (Sierra Leone)</td>
</tr>
<tr>
<td>MoE</td>
<td>Ministry of Education (used for Ghana)</td>
</tr>
<tr>
<td>MoU</td>
<td>Memorandum of Understanding</td>
</tr>
<tr>
<td>NER</td>
<td>Net Enrolment Rate**</td>
</tr>
<tr>
<td>NGO</td>
<td>Non-Governmental Organisation</td>
</tr>
<tr>
<td>NTC</td>
<td>National Teacher Council</td>
</tr>
<tr>
<td>PTA</td>
<td>Parent-Teacher Association</td>
</tr>
<tr>
<td>PTR</td>
<td>Pupil-Teacher Ratio</td>
</tr>
<tr>
<td>SHS</td>
<td>Senior High School (used in Ghana)</td>
</tr>
<tr>
<td>SMC</td>
<td>School Management Committee (used for Ghana)</td>
</tr>
<tr>
<td>SSS</td>
<td>Senior Secondary School (used for Sierra Leone)</td>
</tr>
<tr>
<td>SRC</td>
<td>Science Resource Centre (used for Ghana)</td>
</tr>
<tr>
<td>VAT</td>
<td>Value-Added Tax</td>
</tr>
<tr>
<td>WASSCE</td>
<td>West African Senior School Certificate Examination</td>
</tr>
</tbody>
</table>

* Number of students enrolled in a given level of education, regardless of age, expressed as a percentage of the official school-age population corresponding to the same level of education (UNESCO, n.d.-a).

**Total number of students in the theoretical age group for a given level of education enrolled in that level, expressed as a percentage of the total population in that age group (UNESCO, n.d.-b).
1 Introduction

1.1 Justifying research

Career perspectives in Africa are poor because of the high youth unemployment. Currently, 40% of the Africans is aged under 15. In 2050, it is expected that 2 out of 3 Africans will be aged under 30. While 10 to 12 million youth enter the workforce each year, only 3.1 million jobs are created. Although governments often recognize the importance of creating jobs, they have too many challenges with the exploding population itself and they often lack financial resources which restrains taking real action (Busson, 2020). There are two major causes for the huge youth unemployment. Firstly, as explored, there is an enormous shortage of formal jobs. While the population is rapidly growing, the economy and job creation have a slower growing rate (Busson, 2020). One of the reasons is that “[y]oung Africans have been taught to find a job and not to create one” (Busson, 2020, p.7). This is also related to the second challenge, which is the shortage of skills. While children are increasingly going to school in West-Africa, the quality of the education is still poor (Maxim Nyansa IT Solutions, 2017). One of the underlying causes is the outdated curricula, resulting in the mismatch between education and skills expected to get a job (Busson, 2020). So, the lack of jobs and lack of skills result in huge unemployment. As a result, young Africans who are seen by their families as high-potentials and high education, fail to find work. The expectations of their families are high as they have invested money in them, while ultimately they sit at home or choose to go to Europe (Maxim Nyansa IT Solutions, n.d.-c).

Maxim Nyansa IT Solutions, or simply Maxim Nyansa, is a Ghanaian NGO. They have the mission “to create a career perspective for young Africans with the use of information technology”. To reach their aim, they have two programs: a learning transformation program for primary and secondary schools and a trainee program for university students (Maxim Nyansa IT Solutions, n.d.-a). Since the start in 2015, they have been very successful in Ghana. Since a few months, they are also expanding to Burkina Faso, the Gambia and the townships of Johannesburg, South Africa. In the future they could expand to other countries as well, including Sierra Leone. For my thesis extension I have researched whether Maxim Nyansa is feasible in Sierra Leone and I have outlined opportunities and challenges (de Bruine, 2020).

I narrow the view of my thesis to the learning transformation. I go one step further, by asking how the learning transformation of Maxim Nyansa contributes to development of Ghana and Sierra Leone. I have chosen for Ghana and Sierra Leone since Maxim Nyansa is active in Ghana and I have researched Sierra Leone. My research is important as Maxim Nyansa wants to expand and become a big player in Africa. Currently, methods for impact assessment are lacking. Maarten Smulders, student of the MSc Business Informatics at the Utrecht University, is researching possible impact assessments for Maxim Nyansa for his Master thesis. He already started with his literature research before I started and he will continue after I am finished. With the impact metrics Maarten establishes, Maxim Nyansa will be better able to communicate the impact they create, and this can result in more and better support which helps to upscale their ambition. Part of the trainee program of Maxim Nyansa is the data science team. The bootcamp has occurred from February to June 2020. The data science team has been working on measurement of impact of the learning transformation program. As an integral part of this, I am performing this literature research.

My research builds on the research Maxim Nyansa in 2016. In that year, a team of Maxim Nyansa has already intensively conducted literature research about ICT in Africa. They saw most ICT
interventions in education in Africa failing and wanted to change that. Finally, they identified 7 success factors for ICT in Africa and adapted their integrated approach (Anto, Van der Stelt, Dankyira & Bei, 2019). In Table 1, the success factors and approach are shown. This work on the ground is more dynamic as you work with people who have different stories. In this thesis, I take a closer look at education, ICT and how that contributes to development. Next I will clarify the goal of my thesis and establish my research questions. Afterwards, I provide a reader’s guide.

**Table 1 Success factors and integrated approach of Maxim Nyansa (Anto, Van der Stelt, Dankyira & Bei, 2019)**

<table>
<thead>
<tr>
<th>Identified success factors of ICT in Africa</th>
<th>Integrated approach</th>
</tr>
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<tbody>
<tr>
<td>1. The local community in the lead;</td>
<td>1. Meeting traditional rulers;</td>
</tr>
<tr>
<td>2. Closely monitoring of progress and</td>
<td>2. ICT laboratory setup;</td>
</tr>
<tr>
<td>quality of implementation;</td>
<td>3. Train the trainer;</td>
</tr>
<tr>
<td>3. Long-term financial provisions;</td>
<td>4. Specialized consultancy and change;</td>
</tr>
<tr>
<td>needs;</td>
<td></td>
</tr>
<tr>
<td>5. ICT bringing immediate benefit to the</td>
<td></td>
</tr>
<tr>
<td>stakeholders;</td>
<td></td>
</tr>
<tr>
<td>6. Basic facilities supporting change;</td>
<td></td>
</tr>
<tr>
<td>7. Integrative approach of the above factors.</td>
<td></td>
</tr>
</tbody>
</table>

1.2 Research questions

The scientific purpose of my thesis is to analyse how ICT interventions in education contribute to development, specified for Ghana and Sierra Leone. Maxim Nyansa already made a start in 2016, but ever since many new literature has been written and research has been conducted. Therefore, I give an up-to-date overview of the literature in the field of ICT intervention and education. The social goal is to improve the quality of the ICT interventions of Maxim Nyansa. I will analyse their approach in Ghana and give prospectives for Sierra Leone to make future ICT interventions in both Ghana and Sierra Leone more effective.

My overall research question is: How do ICT interventions in education contribute to development in Ghana and Sierra Leone?

To answer my main question, I have three sets of subquestions:

**Subquestion 1**: How does ICT intervention contribute to development according to literature?

1A How does education contribute to development according to literature?
1B How does ICT contribute to education according to literature?
1C How does ICT relate to development according to literature?

**Subquestion 2**: How do ICT interventions in education get meaning in Ghana?

2A How is the situation of education in Ghana?
2B How is the situation of ICT in education in Ghana?
2C How does ICT contribute to better education and development in Ghana?
Subquestion 3: How do ICT interventions in education get meaning in Sierra Leone?

3A How is the situation of education in Sierra Leone?
3B How is the situation of ICT in education in Sierra Leone?
3C How does ICT contribute to better education and development in Sierra Leone?

The first set of subquestions aims to give a literature overview of the relation between ICT, education and development. This set provides the analytical framework for the second and third set of subquestions. The second and third set have the aim to outline how the relation between ICT, education and development gets meaning in Ghana and Sierra Leone. In these sets of subquestions, I map the situation of education, ICT in education and the contribution of ICT to better education and development. While the second set of subquestions is focused on Ghana, the third set is focused on Sierra Leone. Based on the last two subsets, I can give specific recommendations for Maxim Nyansa.

1.3 Reading guide

The next chapter, ‘2 Theoretical framework’ lays the foundation for the theoretical foundation of the thesis. In 2.1, the key concepts education, ICT and development are explained. In 2.2, the first subquestion is answered, providing a general overview on the role of education in society and the impact and consequences of ICT in education. In the third chapter I explain my methodology for the case studies. In 4.1 I show my results for Ghana, in 4.2 I show my results for Sierra Leone. Both subchapters work towards answering subquestion 2 for Ghana and subquestion 3 for Sierra Leone. The conclusion can be found in chapter 5 and the discussion of my findings in chapter 6. In Chapter 7, I give my recommendations for Maxim Nyansa. Lastly, the references and appendices can be found at the end. Appendix 1 shows Bloom’s taxonomy and Kolb’s learning styles, illustrating the importance of interaction in education. Appendix 2 shows the map of Ghana and Sierra Leone and for Ghana the patterns of poverty as well. Appendix 3 shows data of enrolment in Sierra Leone, provided by the MBSSE in 2018. Appendix 4 closes this document by numbers of schools, entry and pass rates.
2 Theoretical framework

2.1 Concepts and relation: education, ICT and development

In this part, I define the three core concepts. Firstly, education implies the whole system of developing basic and specialized knowledge and skills, problem-solving abilities and the overarching goal is to create productive workers, responsible citizens and lifelong learners (Spector, 2015). Learning is an integral part of education as learning processes lead to the development of the demanded knowledge, skills and abilities. As Maxim Nyansa has their learning transformation program reaching primary and secondary schools, I narrow my focus on these two levels of education. Secondly, ICT simply means ‘digital technology’ (Collins Dictionary, 2020) and related, ICT interventions in education intend to improve the learning process through provision of digital technology. While IT and ICT are often interchanged, I use ICT as it is including IT. Thirdly, Merriam Webster (n.d.-a) provides a useful definition of development as “the act, process or results of developing”. Subsequently, develop means “to make active or promote the growth of” (Merriam-Webster, n.d.-b). Overall, ICT intervention is the act, which promotes the growth of a learning process in education which results in better career perspectives. In my thesis, I identify two learning processes. Firstly, the learning process of learners in education towards career perspectives. Secondly, the learning process of involved actors linked to schools that have had an ICT intervention.

SDG 4 helps to get a clearer focus on the concepts. The SDGs are relevant for my thesis, since all United Nation members have adopted the SDGs in 2015 and therefore are widely applicable. SDG 4 shows the importance of an integrated approach to education. While the prior MDG 2 “achieve universal primary education” focused on access to education, SDG 4 “quality education” takes more aspects into account, including quality, relevance, parity and inclusivity. The lengthier definition of SDG 4 is to “ensure inclusive and equitable quality education and promote lifelong learning opportunities for all” (UN, 2015). As I narrow my research on primary and secondary education and career perspectives, I make use of targets 4.1, 4.4 and 4.6. In addition, I also make use of implementation targets 4a and 4c. See Figure 1 for the targets I use. These targets focus on primary and secondary education (4.1), teaching relevant skills (4.4, 4.7 and 4c) and building good physical school environments (4a). Other targets are focused on other levels of education (4.2 and 4.3), parity (4.5), general literacy and numeracy (4.6) and scholarships (4b), and therefore left out. Note that target 4.1 is also focused on quality education, which is my focus rather than the free education as can be seen in Figure 1. Next I will elaborate on my interpretation, taking a constructivist view.

Figure 1 SDG 4 targets used
2.2 Theory: constructivism

Learning theories provide useful insights in the education system, as they model what learning should look like. Over the previous decades, three big learning theories have dominated: behaviourism, cognitivism and constructivism. In the 1920s to 1960s, behaviourism has been dominant, especially in America. For behaviourism, the effect of learning is measured by the extent of learners’ responses to stimulus and to create success a system of reward and punishment is functional (Huang et al., 2019, Ch. 2.2.1). In the 1950s, cognitivism was initiated and became dominant in the late 1970s and early 1980s, seeing learners as people who process information. Cognitivism already did have more space for interaction compared to behaviourism. During the 1970s, constructivism became more dominant. Constructivism is learner centred, having an active role for the learner and a focus on internal mental constructions and interactions as a mean to learn (Huang et al., 2019, Ch. 2). Over time, the responsibility for the learning process changed from the teacher towards the learner and interaction has become increasingly important. The success of the learning process is no longer measured by the responsiveness of learners on teachers, but on the amount of input learners give and responsibility they take in their own learning process. The design of education depends on the underlying learning theory and is highly important for the learning outcomes (Huang et al., 2019, Ch. 2). I take constructivism as perspective and elaborate on this next.

The interaction of constructivism positively contributes to multiple learning outcomes. Kolb shows the importance of personalized learning, as learners have different learning styles: feeling, watching, thinking, and doing. Although it is important go through all stages, personal preferences differ (Managing for Sustainable Development Impact, n.d.). Bloom’s taxonomy shows that the more interactive education is, the higher the chance of remembering what you learned, and ‘owning it’ and ‘grasping it’ (Wageningen Education & Research, n.d.). See Appendix 1 for the models of Bloom and Kolb. Moreover, social learning, or ‘having social interactions with communities and groups’, positively contributes to education in four domains: social, psychological, academical and assessment. Firstly, socially it creates a better atmosphere for collaboration and various understandings. Secondly, psychologically it helps to overcome anxiety and get a better self-esteem and attitude towards the teacher. Thirdly, academically, it leads to better results, more critical thinking and taking more responsibility for learning and increase problem-solved thinking. Lastly, because of variety of assessments the assessment improves (Laal & Ghodsi, 2012). Social learning prepares students better for today’s world, having 21st century skills that are demanded for employment, jobs and entrepreneurship. Three different studies (Partnership for 21st Century Skills, 2008; NACE, 2009; AMA, 2010) identified skills asked by present employers: communication, teamwork, strong work ethics, professionalism, creativity, critical thinking, problem solving, analytical and technical skills. These skills are similarly needed for entrepreneurship (Ploum, Blok, Lans & Omta, 2018) as they give us the capacity to take responsibility and manage ourselves (Vare & Scott, 2007). In our globalized world, we are increasingly forced to think out-of-the-box and create skills to connect as well, including interpersonal, intercultural and interdisciplinary communication and collaboration (Lemke, 2002; Hodge and Lear, 2011; Ploum et al., 2018). In sum, creative skills, communication and collaboration skills, and critical thinking and problem-solving skills are 3 categories often mentioned to be relevant for today’s society, which are encouraged by the constructivist theory (Huang et al., 2019, Ch. 2.2.3). Overall, interaction is highly recommendable for education to contribute to successful learning processes and create better career perspectives.
While constructivism paves the way for a successful learning process and creation of better career perspectives through interaction, the reality is mostly different. Currently, a major challenge is the weak preparation of learners for the education market. In 2015, an estimated 250 million children did not have enough basic skills to enter the labour market, which makes it very hard to find a job. When all children are fully equipped with relevant skills, for the coming 80 years GDP in low-income countries is estimated to grow 28% per year and in higher-income countries 16% per year (Solberg, 2015). Even though education contributes positively to the quality of the workforce (SDG 4.4), the key barrier to create more positive impact is the mismatch between skills of the available workforce and job vacancies (SDG Compass, 2016; McGivney and Winthrop, 2016). Education also fails to train the future workforce not only for existing job vacancies, but also for innovative thinking and creating new markets. In my result chapter, I will elaborate on the current state of education and ICT in education.

