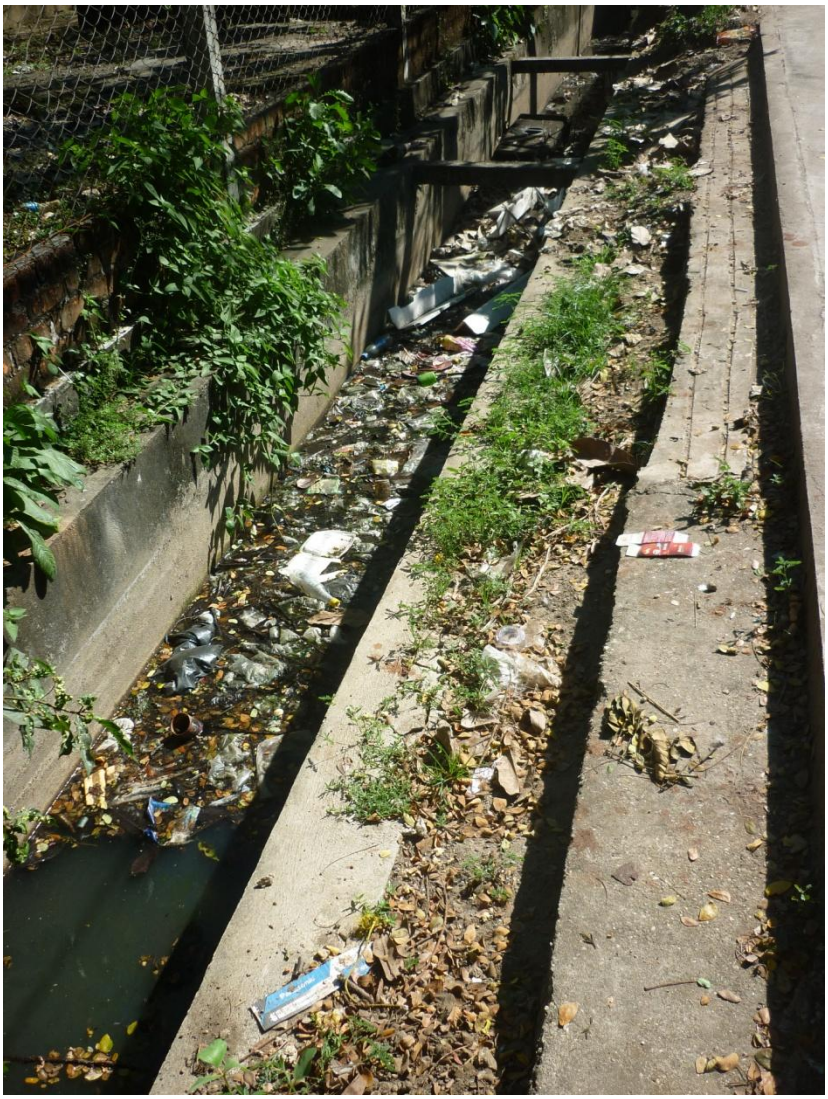
PARTICIPATORY MONITORING MYANMAR

A research on the motivation of people in Myanmar to participate in 'Participatory Monitoring' by making use of Q methodology

Amber van Hamel, January 2018



Bachelor free minor research project

Delft University of Technology
The faculty of Civil Engineering and Geosciences

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PREFACE

This report is the result of a free minor research project that is part of my bachelor programme Civil Engineering at the TU Delft. This project was introduced to me by Dr.ir. Martine Rutten and I was very pleased to get the change to travel to Myanmar for a 10 weeks period. It was a great opportunity to work on a topic related to water management in a country that is so much developing at this moment.

I want to thank Dr.ir. Martine Rutten and Dr. Thom Bogaard for making it possible for me to do this project, for advising me during the process and providing me of feedback. I want to give a special thanks to Nyein Thandar Ko who made me feel welcome in Myanmar and introduced me to the culture. The first four days have been very important for successfully continuing the project and even though she was very busy with her own fieldwork, she always made time free to help me out.

Doing this project gave me the chance