As part of the SDG framework, the UN provides solutions to change the current situation. To improve the situation, barriers to access and quality of education should be eliminated, clean and safe learning environments should be created, educational curricula have to be in better alignment with business needs, and students should have early access to the corporate environment. In other words, education should have qualitative and safe learning environments, which involves qualified teachers and good facilities, providing relevant and effective learning outcomes linked to employment, decent jobs and entrepreneurship (target 4.1, 4.4 and 4a combined) (SDG Compass, 2016). Indicators to measure the impact of SDG 4 include early school leaving, higher education completion, basic skills, and the transition to the labour market (EC, 2017).

Huang et al (2019) show how the learning environment can be adapted to support interaction. They identified components of the learning environment: resources and intelligent tools, teaching and learning communities, and learning ways and teaching ways. Individual learners and teachers interact with resources and tools and within communities, to promote effective learning. Resources include school facilities, curricula, and educational materials (Ch. 9.4.3) and for constructivism should promote the construction of meaning (Ch. 2.2.3). The learning community promotes interaction, collaboration, and exchange of learners, while teaching communities are focused on professional development through knowledge exchange among teachers. While learning resources and intelligent tools provide opportunities for both communities, communities foster development of these resources and tools (Ch. 9.4.3). Learning and teaching ways, should be focused on personalized learning, consider prior knowledge and the psychological state, while aiming to get a meaningful construction of new knowledge (Ch. 2.2.3). Underlying is Piaget’s theory of cognitive development for individual learning which emphasizes the formation, enrichment, and adjustment of cognitive structures through interaction of new and old knowledge and experiences (Ch. 2.2.4). In addition, social constructivism adds the emphasis of the teaching process on learning and creation of meaningful situations (Ch. 2.2.3) through co-construction of knowledge and learning from each other (Ch. 2.2.4). For the learning process the emphasis lays on cooperation with peers and actively processing the information. Moreover, errors are positive, and useful towards self-management skills (Ch. 2.2.3). Examples of constructivism include scaffolding, or giving the right amount of assistance at the right time, having a dialogue between teacher and learner, and collaborative learning (Ch. 2.2.4). Although constructivism is today’s paradigm, educational practices are often rather traditional, having less interaction (Huang et al., 2019, Ch. 2), resulting in the weak preparation for careers.

In this chapter, I explained the need for constructivism in education and how constructivism is shaped in education. In my result chapter, I elaborate on the current state of education and ICT, specify this for Ghana and Sierra Leone, but first, I explain the methodology of my research.
3 Methodology

3.1 Research method

For my thesis, I have done three types of literature research. Firstly, I have outlined the learning transformation of Maxim Nyansa. Secondly, I have researched the relation between ICT, education and development. Thirdly, I have done case studies for Ghana and Sierra Leone to outline how the relation is shaped in these countries. I will elaborate on my research strategies for each type of research below and end with a reflection on my methodology.

To map the learning transformation of Maxim Nyansa, I have searched on the website, conducted an interview with Stanley Dankyira, the Director in Ghana, and based on that read an internal document. Firstly, on the website, I searched for all content related to the learning transformation. Therefore, I thoroughly read the learning transformation page (Maxim Nyansa IT Solutions, n.d.-b) and found the Learning Transformation PowerPoint there (Dankyira & Van der Stelt, n.d.). To supplement my findings and to be better able to analyse the learning transformation approach, I conducted an interview with Stanley Dankyira in which I asked him more deeply about the different steps explored on the website. I discovered that some information on the website has been written at the start of Maxim Nyansa, but not updated, and therefore the interview has been important to show relevant information. The topics were the selection of schools, contact with schools, payment, training, educational materials, and monitoring and evaluation. I recorded the and transcribed the whole interview and I have chosen not to fully code it, but highlight the relevant parts for my thesis and directly write up in my thesis document. Based on the interview, he has sent me more information about the quick scan (Maxim Nyansa IT Solutions, n.d.-d) they do initially and the teachers training content (Maxim Nyansa IT Solutions, n.d.-e). I used this research to analyse the current situation of Maxim Nyansa.

For my general literature, I started searching for an overarching book that provided most information on education, development and ICT. Due to COVID-19, Springer has made many books available for free. This included Huang, Spectsors and Yang's (2019) Educational Technology: A primer for the 21st century, which I have used to provide an overarching overview. In addition, I have searched for available literature in the WUR Library and Google Scholar, using terms related to educational technology and development, to complement and illustrate the findings of Huang et al (2019) for ICT. I selected Courville (2011), Suryani (2010), Lemke (2002) and Trucano (2005) as they provided more insights into the contribution of ICT to education in general, relevant for the 21st century.

For both Ghana and Sierra Leone, I have been searching for policy documents which map the education system, or specifically the learning environment and match with the job market. For Sierra Leone, I added my own research to it. In the later phases I searched for additional literature in Google Scholar and WUR Library, with the aim to get complementary information and other perspectives on the education system.

For Ghana, I found the most recent policy documents of the Ministry of Education: the Education Strategic Plan (ESP) 2018-2030, which referred to the Education Sector Medium-Term Development Plan (ESMTDP) 2018-2021 and the Education Sector Analysis (ESA) 2018 which I googled thereafter. At first I did not find this, as I searched for Education Policies, but later I googled for ‘Education Plan Ghana’ and found the most recent documents. A more recent ESA has not been available on the internet yet and therefore I have used the ESA 2018 and next year another ESMTDP will be published. I have read the ESP and ESA thoroughly, but discovered that the ESMTDP is an
implementation plan for the ESMTDP and therefore less relevant for my thesis. I have used the ESP 2018-2023 and ESA 2018 to illustrate the broad image of the learning environment. Next to the government documents, I have searched for additional literature on the WUR library and Google Scholar to complement the findings. While searching for articles related to ‘education (system) Ghana’, I found Osei, and Quaicoe, Pata and Jeladze writing more often about education and ICT in education in Ghana and therefore searched in their researches for more interesting articles. Osei (2006, 2009, 2010) gives an overview of local responses to educational reform in the 2000s. Although this is not very recent, it helps to understand the educational system and local responses in Ghana, which are in line with constructivism. This gives a dissent to the government and together with the government documents helps to outline the broader picture of the educational sector. Moreover, Takyi, Amponsah, Asibey, & Ayambire (2019) give an overview of the educational system, which has also been useful to outline the educational system. For the outline of ICT in education in Ghana, I have searched for literature on the WUR library and Google Scholar as well. I have used the already mentioned documents, as they speak for a minor part about ICT. In addition, I found different articles of Quaicoe, Pata and Jeladze (2015, 2016, 2017, 2018) writing about perspectives of local people on ICT, including teachers and students. Moreover, I used findings of other articles for illustration of the local context in which ICT is rooted (Natia & Al-Hassan, 2015; Mangesi, 2007), how educational policies influence implementation of ICT (Amedeker, 2020), students perceptions on ICT (Charles & Issifu, 2015), teachers readiness for ICT (Boakye & Banini, 2008) and the influence on professional development (Aygei & Voogt, 2011). I found these articles by searching for these terms, including Ghana in the searching term.

For Sierra Leone, I started in literature used for my previous research in combination with searching at the website of the Ministry of Education. The current government has split it into two: one for primary and secondary education and another ministry for technical and higher education, I have searched in the first one. I started reading the Education Sector Plan (ESP) 2018-2030 thoroughly, as for my previous research I only scanned it quickly. There was relevant information missing, and therefore I decided to thoroughly read the education part (part two, cluster one, p.36-44) of the Sierra Leone’s Medium-Term National Development Plan (SL-MTNDP) 2019–2023, and I read part 1, the broader context for the initial illustration. But I still missed a critical analysis of the education sector, and therefore started googling until I found the Annual School Census Report (ASCR) 2019 published in the beginning of June 2020. While the ESP has been written by the Ministry of Education, Science and Technology, so the overarching ministry including the Ministry of Education, the SL-MTNDP has been written by the government in general, and the ASCR has been written by the Ministry of Basic and Senior Secondary Education (MBSSE). In 2018, the DSTI has been responsible for ICT in education, and therefore I also searched for additional literature of the DSTI (DSTI, December 23, November 16, & September 16, 2019). For this and the next part, I also used my own feasibility study conducted in the end of 2019 and beginning of 2020 in Freetown. For the outline of ICT in education in Sierra Leone, it has not been easy to find literature. Therefore, I mainly used my own research. After searching long, I also found Samarakoon, Christiansen & Munro (2017) who write about Koinadugu and they confirm that Sierra Leone has been largely under researched. As it is not in the title, at first I overlooked this article. In addition, I used UNESCO (2015) and UNICEF (2012) to add some information on ICT in the education system, as they were mentioned in the other documents.
3.2 Reflection

The government documents were easy to find, although the ASCR 2019 came unexpected for Sierra Leone. Beforehand, I expected to find slightly more literature about Sierra Leone, but when I started searching, that was not the case. As researcher, I have tried to be neutral as much as possible. Therefore, during my research, I have not been talking to Diana and Stanley about my findings. To stay neutral especially in the beginning, to work efficient, and partly because of COVID-19, I have chosen not to be on the office of Maxim Nyansa in the Netherlands during the first weeks and only discuss my findings with Maarten Smulders. In week 5 and 6, I have visited it and discussed my findings with the PR-team, and in the 5th week I also conducted the interview with Stanley as previously mentioned. It has only been in the 6th week that I started sharing my findings with Diana to see if it would work.

Already from the start, I have searched for non-Western literature to not get a Western bias. I succeeded to find many authors from Ghana (Natia, Al-Hassan, Charles, Issifu, Aygei, and Quaicoe) and Africa (Boakye & Issifu). On the other hand, for Sierra Leone, there has only been one article available, written by Australians (Samarakoon et al., 2017). For the government documents, the reliability could be questioned, since it is funded by sponsors including the DFID, USAID, EU, and the World Bank and therefore direct to see good results, but also since it is written by the governments which only have one side of the story. I already discovered this during my previous research. I have tried to be as much aware of the bias as possible, discussing my findings with many people, while at the same time searching for neutrality. In the discussion I will elaborate on my reflection.
4 Results

4.1 Maxim Nyansa’s learning transformation approach

In the introduction, I already outlined the success factors of ICT in Africa and the integrated approach of Maxim Nyansa as researched by Maxim Nyansa. Here, I elaborate on the learning transformation approach as it goes on the ground. This is helpful to analyse the learning transformation based on the findings I show in the next paragraphs.

After the research, they further developed an integrated approach, built on 10 elements. These 10 elements can be found in Table 2. When approaching schools, they start with a quick scan mapping the local situation of schools and the local readiness for ICT usage, after which they make a tailor-made design. The 3 steps from the initial phase to implementation are shown in Figure 2. Each of the steps is elaborated on next.

Table 2 Overview 10 elements of the learning transformation (adapted from Maxim Nyansa IT Solutions, n.d.-b)

<table>
<thead>
<tr>
<th>10 elements of the integrated approach</th>
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<tbody>
<tr>
<td>Training</td>
</tr>
<tr>
<td>(1) Training of teachers in basic IT skills</td>
</tr>
<tr>
<td>(2) Training in multimedia teaching practices</td>
</tr>
<tr>
<td>(3) Training education innovation for 21st century skills</td>
</tr>
<tr>
<td>Hardware and Networking</td>
</tr>
<tr>
<td>(4) Set up of IT desktop laboratory</td>
</tr>
<tr>
<td>(5) Installation of other hardware, like smartboards, projectors, iPads, and laptops in class</td>
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<tr>
<td>(6) IT architecture and internet connectivity, possibly combined with on campus Wi-Fi and local servers</td>
</tr>
<tr>
<td>Software</td>
</tr>
<tr>
<td>(7) Individual Learning Management Software (online or offline alternative)</td>
</tr>
<tr>
<td>(8) Open source digital education content matched to the West-African curriculum</td>
</tr>
<tr>
<td>(9) School administration software</td>
</tr>
<tr>
<td>Consultancy and Change Management</td>
</tr>
<tr>
<td>(10) Our consultants can advise you on the way to go in the coming years and steps you can take</td>
</tr>
</tbody>
</table>

Figure 2: 3 steps taken by Maxim Nyansa (adapted from Dankyira & Van der Stelt, n.d.; Maxim Nyansa IT Solutions, n.d.-b)
Step 1: Quick scan

The learning transformation approach of Maxim Nyansa does start with the selection of schools. In earlier years, they actively promoted the new learning transformation concept to schools. Recently, this changed as schools know the concept and are contacting Maxim Nyansa instead. The contact often goes via local authorities, such as paramount chiefs, member of parliaments, and head of schools. When Maxim Nyansa is contacted, they go to the community and perform a quick scan (Interview Stanley Dankyira, 12-06-2020). This entails a small questionnaire with 4 components in which they ask about the current situation. The first component is the ICT-lab, in which the availability and condition of an ICT-lab are addressed, including location, electricity, power sockets, ventilation, security and hardware items. It also includes mapping the usage and maintenance of the infrastructure. The second component is IT skills, which indicates the level of IT skills among staff members. The third component is digital learning material usage, which indicates the use of software, resources, teachers who have knowledge about digital learning materials, learning management systems, and cyber security. Lastly, the local support is indicated, entailing the support of the school board, school headteacher, teachers, parents, religious bodies, and local businesses (Maxim Nyansa IT Solutions, n.d.-d). The quick scan has the aim to investigate the current situation and get an overview of the expected challenges (Dankyira & Van der Stelt, n.d.). Until the local environment and stakeholders are ready, Maxim Nyansa does not go. Therefore, most schools must invest before Maxim Nyansa arrives for the next steps (Interview Stanley Dankyira, 12-06-2020). When schools do not have the resources, there is an option to get the support of partner NGOs to prepare communities for the ICT intervention of Maxim Nyansa, such as creating a burglar proof building (Personal communication, Diana van der Stelt, 18-06-2020). When the quick scan is done, a short report is sent to the school. When the community is ready, Maxim Nyansa enters a 3-years partnership together with local stakeholders, mostly approved with a Memorandum of Understanding (MoU) (Maxim Nyansa IT Solutions, n.d.-b; Maxim Nyansa IT Solutions, n.d.-c; Interview Stanley Dankyira, 12-06-2020).

Step 2: Tailor made design

The minimum amount paid to Maxim Nyansa is 15.000 cedi’s, approximately 3000 euros. For this amount, a community gets 60 computers, which they can distribute themselves over 3 or 4 schools. For example, when a school pays 20.000 cedi’s they get 80 computers. This results in every school having 15 to 20 computers, which is enough to make students experience computers. Additionally, extra accessories are added such as smartboards, projectors, scanners, and printers, based on availability (Interview Stanley Dankyira, 12-06-2020). With the Computer4SchoolsGhana campaign, second-hand hardware is donated from the Netherlands (Anto et al., 2019). Public schools are treated differently than private schools. Whereas private schools often have a budget for ICT, public schools do not have or only have a small budget available. Therefore, public schools are asked to pay out-of-pocket costs, while private schools are asked to also pay the overhead costs of Maxim Nyansa. In addition, when communities are not able to contribute 15.000 cedi’s, it is negotiable what is possible at that moment. When a community or school does not have the resources to pay themselves, communities can choose for a community lab in which schools share the equipment. Moreover, partner NGOs or other funders can choose to help them financially. The 15.000 cedi’s function to cover up transportation costs, costs for some of the equipment and the activities of the logistics team (Interview Stanley Dankyira, 12-06-2020).
Step 3: Implementation

Before the hardware and software is installed by Maxim Nyansa, they train the trainers. Currently, this is a 5-days training given to ICT teachers and teachers of other topics. On the first day, an introduction is given, after which 3 days are spent on technical content what they need for their job. The last day is about ethics, multimedia, and maintenance (Interview Stanley Dankyira, 12-06-2020). Maxim Nyansa IT Solutions, n.d.-e). During the whole training, the same equipment is used which will be used in the ICT-lab. Maxim Nyansa is focused on the effect on students and by making the teachers feel like students during this training as they are the ones learning, they aim to change their way of teaching positively. They make use of open source materials instead of Microsoft since this is free and similar in usage. When teachers use Microsoft in their own environment, they know how to use it. After the training, the lab is equipped by Maxim Nyansa and the open source materials are shared with the school. These open source materials, including videos, are available in collaboration with Computer Shiksha from India, who also helps with the maintenance from the ICT devices via calls. Then they leave and a WhatsApp group is created in every community, so local people can help each other. In case they cannot help each other, they can call Maxim Nyansa. Maxim Nyansa visits them regularly to see if the ICT intervention is successful and occasionally feedback is asked from the schools (Interview Stanley Dankyira, 12-06-2020). Moreover, in 2017 they started with an initiative to provide laptops for the teachers after they have been trained. Unfortunately, there are not enough laptops coming from the Netherlands. Therefore, they started a deal with a local retailer to buy the laptops for a good price but ended up paying the laptops themselves (Personal Communication, Stanley Dankyira, 24-06-2020).

4.2 Literature review: education, ICT and development

In the theoretical framework, I outlined my perspective on the relation between education, ICT and development, based on constructivism. I explained the ideal interactive learning environment and while this shows the ideal situation, the reality is different. In this part, I first give an overview of the potential contribution of ICT to education after which I explain how it gets meaning through social interaction.

4.2.1 Role of ICT in education

In the previous decades, education has been changing. The rapid growth of available educational technology has contributed to this. This is illustrated in Figure 3. Technology has changed what people do and can do (Huang et al., 2019, Ch. 1.1.6). In education, “[t]echnology not only changes how people learn, it affects what they need to learn as well” (Lemke, 2002, p. 7). ICT has three great benefits for the learning environment and learning outcomes, which I will outline here. Firstly, ICT expands possible teaching and learning ways through deepening and broadening teaching and learning ways, and it forces teachers to teach interactive. The increased availability of learning tools such as apps and mindmaps, and educational resources such as online textbooks, videoclips and mindmaps, encourages the development of existing teaching and learning ways (Huang et al., 2019, Ch. 7.2.3). Moreover, technology adds value to the learning environment by providing real world contexts for learners, tools for visualization and analysis, and connections to outside experts (Lemke, 2002). Therefore, unfamiliar content is increasingly visualized, and related to this, intercultural experiences and creativity are enhanced because of broadening experiences (Courville, 2011). The increasingly available databases give access to readily available information sources, which they can use to make their preparation more time efficient (Courville, 2011). In addition, for teachers, ICT forces them to change their role
from knowledge-providers to an advisor, supervisor, or instructor, as knowledge is increasingly available digital (Suryani, 2010). This is related to the second benefit, which entails that ICT enhances interaction among and between learners and teachers. Among learners, ICT promotes collaboration, knowledge creation and student engagement (Huang et al, 2019, Ch. 7.2.3). A positive side effect of ICT is that learners can be more motivated to learn, which can also motivate teachers more (Suryani, 2010). Moreover, for both learners and teachers, ICT provides a platform for problem-solving and feedback, reflection, and revision (Lemke, 2002) and it promotes online teaching and learning communities (Courville, 2011). For teachers, gathering with other teachers gives opportunities for professional development and improve their teaching ways (Suryani, 2010). Thirdly, ICT enhances learning outcomes. Because of the increased tools and resources and increased opportunities for interaction, learning outcomes fit better with today’s society. For example, the possibilities for co-construction of knowledge help students to better grasp the educational materials (Huang et al., 2019, Ch. 7.2.3). Moreover, ICT can also contribute positively to better results as it is easier to keep track of students’ cognitive performances, students results and collaboration, for example making use of Education Management Systems (EMS). By self-appraisal through reflection and evaluation and self-management through planning, selecting and using learning strategies, learners can take more responsibility over their learning process (Suryani, 2010).

In sum, both deepening and broadening education experiences are encouraged by ICT, interaction is promoted, and ICT can keep better track of records. Therefore, the potential of education to successfully equip learners with knowledge, skills and abilities is increased by making use of ICT as increasingly content is available, opportunities to gather, and management system. In the end, learners are increasingly for the real world and labour market. Constructivism enhances this idea, but ICT is also a social construct and therefore should not just be taken as a given fact. Next I will outline the basic elements of constructivism for ICT: context, collaboration, conversation and meaning-making.

4.2.2 ICT interventions as social construct: how it gets meaning

While technology has brought us more freedom to express ourselves and unify the world, it has also brought us a dark side of misinformation and disinformation, pornography, hate speech, which can create depression and alienation (Lemke, 2002). Therefore, generally content should be filtered, personal data protected, and quality should be controlled (Trucano, 2005). Although technology has
the potential to create value for the education system, there are social factors contributing to the creation of extra value which should be considered. A first prerequisite for education to make use of the opportunities ICT offers is the access to ICT, related to the technical dimension. This is important, but the focus of my thesis lays on constructivism and the social embeddedness. In the context of an ICT intervention, the schools are learners, while the ‘intervening agency’ is the teacher. Below I will outline the different components of the social dimension of technology: context, collaboration, conversation and meaning-making.

ICT interventions should be learner centred and therefore driven by the schools. Firstly, agents that do ICT interventions should prioritize context of the schools, as it is not a one-size fits all. This means that ICT should be in line with the schools’ current state. Context relevant factors are the educational curriculum, learning environment, schools’ culture, ICT infrastructure, financial status and skills (Suryani, 2010). For example, when the curriculum is not considered, ICT can be distractive for existing learning processes (Courville, 2011). Moreover, national and local policies, including guidelines and directions for ICT, should be considered (Trucano, 2005).

Secondly, collaboration and conversations are needed to get ‘ownership’. Rather than bringing ICT top-down, bottom-up initiatives should be encouraged, and ICT interventions should be driven by the initiative of the schools itself. Technology is very likely to fail without local support (Huang et al., 2019, Ch. 13) and local attitudes influence the success of ICT interventions (Trucano, 2005). For example, stakeholders can be reluctant to use ICT as they perceive ICT as having an undesirable overload of work and teachers can be afraid to fail before the students who have more sophisticated digital skills. Instead they rather do what they are used to (Suryani, 2010). On the other side, for example a personal computer makes teachers’ preparation more efficient and positively influences teachers’ attitudes (Suryani, 2010). Concretely, it means that teachers, parents, employers, administrators, and students should be regularly consulted (Huang et al., 2019, Ch. 13). The attitude of local stakeholders is closely linked to the context. For example, the attitude of teachers and learners depends on training, computer skills, perception, and workload. Without local people’s readiness and willingness, especially of teachers, the chance is very slim that the ICT will be used (Suryani, 2010).

Thirdly, meaning-making is important to lift the ICT intervention to a following higher level. It means that value should be added to the local situation. There are different ideas about meaning-making, but as mentioned it should be learner centred. However, this can be challenging with ICT interventions. For example, teachers can be forced to use ICT by school leaders, people have a romantic few of technology and do not look at the usefulness, or schools want ICT to have a superior status (Suryani, 2010). There often is a gap between initial ideas of ICT intervention from the outside perspective and the final implementation. Trucano shows that although the initial idea is to equip schools with technology to improve 21st century skills such as critical thinking, collaboration, and international awareness, in the implementation phase ICT is often used to teach ICT skills (Trucano, 2005). Here the complexity of constructivism is highlighted, as the constructivist frame is used for the ICT intervention, but imposing constructivist frame in education cannot be forced looking from the constructivist angle. However, constructivism creates opportunities for empowerment which focuses on full ownership and positive development and therefore should be encouraged.

In sum, ICT interventions should be in line with the local circumstances, navigate on bottom-up initiatives, have local support through collaboration and conversations, and create meaning. This should be learner centred to create ownership and positive development. In this way, ICT can be used for the good and not collecting dust. When teachers are trained as part of ICT interventions, the local context and attitudes towards ICT should be prioritized for meaningful implementation, next to the
technical skills. However, this process can interrupt the constructivist idea of a fully learner-driven process.

4.2.3 Answering first set of subquestions

As part of my broader research question of how ICT interventions in education contribute to development in Ghana and Sierra Leone, my first set of subquestions aimed to create an analytical framework. As explored in the theoretical framework, I approach education, ICT and development from a constructivist view, taking SDG 4 “quality education” as fundament. Below, I answer the three subquestions that are part of the first set, after which I come to the overarching answer.

The first descriptive question is “How does education contribute to development according to literature?”. Education should be learner-centred and create meaning for the learners. To get positive development and create career perspectives, personal contexts should be prioritized and the learning environment should support interaction. The interaction that is promoted in the learning environment contributes to a better preparation for today’s job market and required entrepreneurship skills, including creativity, communication and collaboration, critical thinking and problem-solving.

My second descriptive question is “How does ICT contribute to education according to literature?”. My answer is threefold, as I have outlined three contributions of ICT, defined as ‘digital technology’ to education. Firstly, learning experiences can be deepened and broadened, as there are more tools and resources available. Secondly, interaction is enhanced as ICT encourages learners and student’s engagement, it simplifies giving feedback and stimulates gathering in online teaching and learning communities. Thirdly, learning outcomes can be increased since results and learning processes can be better monitored.

The last descriptive question is “How does ICT contribute to development according to literature?”. ICT does not only have a technical dimension, but also a social dimension, which should be considered. ICT is socially constructed, which means that the local context should be prioritized, and conversation and collaboration pave the way for real ownership and bottom-up processes. In addition, meaning-making is needed for real ownership and learner-centredness in ICT intervention as well.

Overall, literature shows the learner-centredness in both education and ICT interventions and interaction that is highly important for successful learning processes. When there is interaction and ownership is created, meaningful development is created for the involved stakeholders. In education, this means that career perspectives are provided and in ICT intervention, implementation creates value for the local stakeholders.

4.3 Case study Ghana

I start both case studies with a broader introduction related to the socio-economic background, set up of the education system and education financing and policies. After that, I outline the education system, making use of the learning environment components as used by Huang et al (2019) and career preparation. Lastly, I outline the situation of ICT in education and discuss how the way towards a desired learning situation can be achieved.
4.3.1 Background illustration Ghana

Ghana is a lower middle-income country having close to 30 million residents in 2017. In recent years, they have had many successes in expanding access to education. This has been partly possible because of the huge economic growth between 2008 and 2012. However, in 2017, there was a huge fiscal deficit due to the increased expenditures and stagnant revenues. It is a country with many sides. Although English is the official language, there are 69 additional individual languages. While the southeast of Ghana is relatively wealthy, including the Western and Central Accra Region, the northwest is relatively poor, including Upper East and Upper West (see Appendix 2a and 2b). In 2015, just below 40% of the population was aged under 14 and only 1.9% was aged above 65. With a growth rate of school children of 2%, although expected to decline to 1.7% in 2030, the already young population is expected to be very young the coming decades. This is related to how the population is distributed over the country and the level of education (MoE, 2017, Ch. 1.1), therefore the education system is very important.

The Ghanaian education system exists of 7 programmes. The basic education exists of 2 years of kindergarten (KG), 6 years of primary school and 3 years of junior high school (JHS). This part is free and compulsory for all children by law. Afterwards, pupils can go to senior high school (SHS) or follow technical and vocational education and training (TVET), which take 3 more years. In the final year of SHS, pupils have their West African Senior School Certificate Examination (WASSCE), which is valid in the English-speaking countries of West-Africa. In addition, non-formal education focuses on increasing literacy rates for adults and youth. Lastly, education focuses on accountability and planning for teachers as well as the general education system (Ministry of Education (MoE), 2017, p. 1).

As explained, in my thesis, I focus on lower education, and therefore only outline KG, primary, JHS and SHS. Before delving into the education system, I will explain how education is financed and supervised.

Currently, the education system is largely financed by the government, which contributed 87% of the educational finances in 2012, but it has decreased to 78% in 2015. With government expenditures on education, the salaries of teachers are paid. In addition, the GETfund (Ghana Education Trust fund) and ABFA (Annual Budget Funding Amount) invest in goods, services and capital in education. GETfund is an earmarked proportion of VAT (Value-Added Tax), while ABFA is an earmarked proportion of oil revenues. In 2015, the largest expenditures have been made for primary school, but that has been overtaken by JHS, SHS and tertiary. A reason for this is that in JHS, since 2015 there have been more teachers employed. The distribution of expenditures is expected to change, since in 2017 the government has started the ‘free SHS policy’, which provides free education for SHS as it says. Next to the free SHS policy, the government launched the ‘National School Feeding program’ to enable pupils to focus on learning and be free of hunger. In 2015, they reached over 3000 schools and 1.3 million of pupils (MoE, 2017, Ch. 1.2). To oversee the operations of the basic and secondary education, the Education Act established three national agencies: National Inspectorate Board (NIB), National Teaching Council (NTC), and National Council for Curriculum and Assessment (NaCCA). In addition, the Ghana Education Service (GES) oversees the whole sector. The overall goal for education is ‘to deliver quality education service at all levels that will equip learners in educational institutions with the skills, competencies and awareness that would make them functional citizens who can contribute to the attainment of the national goal.’ (MoE, 2017, 2.2.2.2).
4.3.2 Education system Ghana

Learning environment Ghana

The learning environment exists of 6 components, which I discuss in 3 pairs: resources and tools, teaching and learning communities, and teaching and learning ways.

Firstly, the amount of resources and tools in the learning environment is poor. This starts with a backlog of classrooms, with overcrowded schools as a result. In the KG there is a classroom backlog of 5491 (24%), in primary school of 4236 (5%), in JHS of 1247 (4%) and in SHS of 2894 (16%) (MoE, 2017, Ch. 1.3). The shortage is the biggest in the northern provinces and the lowest in the southern regions (MoE, 2018, Ch. 4.1). The percentage shows the share of the total existing classrooms. Although the student-classroom rate has decreased from 51 in 2011/2012 to 43 in 2014/2015 in SHS, it is expected that due to the free SHS policy, pressure on classrooms will increase, as well as other resources. These resources include desks, seats and textbooks, which have not been sufficient for learners to provide everyone a desk, seat and appropriate books for the courses. The textbook-student ratio has decreased for primary school and JHS from 2.2 in 2013/2014 to 1.4 and 1.5, respectively, in 2016/2017. The textbook-student ratio at SHS has decreased as well for maths and English from around 0.75 in 2011/2012 to 0.50 in 2015/2016. Challenges underlying the production of books are the delaying and distribution of books. In addition, there have also been reports of errors in textbooks (MoE, 2017, Ch. 1.3; MoE, 2018, Ch. 4.2 & 5.2). Overall, the curriculum is outdated, which will be elaborated on at teaching and learning ways. Maybe even more important is the infrastructure not directly related to education. For primary school, it is the infrastructure that is important for parents to send their children to school. This infrastructure involves water, toilets, electricity, and considering disabilities of children and special education needs. In addition, feeding is important as well. Currently, these infrastructures are lacking behind as well (MoE, 2018, Ch. 1.4). The overall challenge to provide sufficient resources and tools is largely limited by the lack of money, but also because of a lack of management, which will be elaborated on next.

Secondly, teaching and learning communities are often not present or inactive. The Ministry of Education (2017, Ch. 3.7) mentions that the rare PTAs and SMCs function poorly, resulting in inefficient education. In addition, in all the literature read, I have not found evidence of well-functioning teaching and learning communities and I have not come across actions taken by the NTC. The Ministry of Education confirms the poor accountability structure and weak management over the whole education sector resulting in poor coordination and regulations. This starts with the deployment of teachers, which is challenging since teachers are poorly distributed amongst schools and regions (MoE, 2017, Ch. 3.7), for example because it is unpopular to go to rural posts, and deployment is often lengthy and bureaucratic (MoE, 2018, Ch. 3.4; Osei, 2006). In the whole education system, there is no proper licensing and registration of teachers yet (MoE, 2017, Ch. 1.3) which results in no national minimum standards and schools having their own standards (MoE, 2018, Ch. 3.2). There is a challenge for private schools as well, since they are rapidly growing, but are harder to coordinate and regulate for the government. While they make out 90% of the newly build primary schools and 50% of newly build JHS and SHS, teachers are lower trained (MoE, 2018, Ch. 3.7). On the one hand, the teacher force is underqualified (Osei, 2006). On the other hand, 90% of the teachers in SHS are trained, yet learning outcomes are poor (MoE, 2017, Ch. 3.2). During pre-service teacher training, teachers often do not learn pedagogical skills, or how to teach, and for basic education training is the same for all the levels (MoE, 2018, Ch. 3.1). This has to do with the lack of management and accountability, but also with the lack of effective matching of teaching resources and local needs (MoE,
There is a mismatch between skills teachers have and what they teach, as teachers education curricula are not connected to the curricula of primary and secondary education (MoE, 2017, Ch. 3.1). Although formally teacher management is the task of the GES, good teacher management is lacking. While the Ministry of Education has a zero tolerance for absenteeism, in 2014/2015 national teacher absenteeism still has been 14%. In addition, the education sector faces challenges of teacher attrition and time on task, with attrition having increased from 2% in 2009 to 4% in 2016 (MoE, 2017, Ch. 1.3) and District Directors having the average age of 57 years. Moreover, there is a lack of national standards and guidelines for school leadership (MoE, 2018, Ch. 3.3). In the whole education system, there is no follow-up for teachers after they are trained. This means there is little systemic support, coaching, advice, and continuous professional development for teachers (MoE, 2018, Ch. 3.2; MoE, 2017, Ch. 3.7). In addition, teachers can have a poor motivation because of inadequate career opportunities and housing (MoE, 2017, Ch. 3.7). They also have low motivation for professional development because of the low incentives, the money it costs while provided low wages, and the time it consumes, considering the long working days (Osei, 2006). Functioning teaching communities could improve the situation for teachers and teacher management.

Thirdly, teaching and learning ways are often traditional. The Ministry of Education wants to transfer the education from traditional towards more modern ways of learning. In other words, they want a learning transformation. The curriculum in basic and secondary education is outdated, with the basic curriculum not been updated since 2007 (MoE, 2017, Ch. 3.1) and the secondary curriculum since 2010 (MoE, 2017, Ch. 3.2). The current curriculum does not provide 21st century skills needed for the modern high-tech ventures, such as creativity, English, maths and computer skills, because the curriculum is too much focused on reproducing knowledge, as it is content-overloaded. In addition, education is too much examination driven. The outdatedness school system results in skills gaps (Osei, 2006; MoE, 2018, Ch. 3.1). As already mentioned in the previous paragraph, teachers are often not educated on how to teach, and in addition, they are not taught about classroom management differentiation (MoE, 2018, Ch. 3.1). This results in teachers having knowledge and students listening, education being little personal, having little interaction, and one way of teaching for the whole class and for different levels, resulting in inefficient teaching and learning (Osei, 2006). Teachers must write their lesson notes manually which takes lots of time and digital preparation is not supported by the GES. In addition, teachers often do not know what they are talking about (Interview Stanley Dankyira, 12-06-2020). On the background there are too little resources and tools, but also overcrowded classrooms, or in more technical terms large Pupil-Teacher Ratios (PTRs) (Osei, 2006). The GES PTR norms are 25:1 for KG and JHS and 35:1 for primary school (MoE, 2018, Ch. 4.2). As can be seen in Table 3, the PTR is slightly too high at all different levels, except for JHS. PTRs are expected to increase, as the Free SHS policy will lead to more enrolment. At the same time, the Ministry of Education has the goal to decrease pupil-trained teacher ratios, since they want to train all teachers. When classes have more than 30 pupils, quality is reduced, especially in SHS where the syllabus is more complex. For example, it is harder to initiate projects which help pupils to improve their critical analysing skills. Due to this overcrowdedness, in combination with the low wages compared to the private sector, the teacher profession has been decreasingly popular for the younger generation, and present teachers search for other jobs. In addition, teachers must pay educational materials themselves, which leaves less of their already small income, and they have long working hours. The small income forces teachers to get additional income (Osei, 2006). These challenges restrain teachers from innovative ways of teaching. However, changing learning ways have changed the role of the teachers and demanded teaching ways. While before 1979, the attitude of pupils was good, as they were self-disciplined and
obedient and respectful towards the teacher. In addition, results on SSSCE were also good. Since 1997, results of SSSCE have been declining and pupils have shown less respect. This trend can be explained due to the loss of symbolic value of education, as it was new in 1979 and people were very grateful because it provided them opportunities as never before. Moreover, rapid social change and political unrest resulted in the lack of self-discipline of students. The combination of overcrowdedness and the lack of self-discipline has changed the role of teachers towards more pastoral and pedagogical, while having limited contact with teachers. However, most teachers have often not been taught about pedagogy (Osei, 2006). Therefore, a learning transformation is desired.

Career perspectives and educational reform Ghana
The low interactivity of the learning environment result in a low impact on career perspectives. Because of the low interactivity, graduates are poorly prepared for careers. In addition, there is a poor internal efficiency, which can be seen in poor enrolment and completion rates (see Table 3). I elaborate on the poor internal efficiency first, after which I address recent educational reform.

Firstly, Gross Enrolment Rates are relatively high, while Net Enrolment Rates are much lower. This means there are many pupils that enrol in a grade over- or under-age, in the case of Ghana over-age. This is caused by late enrolment in KG and primary school, but especially by the high number of repeaters. In Table 4, the repeat and drop-out rates are shown per grade. Remarkable is the high percentage of repeaters at JHS 1 (19%), pointing to a weak transition of primary school to JHS and unpreparedness, and the high percentage of drop-outs at JHS 3 (23%), meaning they are not moving to the next level of education, SHS. Out of 100 pupils entering KG, only 16 make the transition to SHS. In addition, out of 100 pupils entering primary school, 80 reach P6, 75 JHS1, 59 JHS3, 41 SHS 1 and 38 reach SHS3. Alarming is that of the poorest quintile, out of 100 who enter KG, only 4 enter SHS. In addition, the poorest quintile is 5 to 6 times more likely not to access SHS. Scholarships raise school completion with 30% and therefore, the free SHS policy is expected to contribute positively to income parity (MoE, 2018, Ch. 3.6). Although the major reason for repetition is the poor internal efficiency, there are also external reasons. Individual reasons for repetition include seasonal work, family responsibilities and lack of fees. The lack of fees will be reduced by the free SHS policy and therefore improvement is expected.

Although I do not include inclusivity and parity in the analysis my thesis, I shortly look at factors underlying efficiency of education. Both the access and results highly differ per income, gender and region. This is confirmed by Takyi et al (2019). As explored, poverty is a main driver not to access, but it also influences results. In addition, geography is a main driver as well. As mentioned, in the three northern areas there is more poverty, but in general there are smaller chances compared to for example the Greater Accra Region. When you are a poor female living in the poorer rural areas of Ghana, you have followed an average amount of 4.4 years of education, while for wealthy male living in the wealthier urban areas of Ghana, the average is 13 years. In addition, the three northern regions score poor on the BECE compared to the Greater Accra Region. Results of girls are significantly poorer for maths, science, and social studies in primary and secondary education. Moreover, in the 3 northern regions girls also score weaker for English and in general pupils have scored significantly lower in WASSCE for compared to the other regions. Overall, the Greater Accra Region outperforms all other region, especially the three northern regions and urban outperforms rural. Although the gender difference is less clear, in the poorer areas gender has a larger influence on access and results. However, in all regions, some schools have excellent results, while others have
Table 3 Education system Ghana (MoE, 2017, p. 104-111)

<table>
<thead>
<tr>
<th></th>
<th>KG</th>
<th>Primary</th>
<th>JHS</th>
<th>SHS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2016/17</td>
<td>2029/30 (target)</td>
<td>2016/17</td>
<td>2029/30 (target)</td>
</tr>
<tr>
<td>GER (Gross Enrolment Rate)</td>
<td>115.6</td>
<td>100</td>
<td>111.4</td>
<td>100</td>
</tr>
<tr>
<td>NER (Net Enrolment Rate)</td>
<td>74.6</td>
<td>100</td>
<td>91.1</td>
<td>95</td>
</tr>
<tr>
<td>Completion Rates (over age-appropriate population)</td>
<td>-</td>
<td>-</td>
<td>100.8 (P6)</td>
<td>100 (P6)</td>
</tr>
<tr>
<td>Transition Rate For SHS: qualify for tertiary institutions</td>
<td>-</td>
<td>-</td>
<td>94.3 (P6 to JHS1)</td>
<td>100 (P6 to JHS1)</td>
</tr>
<tr>
<td>PTR (Pupil-Teacher Ratio)</td>
<td>30</td>
<td>35</td>
<td>39</td>
<td>35</td>
</tr>
<tr>
<td>Pupil-trained teacher ratio</td>
<td>63.5</td>
<td>35</td>
<td>52.4</td>
<td>35</td>
</tr>
<tr>
<td>% trained teachers (in public schools)</td>
<td>65.1</td>
<td>100</td>
<td>76.0</td>
<td>100</td>
</tr>
<tr>
<td>% computers and internet for teaching</td>
<td>-</td>
<td>-</td>
<td>4</td>
<td>60</td>
</tr>
</tbody>
</table>

Table 4 Percentage of repeaters and drop-outs at each grade (MoE, 2018, p. 26; data from EMIS database/ Perry et al., 2018)

|            | KG1 | KG2 | KG3 | KG4 | KG5 | KG6 | Primary  | P1 | JHS1 | SHS1 | Primary  | P1 | JHS1 | SHS1 | JHS2 | SHS2 | JHS3 | SHS3 | JHS4 | SHS4 |
|------------|-----|-----|-----|-----|-----|-----|----------|----|------|------|----------|----|------|------|------|------|------|------|------|------|------|
| Repeater rate | 37% | 10% | 16% | 16% | 15% | 10% | 12%      | 12%| 19%  | 15%  | 16%      | 15%| 5%   | 15%  | 15%  | 15%  | 15%  | 15%  | 15%  |
| Drop-out rate | 1%  | 1%  | 1%  | 1%  | 3%  | 3%  | 1%       | 1%| 3%   | 4%   | 3%       | 3%| 23%  | 3%   | 7%   | 4%   | 4%   | 4%   | 4%   | 4%   |
very poor results, also depending on the elite status of SHS (MoE, 2017, Ch. 3.2) and it has to do with school management and leadership (MoE, 2017, Ch. 1.3 & 1.4). In addition, excellent results have been achieved by schools that did have good preparation of teachers and investment in Science, Technology, Engineering and Maths (STEM) facilities (MoE, 2018, Ch. 4.2).

The better the exam results, the better prepared learners are for the job market. It also depends on the extent of being equipped with 21st century skills. Due to the lack of interactivity of the learning environment, the government has tried many educational reforms recently. Although the Ministry of Education has taken initiative, the discourses about educational reform and central expectations largely differ from local realities. While changing the hierarchical governance towards more decentralised, educational reform still is top-down, not considering local stakes, including interests of teachers (Osei, 2009). Osei (2009) claims for Ghana, although wider applicable, that they need to prepare people to lead instead of follow. Therefore, ongoing training of teachers is important as they will have different roles compared to the past. Moreover, appreciating existing connections and bases for social cohesion within the community, and analysing the receiving community is important to understand the local context in which you are working. In addition, recruiting the right people and considering the harsh climate, poor communication and infrastructure, helps to succeed in educational reform. Community support is also very much important for educational reform to succeed, as it reduces the financial burden of the government and together with government support is the key towards success. In recent years, the Ministry of Education has focused too much on the technical aspects of innovation. Having a dialogue with schools and creating joint definitions and goals, plan implementation and management, and have proper communication and use the local environment, are keys to get educational reform that works on the ground. (Osei, 2010).

In this part I have outlined the education systems and shortly outlined how educational reforms have taken place. Next I will address the ICT usage in education and ICT intervention as social construct.

4.3.3 ICT in education Ghana

ICT usage in education in Ghana is low yet increasing. As can be seen in Table 3, percentages of primary schools and JHS using computers is low and for SHS there is no data available (MoE, 2017, Ch. 3.2). Technology can initiate reform and enhance existing educational reform (Osei, 2009). Although since the 1990s, ICT has been implemented in education, real action has not been taken until the early 2000s. In the 1990s, ICT was mainly used for lesson plans, preparing teaching materials, administrating grades and communication. It was only used as tool for professional work, but not for learning activities (Becker, Ravitz & Wong, 1999). The New Education Reform of 2007 was enhanced by the ICT in Education Policy of 2008 and the first national agenda for ICT and education was developed (Quacic & Pata, 2018; Jeladze, Pata & Quacic, 2017). The purpose of ICT in education in Ghana, according to the Ministry of Education (2015), is “to enabl[e] graduates from Ghanaian educational institutions - formal and non-formal - to confidently and creatively use ICT tools and resources to develop requisite skills and knowledge needed to be active participants in the global knowledge economy at all times.” (p. 28). Since 2007, ICT has been introduced in schools as subject and integrated in other subjects. Moreover, tools and resources have been supplied to schools and teachers have been trained (Jeladze et al., 2017). However, these ICT interventions have been top-down. In this part I first provide an overview of how ICT interventions have been taking place, after which I address how it socially gets meaning.
ICT interventions in education Ghana

On the national level there has been collaboration and regional and district officers have overseen the ICT coordination. The National Inspectorate Division monitors instructions and curriculum in accordance with the GES (Jeladze et al., 2017). However, these and other programmes has been performed within a top-down governance structure. Therefore, in recent years, there have been multiple initiatives to improve ICT access in schools, which have not been successful. These initiatives have been taken by the government as well as institutions and individuals, including NGOs and PTAs. For example, the government has proceeded the one laptop per child policy in the early 2000s, which discontinued because of political reasons (Quaicoe & Pata, 2018). In addition, the Ministry of Education has rolled out an i-box, an online site for learning resources, and they have started to track students with a student ID (MoE, 2017, Ch. 2.3). Another example is The Basic School Computerization Policy of 2011, to supply ICT resources in schools (Natia & Al-Hassan, 2015). It is widely accepted that ICT can improve education and provide students with 21st century skills to function globally (Amedeker, 2020; Quaicoe & Pata, 2018). The Ministry of Education expects ICT to contribute to new ways of accessing and analysing information, create a change of traditional-memory based education towards education stimulating 21st century skills, and finally expects excellent academic performances. Although they have made lots of progress, there has been gaps in implementation and positive results have been occasionally. For donors, on which the educational system is largely dependent, the projects have been mostly uncoordinated. While aiming to ‘fill gaps’ in the education system, they missed the involvement of local stakeholders, including educational authorities, teachers and students (Amedeker, 2020). For the government, involving local stakeholders has often not happened as well. Because of the top-down governance, local circumstances have only rarely been considering by the different governments. Subsequently, there has been a large focus on the technical aspect of ICT, having no focus on crucial aspects including digital literacy and the implementation of ICT in the current way of teaching. For example, there has been no attention for how to integrate ICT pedagogically or in the different topics (Amedeker, 2020; Osei, 2009; Jeladze et al., 2017). This is illustrated with the ‘double intake’ procedure set up in 2018. Although this is not directly related to ICT, it shows the lack of local involvement. ‘Double intake’ means there are different batches of students following education. As there was no intensive communication and there was no pilot conducted, the opposition did not feel heard. Moreover, the anecdote in box 1 about Science Resource Centres (SRCs) shows the reality of ICT integration in education which lays far behind.

An example is shown in the set-up of Science Resource Centres (SRCs) and a national ICT centre in Accra with the goal to make science in SHS more ICT-oriented. Due to a lack of resources, and other local problems, it did not have many positive contributions to education. Although the Ministry of Education supplied buses for transport to the centres, fuelling was challenging due to a lack of funds. In addition, timetables were disrupted since the curriculum is very much examination driven. Therefore, teachers are not willing to compromise missing a subject of the syllabus for going to an ICT-lab. Moreover, only a small number of teachers have been trained and they were lacking incentives as they did not have clear conditions of service and prospects were weak. Some started working at the SRCs, but the work was too tasking. While SRCs have been introduced, school curricula have also been revised. But there has been no procedure of how to integrate ICT in education and therefore teachers have been lost. Overall, supervision plans, sustainable measures, a culture of maintenance, good conditions of service and a proper infrastructure have been lacking in the centres and SRCs ended with teaching science in a normal classroom from a desk (Amedeker, 2020).

Box 1 Anecdote of failed ICT implementation, SRCs
expectations (Amedekker, 2020). Here we already see the importance of the social construction of ICT, which will be further elaborated on below.

**ICT interventions as social construct in Ghana: how it gets meaning**

For a meaningful implementation, local factors must be considered, involving use of teachers and students, but it should also be rooted in the broader environment. Quaicoe & Pata (2015; 2018) have identified environmental variables, and personal attitudinal and cultural belief variables for the successful use of ICT by teachers. Environmental variables are the digital agenda, ICT equipment and ICT support system. Personal and cultural variables are digital attitudes, opinions on ICT in education, and the perception on ICT projections, ICT obstacles and ICT impact and the perception of interventions for teaching and learning. They identified digital training as the targeted intervention to get desired development, involving digital confidence, knowledge, skills, activities, and applications. For the Western region of Ghana, equipment and support systems are not associated with the desired development, while attitudes, perceptions and digital agenda are. For teachers using ICT can be burdensome as it demands additional responsibilities and therefore the attitude, perception and digital agenda are important (Quaicoe et al., 2016). For example, teachers who are not willing to use ICT say want to use it when they are forced by peers or out of punctual necessity (Boakye & Banini, 2008). To successfully implement ICT interventions, including digital training for teachers, interventions should be specified for environmental and personal and cultural factors to enhance the knowledge, skills, confidence and application, and finally digital activities (Quaicoe & Pata, 2015; 2018). Boakye & Banini (2008) add to this that training and the environment are important and both should reflect on teaching practices. In addition, they mention that for durability, parents and school committees should be involved to be responsible for ICT integration.

Successful implementation does not only depend on use of teachers, but also on the use of students. In general, students’ perceptions of ICT are positive. One the one hand, positive attitude towards ICT raises computer usage. Overall, students in secondary-cycle education in Ghana have an expectancy of success and positive perceived value, which is higher than the perceived costs. Factors influencing the attitudes, include the classroom organization, classmates, teachers and resources. In general, males are slightly more positive than females about the value and costs, and public schools’ pupils are more positive for value items. On the other hand, the higher the computer usage, the more positive the attitude towards computers. Although students can be less willing to use, generally through using they will change their attitude positively (Charles & Issifu, 2015). Unfortunately, there are few resources that are unevenly distributed. In primary school, only 4% has access to computers in school, and in JHS 10% resulting (Natia & Al-Hassan, 2015). In addition, the schools that have computers, do not always have sufficient computers. The low computer ratio combined with large class sizes result in low usage per student (Quaicoe et al., 2016). This results in computers often being used for ICT classes only, since these classes get priority to use computers. Therefore, ICT is especially integrated in ICT as a subject, but ICT is lesser integrated in other subjects, resulting in the weak development of ICT competences across other subjects (Agyei & Voogt, 2011). In addition, the attitude of students also has to do with the extent of teachers’ readiness (Natia & Al-Hassan, 2015). Students often have better developed ICT competences. Over 78% of teachers researched in more urban areas said to be willing to learn, but only 29% does use ICT in the classroom and only 24% of the teachers received training. Due to this lack of teacher readiness, students are not fully benefitting of the new technologies in schools. Therefore, you could say ICT implementation should focus on teachers particularly (Boakye & Banini, 2008).
Towards a learning transformation using ICT in Ghana

Although there are huge opportunities to improve the education system, underlying challenges for the whole system are huge as well. As mentioned, there is lack of knowledge and skills among teachers and students. Other often mentioned challenges are the unsafe environment, weak power supply, weak access to internet, lack of resources, and lack of funding. Closely related to the lack of resources and the lack of skills results is the weak maintenance and repair of devices and outdatedness. An overall challenge is funding, since schools often do not have money for electricity, internet, Wi-Fi, digital devices and subject-related software, and therefore are dependent on donors for effective use (Quaicoe et al., 2016). Moreover, there is weak monitoring and evaluation and often a proper ICT plan with specific steps is lacking (Quaicoe & Pata, 2017; Amedeker, 2020). This is supplemented by the few sharing and supporting networks of ICT competences among schools (Quaicoe, Pata & Jeladze, 2016).

The extent of the challenges and opportunities for ICT are unevenly spread among the country. In the whole education system, there is a trend of uneven distribution of ICT. This results in a bias for urban and wealthy areas and therefore ICT interventions easily reinforce elevate existing inequalities. In addition, primary school have less ICT compared to JHS and SHS (Mangesi, 2007; Natia & Al-Hassan, 2015). Considering gender, in general more male teachers use ICT and male students are more positive to ICT as mentioned (Charles & Issifu, 2015).

At the same time, not all schools that are equipped with ICT use ICT efficiently in teaching. Agyei & Voogt (2011) identified two reasons for the inability of mathematic teachers in SHS, that have a relatively good technology infrastructure, to use ICT in class. Firstly, because courses are not designed for ICT and secondly because there is a lack of ICT integrating skills. Underlying causes for this inability are the lack of training provided by the GES and when provided only teaching basic skills, such as office and internet usage. For example, technical, subject-specific, pedagogical, and multimedia skills are not taught. Therefore, teachers remain with their usual chalk and talk approach. Moreover, the overloaded curriculum forces teachers to rush over topics, having no time for in depth learning. While the willingness of teachers is high, these barriers refrain teachers from using ICT (Agyei & Voogt, 2011). Due to this, students often remain illiterate in 21st century skills such as problem solving, collaboration, cocreation and safety (Quaicoe et al., 2016). Therefore, much progress can still be made where ICT seems to be integrated at first glance.

For ICT interventions to achieve meaningful ICT implementation and overcome the local challenges, a paradigm shift is needed from top-down to bottom-up interventions. Bottom-up interventions, including local stakeholders, are needed to create smart digital ecosystems. Jeladze et al. (2017) identify 3 dimensions of a digital ecosystem which they apply to Ghana: mediating, transformative and flow components. Firstly, mediating components include resources, tools, and a computer class. Secondly, transformative components include change management, ICT rules, ICT incentives, support system and ICT training. Lastly, flow components include digital learning, networking, information management and analytics. They also identify 3 clusters of smartness based on 3 indicators: intensity of flow components, connectivity of the mediator and transformative components to each other and to the agent, and the responsiveness to the socio-technical landscape. Whereas the first cluster is using ICT on a low level and using ICT mainly for administration and management, cluster 2 has medium availability and is top-down. The 3rd cluster is most desired as it has the smartest digital ecosystem, it is bottom-up and based on self-realization. The researched schools in the Western area of Ghana are in the first and second cluster and only rarely in the 3rd cluster. In addition to the identified challenges, a big challenge found in Ghana is that in the schools researched, teachers and staff often did not know about new rules, visions and agendas, which
indicate that teachers’ agency has not been included. Therefore, schools often created their own ICT vision and agenda (Jeladze et al., 2017; Quaicoe et al., 2016). A desired intervention includes local stakeholders as co-implementors and considers context. A meaningful intervention requires communication and collaboration. When intervening with training, school’s environment, attitudes and cultural beliefs towards technology and ICT should be integrated to improve digital confidence, knowledge and skills and to engage teachers in digital activities and applications (Quaicoe & Pata, 2018). By seeing ICT as social construct, doors are opening towards meaningful implementation that directs a learning transformation in Ghana.

4.3.4 Subconclusion case study Ghana

Ghana is a country with many sides. With their young and dynamic population, the education system if more important than ever before. However, Ghana’s education system has lots of room for improvement. The purpose of this case study is to outline how ICT interventions in education do get meaning in Ghana.

The first subquestion of the case study of Ghana is “How is the situation of education in Ghana?” Therefore, I outlined the learning environment and addressed career perspectives and educational reform. The learning environment is generally poor. In the whole system, there is a huge classroom backlog resulting in overcrowded schools and many schools miss basic infrastructure including water, toilets and electricity. Looking at the learning environment, I identified 3 components in the theoretical framework: resources and tools, teaching and learning communities, and learning and teaching ways. Firstly, in the classroom resources and tools are often lacking, including desks, seats and textbooks. Secondly, communities are rarely present and not very active. In the broader system, weak management and poor regulations are limiting the unity in the system. Therefore, monitoring and evaluation is rarely taking place and there are no clear standards for teaching. This causes absenteeism and attrition, and a lack of professional development. Thirdly, teaching ways are mostly traditional. Teaching is often not specified on individual learning styles and there is low interaction. This also has to do with the content-overloaded curriculum which does not include desired 21st century skills. Career perspectives are poor as well. This has to do with the low interactivity in the learning environment and the poor internal efficiency. The high GERs and low NERs suggest over-age enrolment because of high grade repetition. In addition, the dropout rate is high as well. While the rates are negatively distributed among gender, urban-rural and wealth, teachers’ preparation and investment in STEM positively contribute to learning outcomes. Educational reforms to change the current system has been taken, but due to top-down initiatives have not been successful. The educational reforms are too far away from local realities and therefore not learner centred as desired by constructivism.

The second subquestion is “How is the situation of ICT in education in Ghana?”. In earlier years, ICT has only been used for professional development rather than learning activities. Since 2007, increasing ICT interventions have been done by the government, individuals, and organizations and therefore access to ICT has increased. At the same time, it remains low for primary and JHS, and having no data for SHS. Where access is increasing slowly, the ICT does not have the desired change. While the government envisages education to change from traditional to interactive education, this does not happen in most practices. Considering the learning environment, the amount of available resources and tools has expanded, while teaching and learning ways have only changed to a small extent, as they have often remained traditional. A reason for this is the outdated curriculum that has
not been modernized yet. In addition, teaching and learning communities have not been changed because of ICT. A big underlying challenge is the over-dependence of the education sector on donors, since there is a huge lack of ICT resources and funding. The challenge is that both the government and donors often do not involve local stakeholders and therefore do not have intensive communication, which results in policies having a large distant from the reality on the ground. Although they have big dreams, reality remains poor.

The last subquestion is “How does ICT contribute to better education and development in Ghana?” Implementing agencies seem to forget the social construction of ICT. The local context must be considered for successful implementation. For Ghana, the perspectives of stakeholders and their digital agenda are key factors for local support. Moreover, in trainings, integration of pedagogy, technical know-how, and how to integrate ICT in specific subjects are identified to increase success. When implementing agencies start listening to bottom-up initiatives and collaborate and have useful conversation, a way is paved towards equipment of ICT labs that do not collect dust. Co-implementation opens in its turn open ways towards a learning transformation as it is school-centred and brings value to the school. To bring it to the level of self-realization, one should look beyond mediating components such as resources and tools, and transformative components such as ICT rules and training. Nevertheless, it is important to consider constraints such as the weak power, internet access and overloaded curriculum. To reach self-realization, co-implementation should focus on flow components that keeps the development going, such as digital learning, networking, and information management. Currently, this is not happening in Ghana.

Overall, the situation of education and ICT in education in Ghana is poor. The current situation is far away from the desired interactive education system and ICT has not created the desired change towards the interactive learning environment yet. The potentials of ICT to promote the growth of learning processes are not fully utilized. The potentials as explored in the 4.2 can be rarely seen, and therefore there is still much space for improvement. When interventions are done in the constructivist way, potentials for meaningful implementation can be more utilized.

4.4 Case study Sierra Leone

4.4.1 Background illustration Sierra Leone

Sierra Leone is a West-African country like Ghana. Overall, the systems are quite similar, although there are small differences (SL-MTNDP, 2019). Both Ghana and Sierra Leone have been colonized by Britain and therefore the official language is English. In addition, there are four national languages, Krio, Mende, Temne and Limba (Education System, n.d.) and multiple other languages. A big difference with Ghana is the socio-economic state of the country. Due to the 10-years during civil war in the 1990s, the country got largely donor-dependent. Moreover, during the Ebola epidemic from March 2014 to January 2016 the country got a huge setback (SL-MTNDP, 2019). Overall, 64% of the Sierra Leoneans is multidimensional poor. The Western area, where the capital Freetown is located, has the lowest multidimensional poverty rate (28.5%), while the South, East and Northern regions are poorer. The dimensions include health, education, living standards, housing, and energy. The different regions are shown on a map in Appendix 2c. The higher the education, the lower the poverty incidences. Currently, over half of the population is uneducated, leaving many opportunities for education (SL-MTNDP, 2019). The population is young and fast-growing. In 2015, 40.9% has been aged below 15 and only 3.5% was older than 65 (MEST, 2016). Young people increasingly come from the provinces (South,
Easter, Northern region) to the Western Urban Area (including Freetown). This results in 41% living in urban areas while Sierra Leone exists for a large extent of rural area (MEST, 2018).

The education system in Sierra Leone has a similar set up as Ghana. After 2 years of pre-primary education, like the kindergarten, pupils follow 6 years of primary school. However, in 2016, 85 of the 149 chiefdoms were lacking pre-primary schools (MEST, 2018). Primary school ends with a Primary School Examination, after which pupils when passed can follow Junior Secondary School (JSS) for 3 years. After JSS, which is like JHS in Ghana, they have their Basic Education Certificate Examination (BECE). Passing the BECE means they qualify for Senior Secondary School (SSS), like Senior High School (SHS) in Ghana. The SSS provides a way to university when passing the WASSCE, which is the same for all Anglophone West-African countries. Since 2018, the government has focused on enrolment in basic education, as the literacy rate and education rate are low, and the lack of funding is the major reason for pupils not to go to school. The current Sierra Leonean government has launched its free Quality Education Programme for basic education (SL-MTNDP, 2019).

In 2019, 54.1% of school revenues were coming from the government, 9.3% from performance-based finance, 22.5% from parents and 3.8% from religious groups (MBSSE, 2019). The current government launched their school bus system and school feeding programmes. Moreover, they established the Teaching Service Commission for all subjects related to teachers to strengthen the system (SL-MTNDP, 2019). The overall mission of the Ministry of Education, Science and Technology (MEST, 2018) is “to provide opportunities for children and adults to acquire knowledge and skills, as well as nurture attitudes and values that help the nation grow and prosper” (p.3). To reach this, they have written the Education Sector Plan 2018-2020 and the Annual Schools Census Report, which I use to analyse the sector.

4.4.2 Education system Sierra Leone

Learning environment Sierra Leone

A description of the learning environment provides an appropriate overview of the education system in Sierra Leone. However, because of the lack of an Education Management Information System (EMIS) over the whole system and on the local level, data are unavailable or unreliable. It has only been since last year that initiatives for digitization have been taken. Therefore, it remains with estimations for most of the different elements. Below I will discuss general findings for the learning environment in Sierra Leone.

Firstly, the availability and quality of resources and tools is poor. In general, there is a school backlog, but there are no clear data about the exact backlog available. Although the amount of schools has increased from 7.972 in 2011/2012 to 8.784 in 2015/2016, the enrolment has also increased, resulting in the education system remaining with overcrowded classes (MEST, 2019). From 2018 to 2019, the amount of schools has largely increased from 10.747 to 11.180, an increase of 4.7%, of which most in pre-primary (7.8%) and SSS (7.4%). At the same time, enrolment has increased in pre-primary with 44.1%, in primary with 29.4%, in JSS with 43.2% and in SSS with 49.9%. 56% of the total schools in 2019 are mission schools, 16.2% is private owned, 14.1% is from the community and 13.8% is from the government. Overall, the total amount of students per school and class has increased (MBSSE, 2019). This also has to do with the number of teachers, which will be discussed later. The goal for 2020 is to have a maximum of 25% of the primary classes with more than 50 students, 20% of JSS with over 40 students and 15% of SSS with over 40 students (MEST, 2018). Moreover, the Education Sector Plan 2018-2020 shows that MEST has the target to construct and maintain fully functional classrooms. Due
to overcrowdedness, there is not enough learning equipment available, such as books. But in some districts and chiefdoms, there are no secondary school facilities. “Many students lack basic learning materials such as core textbooks, exercise books, pens, pencils and rulers to use in school, especially at the primary school level.” (MEST, 2018, p. 59). For MEST, another goal is that 50% of pupils in basic education are equipped with enough learning materials. The MBSSE shows that currently, there are high pupil-textbook ratios, especially in the rural areas (MBSSE, 2019). Moreover, basic facilities including clean water facilities and toilets are often lacking (MEST, 2018). In 2019, 1 out of 2 pre-primary schools did not have water, 4 out of 10 for primary, 3 out of 10 for JSS and 2 out of 10 for SSS. In addition, the number of pupils per toilet ranges from 33 in pre-primary to 96 in JSS. The number of students per good quality toilets ranges from 47 in pre-primary to 157 in SSS (MBSSE, 2019). Overall, resources and tools are more available in urban areas and at private schools (De Bruine, 2020).

Secondly, teaching and learning communities are rarely available. While there is a formal teacher union to which teachers must contribute a fixed monthly pay, teachers do not seem to have a voice in the country (SEM, 2013). Currently, there is no national strategy and plan for the whole education sector and implementation is weak. In addition, there are no standards, lesson plans, and structured supervision, inspection, and monitoring. Moreover, registration and licensing of teachers is lacking, and guidelines and tools must be implemented (MEST, 2018). Recruiting and allocating teachers has been a fully paper-based process and processes were long as it was processed via three agencies, until the Directorate of Science, Technology and Innovation (DSTI) launched the Teacher Application, Approval, and Allocation Portal (TAAAP). The TAAAP is tested by the Teaching Service Commission (DSTI, 2019, December 23). More about the DSTI can be found in 4.3. Only 26.3% of the teachers recruited in 2019 have been based on enrolment (MBSSE, 2019). Overall, competencies and commitment of teachers and institutions is weak, the teacher workforce is poorly managed (MEST, 2018) and there is a general lack of accountability and transparency (DSTI, 2019, December 23). This has to do with the poor training of teachers (De Bruine, 2020). In 2016, according to government data, 41% of the male teachers in JSS taught without qualification or qualification below the required level, compared to 28% of females in JSS. In SSS this is 44% for male teachers and 53% for female teachers (MEST, 2019). In 2016, 34% of all teachers did not have a training as educator (SL-MTNDP, 2019). In 2019, of the total 48.761 teachers, 72.1% is male and of the total amount, 58.7% did have the required minimum qualification to teach (MBSSE, 2019). In their research in 2014 in Koinadugu, Samarakoon et al (2017) found that only 11% did have university qualification, and 60% did have a teaching certificate. At the same time, 29% of the teachers did not have teaching qualifications at all. They also found that 45% of the teachers got salaries, while the rest worked on voluntary basis. In addition, teachers often need a second job to meet in their financial needs. Over the whole country, the lack of qualification of teachers in primary school was higher (42%) than JSS (27%) and SSS (12%). Since 2010 it has been declining from 45% to the 34% in 2016. The percentage in 2016 is lower for the provinces and higher for the Western Area (SL-MTNDP, 2019, see Table 5). The findings of Samarakoon et al (2017) for Koinadugu in the northern region are in line with this, as the northern region has the highest proportions of not qualified teachers. In general, the data of the government can be questioned since the whole system is paper-based and having routine malpractices. In general, the government itself is also lacking a digital system (De Bruine, 2020). For teachers, there is no continuous professional development, including specific content knowledge, pedagogy, attitudes, child development, communication, and ethics. Over the whole system there is corruption, violence, and malpractices. Therefore, the current government established the Teaching Service Commission to implement standards and competencies and a better management of the teacher’s workforce. Unfortunately,
until now, there has not been much action involved (MEST, 2019), reflecting the overall tendency of plans and policies not to be implemented and therefore not get meaning in the practice (De Bruine, 2020). Not only skills shortage, but also the shortage of teachers in the whole system limits the learning environment (De Bruine, 2020). However, data are not available to show this. In the broader system, 41% of the total schools is approved by the government. Of the total 8,907 schools in 2016, 4,777 was not approved. While in the Western region, 50% of the schools is approved, in the Eastern and Northern region only 35% is approved (MEST, 2018). In 2019, this has improved for primary school, resulting in only 3% being not approved (MBSSE, 2019). There are many instances where unapproved schools serve low-income, and they assume that they are generally less accountable and lack conducive learning environments. The unapproved schools have a higher risk of not enrolling and dropping out involved and do not get support from the government as they do not fit standards. This means they do not receive inputs such as payment of teachers, basic materials, and provision of school feeding. However, for the approved schools, there are challenges as well since there are no clean payroll records, and as mentioned earlier, timely, reliable, and accurate data is lacking (MEST, 2018).

Thirdly, learning and teaching ways are traditional. Almost all learning and teaching is done manually with a chalkboard (De Bruine, 2020). Of the total amount of schools in 2019, only 2% did have a functioning science lab. In addition, only 6% does have a functioning library, of which the majority is in SSS (MBSSE, 2019). The low qualifications of the teacher workforce results in poor teaching ways and interaction with students is low (MEST, 2018; De Bruine, 2020). Attendance among learners in the whole education system was approximately 80% (MBSSE, 2019). The common teaching way is to talk and students repeating, and students do not have much space to experiment as they are expected to give the right answer directly. In addition, the education is highly focused on equipping students with knowledge and skills required for the formal assessments. In addition, the curriculum is outdated. While the curriculum is revised, it is not implemented yet (MEST, 2018; De Bruine, 2020). In Sierra Leone, implementation of developed policies is a huge problem. An underlying cause is that there is no culture of enforcement and the overdependency on donors resulting in a lack of independent behaviour of local stakeholders on different levels (De Bruine, 2020). Currently, the more focus is on enrolment than the learning and teaching ways within the Ministry of Education. Due to Ebola and other diseases such as floods, the government also focuses on being prepared for disasters. Currently, less than 5% of the Education Units is prepared with an Action Plan and less than 3% of schools have access to an Emergency Response Telephone Directory to call in case of emergency. The aim for 2020 is to get both above 75% (MEST, 2018). However, the DSTI is increasingly focusing on improving the learning environment, including making use of digitalized data (DSTI, 2019, September 16).

Table 5 Pupil-to-qualified teacher ratio (SL-MTNDP, 2019, p. 43)

<table>
<thead>
<tr>
<th>Region</th>
<th>Preschool</th>
<th>Primary</th>
<th>JSS</th>
<th>SSS</th>
<th>All</th>
</tr>
</thead>
<tbody>
<tr>
<td>East</td>
<td>62</td>
<td>71</td>
<td>64</td>
<td>75</td>
<td>70</td>
</tr>
<tr>
<td>North</td>
<td>38</td>
<td>65</td>
<td>38</td>
<td>73</td>
<td>58</td>
</tr>
<tr>
<td>South</td>
<td>41</td>
<td>73</td>
<td>47</td>
<td>35</td>
<td>63</td>
</tr>
<tr>
<td>West</td>
<td>29</td>
<td>39</td>
<td>29</td>
<td>50</td>
<td>37</td>
</tr>
<tr>
<td>National</td>
<td>37</td>
<td>61</td>
<td>40</td>
<td>55</td>
<td>55</td>
</tr>
</tbody>
</table>
Career perspectives and educational reform Sierra Leone

As mentioned, the data is highly unavailable and unreliable. For example, the relevant figures from the Education Sector Plan 2018-2020 (MEST, 2018) show numbers of students instead of shares (see Appendix). Therefore, it is too complex to compare it to other years and other countries such as Ghana. In addition, there is a lack of transparency in the ESP about how the data is gathered. However, since the DSTI has been launched, the Annual School Assessment 2019 has been much better as databases have been established and there is high transparency of how the data is gathered (MBSSE, 2019). The DSTI launched an education hub to get better data available. Based on this data, new policies and action can be taken based on real data rather than guesswork (DSTI, 2019, September 16). "While most people had an idea that our education system had challenges, they believed that their districts, schools, and children were doing well because they did not look at the entire data. But when you see the numbers, it becomes clear that something major is wrong and that education over the years has been a disaster in Sierra Leone," said Dr. Sengeh [Chief Innovation Officer of DSTI] (DSTI, 2019, September 16).

The data from the education hub suggests that both the access to and the quality of education are poor. It is estimated that 10% of all the children is out of school. While the Gross Enrolment Rate (GER) in 2016 has been 125.5% for primary, for JSS the rate was only 61%. For pre-primary and SSS it has been terribly low in 2016 on 11% and 28% respectively. For pre-primary this mainly has to do with the lack of schools. Due to Ebola, these rates have only been slowly increasing from 2013 to 2016 and there are no Net Enrolment Rates available (MEST, 2018). In 2019, the GER has been better for pre-primary (13.5%) and SSS (30%), but worse for primary (108%) and JSS (55%) compared to 2016. At the same time, JSS has improved with 22 percent points to 77% for the enrolment of the eligible population. The increase in GER has been more positive for girls (+34%) than for boys (+30%) (MBSSE, 2019). As indicated for Ghana, Sierra Leone similarly has over-age enrolment. At the same time, the government does not give concrete numbers and provides excuses saying that it is hard to measure since births are often not registered by parents and therefore guessed by schools. In previous years, half of the new schools build have been primary schools. This is positive, since having no functioning school in the village is for parents an important reason not to send their children to school. In addition, high costs of extra activities despite the free schooling itself, marriages and pregnancies are reasons not to send children to school and result in a gender divide. Other costs include expenditures for books, transportation, uniforms, report cards and assignments and 28.6% of girls is excluded of education because of teenage pregnancy (MEST, 2018). After the first years of JSS there is a huge drop of the participation of girls in education (UNICEF, 2012). While the enrolment rates are poor and therefore increasing access is desirable, the quality of the education is also poor as explored. This is clearly shown in the low transition and completion rates. In 2015, the transition rate from primary to JSS was 83% and the completion rate from JSS has been 64%. In 2016, the transition rate increased to 88%. Due to Ebola, overall completion rates and transition rates have been lower in 2017 compared to 2016. For example, for JSS the Gross Completion Rate decreased from 61% to 49% in that timeframe. Moreover, the transition rate from primary to JSS decreased from 88% to 78% in 2017 (SL-MTN, 2019). Over the whole system, internal efficiency is low, which can also be seen in the poor results for the BECE and WASSCE, especially in science and mathematics (MEST, 2019).

While access is poor, quality is very poor as well. Underlying challenges for the whole sector are huge. Good results are not encouraged, since there is no system of financing that encourages good learning outcomes and exam results (SL-MTN, 2019). In the whole system, enrolment and results are unevenly spread among gender and region. The main factor contributing to enrolment and
completion is gender. As can be seen in Appendix 4, males score better on final examinations for primary, JSS and SSS. In Appendix 4, which shows estimated data before the DSTI was launched, it is shown that pass rates for primary school differ per region. Port Loko and Kambia score lower than the other districts, but Western urban and Western rural do not differ a lot from each other and compared to other districts. Therefore, from the Education Sector Plan 2018-2020, no conclusions about regions can be drawn, although the quality of rural schools is poor compared to urban schools (MEST, 2019). The education hub of the DSTI shows other data based on real data, rather than guesses. In 2016 to 2018, at least 80% of the students failed the WASSCE. As can be seen in Figure 4, the Western Area Rural and Urban have much better pass rates for WASSCE in 2016-2018, while Bo, Bombali, Bonthe, Moyamba, and Pujehun have reported fail rates above 96%. These numbers provide a better insight in how the situation is on the ground, which is worrying.

It is not only the completion and pass rates that are poor, but the education does not prepare students properly for careers. The underlying challenge is the mismatch between the educational curriculum with national development needs and skills required for the job market. Although the curriculum has been revised, it has not been implemented yet (MEST, 2019). Barriers for the economy are the low human capital development and low productivity. In addition, there is an undiversified economy focused mainly on farming and trading. While farmers are more than 60% of the labour force, farming only contributes 55.1% to the GDP. Of the farmers, 72% is poor and from the traders, 42% is poor. The higher the education, the higher the chance to diversity and to contribute to national development. Or in other words, the low literacy rates maintain the undiversified economy and poverty. On the individual level, the chance is higher to get out of poverty as explained. While education paves the way to come out of poverty, there are still poor learning outcomes. Underlying reasons are the outdated curriculum, but also the limited links with the industry, and poor quality of instruction and instructors. Broader challenges impacting other sectors negatively as well are the low electricity access, high transportation and communication costs because of the weak infrastructure and the limited availability of money.

In recent years, policies have been written to change the education. However, because of over-centralization, there is poor local ownership at the community level and the target of MEST is to decentralize. Therefore, we can conclude that the education system is too much top-down, like Ghana. At the same time, there is a strong willingness of development partners (SL-MTNDP, 2019). In addition, the current government is taking steps to really implement their policies, starting with the DSTI (De Bruine, 2020). Moreover, reliable data is being produced recently. However, scientific research about the recent steps taken is not available yet, and therefore more can be said about educational reform in the future. Next I will outline ICT in education in Sierra Leone.

4.4.1 ICT in education Sierra Leone

Although ICT is added to the West-African curriculum in the early 2000s, Sierra Leone has only implemented ICT in the curriculum in 2018. In 2004, the Education Act has given some guidelines for ICT, but it has never been implemented until 2018. ICT is seen as important to prepare students for the 21st century having digital skills, yet no action has been taken. The current government is prioritizing ICT, which can be seen by for example launching and supporting the DSTI. The government (SL-MTNDP, 2019, p.106) “recognizes ICT as an enabler to address the bottlenecks of outdated practices that have hindered sustainable development for far too long.” On the same page of the SL-MTNDP, key challenges are identified, “an inadequate legal framework, an inadequate regulatory and
institutional environment, high costs and the lack of a national electronic governance system to improve capacity and the delivery of public services, among others.”

**ICT interventions in education Sierra Leone**

To harness the power of ICT for the good, the DSTI was launched in 2019 (DSTI, 2019, November 1). With their education data lab, they provide insights in the situation of the education system (DSTI, 2019, September 16). Since the government has just started digitizing, digitization of the education will be only effective when there is a national backbone, which is currently developing (De Bruine, 2020). Overall, the access to electricity, computers and internet has been very poor. In 2012, only 3% of the primary schools did have access to electricity, and for JSS this was 16% (UNESCO, 2015). In 2019, the access for the whole education system has been 22% for electricity, 4% for computers and 1% for

![Figure 4 Student Pass Rate WASSCE 2016-2018 per district (DSTI, 2019, September 16)](image-url)
internet (MBSSE, 2019). The overall challenge is the weak integration with the curriculum. While the government has started a pilot equipping 200 schools in 2018, for most schools using ICT in education is for almost all schools based on the initiative of NGOs and the school itself (De Bruine, 2020). In addition, there has not been much written about ICT in Sierra Leone, making it challenging to map ICT. It also suggests the poor state of ICT in Sierra Leone. Samarakoon et al (2017) have researched in Koinadugu, the poorest district of Sierra Leone. They found that although there are devices in one of the researched schools in Koinadugu, they are not used due to the unavailability of power. When more data is collected, this is easier and it can also drive investment for local infrastructure and capacity (Samarakoon et al., 2017). Currently, it suggests that Sierra Leone finds itself in a vicious circle of challenges.

**ICT interventions as social construct in Sierra Leone: how it gets meaning**

As the poor state of ICT in education suggests, not many interventions with ICT has taken place. This has mainly been done based on individual initiatives and it is only since 2018 that the government has started a pilot. Sierra Leone can learn a lot from Ghana, as Ghana has been in this phase since 2007 and they are already one step ahead. The local context must be considered. Samarakoon et al (2017) show a local story about access to light (see Box 2). This story shows that energy should be directly linked to ICT implementation and that there is an urban advantage for electricity. This advantage does also apply to resources in schools. In the whole system, teachers’ skills in ICT are weak and ICT labs are overcrowded. As explained, teachers have low qualifications, let alone ICT skills. A lack of funding in combination with the lack of skills result in ICT often being taught theoretical without practical assignments using digital technology. This results in an overall lack of basic ICT skills for students in the whole education sector (De Bruine, 2020). There already is a lack of capacity of teaching skills in general, so ICT integration must be done with care. Overall, integration of ICT with the broader context and considering technical and psychological readiness, including beliefs, attitudes, and attentions, is a requirement for successful usage of ICT devices (Samarakoon et al., 2017).

**Towards a learning transformation using ICT in Sierra Leone**

While the challenges in Sierra Leone are huge, you should start somewhere to improve the situation. Underlying the lack of electricity is the lack of a proper ICT infrastructure, resulting in a lack of power and high costs for electricity usage. This has to do with the insufficient generation and overloaded transformers in combination with old cables. Like electricity, internet is also costly and poorly available (De Bruine, 2020; Samarakoon, Christiansen & Munro, 2017). Broader development questions can be asked about the availability between different regions. The access highly differs per region, as there is an urban-rural divide, where rural areas are not connected to the electricity grid, while urban areas

<table>
<thead>
<tr>
<th>Box 2 Light use in Koinadugu among students</th>
</tr>
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<tbody>
<tr>
<td>The insufficient access to the electricity grid results in students being unable to learn properly in the nights. Night times are preferred by 96% of the JSS students and 69% of the SSS students researched in Koinadugu. The cost barrier is the major issue for 93% of the researched JSS students and 94% of the researched SSS students. The more urban, the more generators are used, while the more rural, the more candles are used. Overall, students prefer to study at school at night, as there are printed resources and there is interaction with students and teachers, but there are also constraints with light since the costs are high. Overall, energy should be directly connected to ICT as it is a prerequisite (Samarakoon et al., 2017).</td>
</tr>
</tbody>
</table>
often are. At the same time, in rural areas households and schools make use of off-grid solar systems, but those are expensive and therefore currently insufficient available in the rural areas, which are the poorest (Samarakoon et al., 2017; De Bruine, 2020). At the same time, there are initiatives to expand access to solar panels and efforts are taken to improve the whole energy system (De Bruine, 2020; Ministry of Energy, 2020). Another hopeful trend is the rise of mobile phones. Because of the lack of power, mobiles are often more suitable for using internet. In their research in Koinadugu, Samarakoon et al (2017) found that only 3% of the JSS students did have experience with computers, compared to 11% in SSS. Those users came almost all from Kabala, the capital city of Koinadugu. No one accessed computers on weekly basis. At the same time, 43% of the households of the JSS students did own a mobile phone. However, only 2% of these phones are smartphones having access to a 3G network. For SSS students, the total share of households having a mobile phone is 64%, of which 35% has access to a 3G network. These users are also especially living in Kabala. Next to phones, radio offers opportunities to work and study off-grid. Beside the urban-rural divide, currently there is not much data available about the gender divide, so this could be researched later (Samarakoon et al., 2017).

As mentioned, Sierra Leone can learn from Ghana. In Sierra Leone, over-centralization of the education system is challenging. Therefore, this can be a challenge again when implementing ICT in education. Local stakeholders should be involved and local challenges integrated in the design. Collaboration and conversation are the key towards meaningful intervention which paves the way for a learning transformation in Sierra Leone.

4.4.2 Subconclusion case study Sierra Leone

Like Ghana, Sierra Leone is an Anglophone country, having a young dynamic population with lots of potentials. However, due to the setbacks of Ebola and the civil war, the country is significantly poorer, not only in terms of money, but also in terms of infrastructure. The purpose of this case study is to outline how ICT interventions in education get meaning in Sierra Leone.

The first subquestion is “How is the situation of education in Sierra Leone?”. The education system has highly become donor-dependent because of the recent setbacks, including the civil war and Ebola. For a long time, the government has focussed on increasing the enrolment, since that has been very low in previous decades. Because of the high enrolment, there is shortage of classrooms, especially in pre-primary and SSS. In addition, the basic infrastructure is very poor, involving water, electricity, and toilets. While enrolment has largely increased, in the whole system, the quality has recently become a focus as well. In the theoretical framework, I identified resources and tools, teaching and learning ways, and teaching and learning communities as components of the learning environment. In the learning environment, there is much room for improvement. Firstly, resources and tools are lacking, including pen and pencils, books, rulers. Secondly, teaching and learning communities are functioning poorly and a national strategy and system for registration and licensing of teachers is lacking. Moreover, many processes are paper based until 2019 when increasingly digital solutions have been started. In addition, there is no continuous professional development, including content knowledge, pedagogy, communication, ethics, and attitudes. Another related challenge is the large extent of non-approved schools, which do not get support from the government and the large extent of underqualified or not qualified teachers. Thirdly, learning and teaching ways are traditional, making use of chalkboards. Repetition of what is said and formal assessments are limiting interaction. When educational policies are created, due to the lack of enforcement it is often not materialized. In the whole system, GERs are low, especially in pre-primary and SSS, with an exception for primary. A big underlying challenge is the unavailable and unreliable data, until the DSTI was launched in 2018. The education hub shows that the overall performances in BECE and WASSCE are tremendously low.
Completion rates are low as well as transition rates. Next to the internal inefficiency, a mismatch of the curriculum with national development needs is limiting the preparation of successful students for careers. Currently, the undiversified economy has to do with the high illiteracy rate, but also with skills that meet demands.

The second subquestion is “How is the situation of ICT in education in Sierra Leone?” For this question, the unreliable data have been challenging as well. Recent data show the poor state of ICT in Sierra Leone, and a slowly increase of access to ICT. The major underlying challenge is the old power infrastructure. At the same time, solar panels and mobile phones are promising. In addition, internet access is poor limiting meaningful use of ICT. Moreover, teacher’s and student’s ICT skills are lacking.

The last subquestion is “How does ICT contribute to better education and development in Sierra Leone?”. As access to ICT and literature are lacking, social stories are only limited available. As mentioned, opportunities are not only seen in the solar panels, but also in the rise of mobile phones. ICT has lots of potentials to improve the situation. When more research is done and reports written, investment can be boosted and vice versa. To come out of this vicious circle, good leadership is needed. The government has launched the DSTI to digitize Sierra Leone. As the government itself mainly works manual, malpractices, a lack of accountability and transparency, digital devices and systems can bring positive development by revealing and tackling these challenges. This also applies to the government. As Ghana is a few steps ahead in ICT implementation, Sierra Leone can learn a lot from them. While top-down educational initiatives are common in Sierra Leone, bottom-up ICT interventions seems a challenge, but needed for meaningful ICT use that paves the way towards a learning transformation.

Overall, the situation of education in Sierra Leone is poor, let alone the situation of ICT in education. The current education system is not interactive and therefore does not promote the creation of career perspectives. ICT interventions have not been done on large scale and therefore the potentials for a learning transformation have not been utilized at all. When they want to have ICT interventions in the future, it should be done in an interactive way. Currently, the reforms taken have been centralized and top-down, and therefore when they want to create meaningful implementation, they can learn from Ghana by starting bottom-up.
5 Discussion

During my research, I have tried to stay neutral as much as possible and at the same time accurate. Therefore, I did not have contact about my research with individuals of Maxim Nyansa during the performance of my case studies except Maarten. I did not tell them the purpose of my research so they were not influenced by that and finally I presented the findings as neutral outside Maxim Nyansa. Moreover, to make it accurate for Ghana and Sierra Leone, I tried to find Ghanaian and Sierra Leonean authors as much as possible and discuss my findings with people who are in the field. As explored in the methodology, some of the literature is written by Western scholars, rather than Ghanaians and Sierra Leoneans. It can be questioned how appropriately they understand the situation. In addition, I am a Western scholar who is not raised in the system. Therefore, questions could be asked for the applicability. To tackle the gap between theory and practice due to the Western view, I discussed my findings afterwards. The people that were available are in or closely linked to Maxim Nyansa. Yet I do not think this influenced my research negatively, since I did not tell the purpose of my study until I finished writing. I interviewed Stanley Dankyira to give accurate recommendations without telling my purpose and later I discussed my recommendations with him to see if it is accurate. At the same time, I have tried to stay neutral as much as possible and not holding back my critical view when it was needed. A major limitation of my research is the type of government documents. Firstly, I used different type of government documents. They are published by different ministries and written in another year. In addition, the government documents can change largely over time. For example, in Ghana, this year a new document will be published and next to that when government parties change, documents can change significantly. Therefore, replication of this study could be questioned.

Beside these limitations, my findings are widely applicable and confirmed by most different sources. My first finding is that the education system of Ghana and Sierra Leone are traditional and resources are poor and not promoting the growth of learning processes to prepare learners for careers. My second finding is that the potentials of ICT to promote the growth are not fully utilized, and the state of ICT in education is worse in Sierra Leone compared to Ghana. While in Ghana there have already been larger scale multiple top-down initiatives, Sierra Leone is in the initial phase having only scarce small-scale ICT-interventions and having large challenges with their ICT infrastructure. The first finding is confirmed by government documents as well as additional scientific literature, experiences of Maxim Nyansa (Maxim Nyansa IT Solutions, n.d.-c; Dankyira & Van der Stelt, n.d.; Interview Stanley Dankyira, 12-06-2020) and my own research in Sierra Leone (De Bruine, 2020). The second finding is confirmed as well. It is only slightly mentioned in the different government documents, while all of them highlight the potentials of ICT in education. Samarakoon et al (2017) also confirm this finding and mention that while wealthier countries are researched well and provided with a lot of resources, poorer countries are under researched and remain with little resources. They show the finding that poorer countries often encountered nature or man-made disasters, such as war. Compared to Ghana, Sierra Leone has had difficult decades with the civil war and Ebola outbreak. Many sources confirm that Ghana is wealthier than Sierra Leone in multiple dimensions. For example, on the Human Development Index, Ghana is ranked 140, while Sierra Leone is ranked 184 out of 189 countries (World Population Review, 2020). Moreover, in Ghana you are 14.4 times more likely to access electricity, 2.9 times more likely to access internet. Being unemployed is way less likely (30.8%) as well, and GDP is higher in Ghana ($4.700) compared to Sierra Leone ($1.600), resulting in the higher rate of poverty, which is 70.2 in Sierra Leone compared to 24.2 in Ghana (My life elsewhere, 2020). These data are based on the World Factbook, Ghana Revenue Authority and National Revenue Authority.
My findings supplement the success factors identified by Maxim Nyansa in 2016. For the convenience, I repeat them here once more: local community in the lead, progress and quality of implementation, long-term financial and technical provisions, programs that are tailor made, ICT that brings immediate benefit to the stakeholders, basic facilities that support the change, and an integrated approach. Therefore, they decided to create their holistic approach in which meeting traditional rulers, ICT laboratory set up, training of teachers, specialized consultancy and change, and monitoring and evaluation, are combined. Rather than the broad success factors identified for ICT in Africa, I specified my research on success factors for ICT intervention in education in Ghana and Sierra Leone. For the case studies, I did not only use literature, but also researched relevant government documents and therefore I provided a fuller picture of the education system specified for Ghana and Sierra Leone. My findings are in line with the findings of Maxim Nyansa but add information. While for Sierra Leone I have unavailable information, for Ghana literature shows additional findings. All the steps identified by Maxim Nyansa are relevant. My findings highlight the importance of local perspectives and attitudes and the bottom-up initiatives. While this could be seen in ‘the local community in the lead’, it is not necessarily a part of it. In addition, for a higher level of self-realization, flow components should be prioritized: networking, information management and analytics. Moreover, I found additional findings for the training content. Currently, the training incorporates technical know-how, maintenance, ethics and multimedia. However, it does not incorporate pedagogy, and subject-related content. In the next chapter, I give my conclusion, after which I give my recommendations for Maxim Nyansa.
6 Conclusion

The main question of my thesis is “How do ICT interventions in education contribute to development in Ghana and Sierra Leone?” ICT has lots of potentials to lift the learning environment towards a more desired interactive learning place, as envisaged by constructivism. Currently the big challenge in education is the mismatch with potential careers and therefore a learning transformation is desired, for which I created a Theory of Change. ICT has potentials to expand the availability of resources and tools, there are increasing potentials for teaching and learning communities, and learning and teaching ways can become more interactive. However, ICT is a social construct itself and therefore ICT interventions should consider the key components of constructivism to be meaningful: context, collaboration, conversation and meaning-making. Instead of top-down interventions, meaningful bottom-up initiatives making use of co-implementation open doors for real ownership. In my case studies, I mapped the education system and ICT usage in education of Ghana and Sierra Leone, and I set a direction towards a learning transformation. These findings are shortly summarized below.

In both countries, the learning environment is fragile, having little resources and tools, unavailable and poor functioning teaching and learning communities, and traditional learning and teaching ways, often manual. In addition, for Ghana there are high repeat and drop-out rates. For Sierra Leone, there are no data available. Challenges in the whole system include the lack of power and funding, and outdated content-overloaded curricula, which do not prepare learners properly for the 21st century. Therefore, the Theory of Change as designed is very relevant for both countries. In terms of education and ICT use, Ghana is one step ahead of Sierra Leone. Since the early 2000s, the Ghanaian government has done top-down ICT interventions, although those have not looked at the social construction. The government of Sierra Leone has launched the DSTI in 2018 and in that same year started a small-scale pilot of ICT intervention in education. Until that time, ICT interventions have only been done based on initiatives of schools and NGOs. In addition, since 2018, more reliable data has been gathered which is traceable. As proper databases have been lacking in Sierra Leone until 2018, data are weakly available and unreliable until then. For Ghana, I have identified successful factors for ICT implementation, of which Sierra Leone can learn:

1. Enough, accessible, and relevant equipment.

   Although this is not the major factor contributing to meaningful implementation, it is a prerequisite for a meaningful learning transformation. As classes are often overcrowded, enough equipment is needed for individual interactive learning experiences. To make sure it remains accessible, there should be access to repair and maintenance and funding should be considered as a lack of money is a reason for schools not to repair the equipment after it is spoilt. For Sierra Leone, a challenge underlying accessibility is the old power infrastructure. Opportunities can be found in solar panels and mobile phone use. Lastly, relevant equipment is important, as the teachers must put it in their already full curriculum and their workload is heavy. In Ghana, ICT interventions has been happened mainly top-down, not considering local circumstances. However, they have failed to look at local circumstances. These are outlined next.

2. Community support & school leadership.

   Underlying local support are perspectives of the impact of ICT for the education, opinion on ICT, digital attitude, and projections, which highly influence successful use of ICT. Therefore, when attitudes...
positively influence local support, ICT interventions are likely to succeed and vice versa. Beside community support, school leadership is highly important, people who lead and dare to act, plan and achieve what they want to do in collaboration with the community. School leaders are the individuals pioneering, leading by example for others to follow them. In addition, a school leader can help to get the crucial change management, ICT rules, ICT incentives and support system. Lastly, the school leader can influence teachers positively to join an ICT-training, which is the next point.

3. **Training meets local demands.**

Teacher readiness is one of the most important parts of successful implementation. Therefore, accurate training meeting local demands is crucial. The training should not only include basic IT-skills, but also technical knowledge, subject-specific knowledge, pedagogical skills, multimedia, and attitudes of the teachers. Digital confidence and cultural beliefs can influence the attitude of teachers, and the attitude influences the motivation of teachers to use and finally the successful usage. The training should have the purpose to improve not only the skills, but also the attitude. Next to skilled staff, there should also be enough staff for successful implementation.

4. **Create ownership and lifelong learning.**

To get ICT intervention to a higher level of meaning-making, co-implementation and a bottom-up approach is needed. To go beyond provision of resources and tools and creating a transformation towards self-realization, flow components should be encouraged: networking, information management and analytics. Currently, this is not happening in Ghana, let alone Sierra Leone. Self-realization requires intensive communication and collaboration from the implementing agency and asks action from the involved schools.
7 Recommendations

In this chapter, I give my recommendations for Maxim Nyansa in Ghana and Sierra Leone. As I write my thesis for Maxim Nyansa and the social purpose is to improve the learning transformation of Maxim Nyansa, I have three tangible recommendations for Maxim Nyansa.

7.1 Recommendations

1. **Create a Maxim Nyansa Teachers Family (MNTF)**

   This recommendation is related to the fourth point of my conclusion “create ownership and lifelong learning”. I advise Maxim Nyansa to start a teaching community exclusively for participating schools of the learning transformation of Maxim Nyansa. The purpose of the MNTF would be twofold. Firstly, it provides a platform for professional development, networking and sharing experiences of being part of the Maxim Nyansa Family related to the learning transformation. Secondly, this is a platform to for local people to get feedback. Initially, this would be a place for teachers and head of schools, but when supervisors, members of parliaments, chiefs and parents are showing interests, a side branch can be created for them. A side branch, because you want to maintain the freedom of speaking the way you want as a teacher, without other interests involved. The platform can be in Telegram or WhatsApp. In addition, there should be a forum space to discuss educational and technological topics. Events such as network and innovative congresses, and trainings can be organized and shared on the platform. During the network congresses they can chose to invite other players in the field of technology and education, and NGOs and funders that are willing to invest in those innovative schools. This platform will help to upgrade the involved schools towards the third level bottom-up cluster of self-realization as explained by Jeladze et al (2017). In addition, it will help Maxim Nyansa to increase their brand awareness. When teachers are part of the ‘club’ or ‘family’, they have regard. Therefore, the membership could be confirmed with not only a certificate, but for example a Maxim Nyansa shirt as well. I believe that this matches with ‘the best of two worlds’ as it is mentioned on the website: “A circle of trust where family members know they will find the necessary support.” (Maxim Nyansa IT Solutions, n.d.-a). For this concept, I have got inspiration from the concept of Professional Learning Communities (PLC), which is explained by Education World (2012).

2. **Qualitative research training efficiency and open source materials**

   This recommendation is related to the third point of my conclusion “training meets local demands”. Currently, the holistic approach includes many aspects. One of them is the training. There is not much known about the impact of the learning transformation yet. The data scientists have done a small quantitative research and Maarten is researching quantitative impact assessment and doing some qualitative research for the impact as well. In my view, it would be good to have future research which focuses on the qualitative impact of the learning environment, especially with a focus on the training. The first two steps Maxim Nyansa takes, the quick scan and tailor-made design, are in line with literature. However, the last step of implementation is not directly in line with the literature. For example, course-specific training help to increase efficiency. Now, I do not have enough information to make conclusions about the quality of the training and the implementation. However, my first assumptions are that (1) the training should include topic-specific knowledge, (2) pedagogical skills, and (3) discussion of perspectives/attitudes, and (4) head of schools should have ICT skills to lead others. The extent to which this is applicable to Maxim Nyansa can be researched further. I would advise qualitative research including observation in the training and interviews with teachers. Next to the training, researching the efficiency of the open source materials can also help to improve the
program. I did not find lots of information about this, but in line with the findings of the training, it would be useful if there is a large amount of topic-specific content available. The MNTF can provide a platform for feedback and therefore contribute to a desired feedback loop and improvements, but this is based on schools’ own initiatives. In addition, I advise to do further research to local experiences, focussing highly on the social dimension as mentioned. Currently, Maarten will partly do this, and I would advise him if possible, to consider these findings.

3. Equip teachers with personal laptops

This recommendation is linked to the first point of my conclusion “enough, accessible and relevant equipment”. Personal computers help teachers to prepare their class and to professionalize their teaching. For example, the laptops help to prepare lesson notes digital rather than manual. In addition, when teachers use the laptops for their preparation, teachers that used to use desktops in the ICT-lab can be used for other purposes. Better prepared teachers translate almost directly into better education results. Currently there are not enough laptops shipped to Ghana. Therefore, I advise to focus more on laptop collection in the Netherlands. These laptops can be sold for a small price, as it will give the teachers sense of ownership and they will only buy a laptop when motivated. Like public schools that do not have the money, arrangements can be made for teachers that cannot pay but are motivated to use a laptop. In case they do not pay, you have no loss as an NGO. On the other hand, when you ask teachers to pay, you cannot track the equipment as it is their ownership. Therefore, Maxim Nyansa should attentively think about the trade-off.

7.2 Advice

All three recommendations require long-term planning and coordination. For the first two recommendations, I advise Maxim Nyansa to have a document with research opportunities for future interns. I advise Maxim Nyansa to not only look for Dutch interns, but especially for Ghanaian interns. In this way, Ghanaian interns can also increase their skills level by practical experiences, the same way as I have done with my research. The interns that are coming, can also chose to research creation of MNTF or research the training and open source materials. In this way, the motivation of the intern is high since the intern has chosen the direction. Creating a Maxim Nyansa Teachers Family is a good assignment for a future intern that is part of Maxim Nyansa. He or she can research opportunities for platforms, but also how local people think about this idea. This platform can be set up soon, as it will help Maxim Nyansa to grow and develop their project, for sure when they want to expand in West-Africa very soon. The second recommendation requires a qualitative research method which brings up stories of the schools. The accurate method of researching can be discussed and when the research is done, further action is needed to make it meaningful on the ground. Lastly, for the laptop equipment, internal action is needed. This requires steps to be taken by the PR-team of Maxim Nyansa to collect more laptops in the Netherlands. In Ghana, the Maxim Nyansa team should think of a reasonable price to be asked for the laptops and an appropriate paying method, for example whether they must pay full from the beginning, in terms, or afterwards. In addition, they should think about ways of arrangements for teachers who are less wealthy.

The 3 recommendations can be done simultaneously and strengthen each other. The last one ‘equipping teachers with personal computers’, is the most accurate and easy-to-reach. Moreover, the first recommendation ‘MNTF’ is clearer than the second one of qualitative research for the learning transformation as this requires more individual research initiative. All in all, all three can improve Maxim Nyansa and they strengthen each other. For example, when teachers are equipped with laptops, you do not know the impact when you have no qualitative data and feedback loop (MNTF).
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v eNUE: TINKONG, EASTERN REGION


Appendix 1: Interactive learning models (Bloom’s Taxonomy & Kolb’s learning styles)

Van der Bilt University (2020), retrieved from https://cft.vanderbilt.edu/guides-sub-pages/blooms-taxonomy/

Appendix 2: Maps of Ghana and Sierra Leone and patterns of inequality

Appendix 2a Provinces of Ghana (MoE, 2017, p.2)
Appendix 2b Regional patterns of inequality Ghana (MoE, 2018, p. 5)

Appendix 2c Provinces of Sierra Leone (Ezilon, n.d.)

Note: the Western province is richer than the other provinces and urban more than rural. Unfortunately, there is not a map available for Sierra Leone as for Ghana.
Appendix 3: School enrolment in Sierra Leone
Source: MEST, 2019, Annex III
Appendix 4: Amount of schools, entry and pass rate Sierra Leone

National Primary School Examination (NPSE)

<table>
<thead>
<tr>
<th>Year</th>
<th>Schools</th>
<th>Entry</th>
<th>Sat</th>
<th>Passed</th>
<th>Pass Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>2013</td>
<td>3,358</td>
<td>94,012</td>
<td>93,767</td>
<td>71,077</td>
<td>76%</td>
</tr>
<tr>
<td>2014</td>
<td>3,401</td>
<td>100,678</td>
<td>100,508</td>
<td>76,733</td>
<td>76%</td>
</tr>
<tr>
<td>2015</td>
<td>3,363</td>
<td>104,722</td>
<td>104,656</td>
<td>79,399</td>
<td>76%</td>
</tr>
<tr>
<td>2016</td>
<td>3,434</td>
<td>115,706</td>
<td>115,556</td>
<td>86,985</td>
<td>75%</td>
</tr>
<tr>
<td>2017</td>
<td>3,494</td>
<td>121,318</td>
<td>121,027</td>
<td>95,603</td>
<td>79%</td>
</tr>
</tbody>
</table>

Basic Education Certificate Examination (BECE)

<table>
<thead>
<tr>
<th>Year</th>
<th>M_Sat</th>
<th>F_Sat</th>
<th>M_Pass</th>
<th>F_Pass</th>
<th>M_Pass Rate</th>
<th>F_Pass Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>2014</td>
<td>50,301</td>
<td>50,207</td>
<td>39,166</td>
<td>37,567</td>
<td>78%</td>
<td>75%</td>
</tr>
<tr>
<td>2015</td>
<td>52,213</td>
<td>52,443</td>
<td>40,426</td>
<td>38,973</td>
<td>77%</td>
<td>74%</td>
</tr>
<tr>
<td>2016</td>
<td>57,556</td>
<td>58,000</td>
<td>43,914</td>
<td>43,071</td>
<td>76%</td>
<td>74%</td>
</tr>
<tr>
<td>2017</td>
<td>60,662</td>
<td>60,365</td>
<td>48,646</td>
<td>46,957</td>
<td>80%</td>
<td>78%</td>
</tr>
</tbody>
</table>

West African Senior School Certificate Examination (WASSCE)

<table>
<thead>
<tr>
<th>Year</th>
<th>Schools</th>
<th>Entry</th>
<th>Sat</th>
<th>Passed</th>
<th>Pass Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>2012</td>
<td>226</td>
<td>58,195</td>
<td>56,893</td>
<td>4,177</td>
<td>7%</td>
</tr>
<tr>
<td>2014</td>
<td>224</td>
<td>27,370</td>
<td>26,782</td>
<td>1,889</td>
<td>7%</td>
</tr>
<tr>
<td>2015</td>
<td>214</td>
<td>24,300</td>
<td>23,587</td>
<td>3,445</td>
<td>15%</td>
</tr>
<tr>
<td>2016</td>
<td>205</td>
<td>36,696</td>
<td>35,938</td>
<td>6,095</td>
<td>17%</td>
</tr>
<tr>
<td>2017</td>
<td>186</td>
<td>29,922</td>
<td>29,222</td>
<td>5,728</td>
<td>20%</td>
</tr>
</tbody>
</table>

Source: MEST (2019), Annex VIII
Source: MEST (2019), p. 52

Note: This is the old data used in the Education Sector Plan 2018-2020, Figure 4 is from the recently launched DSTI and the Annual School Census Report 2019.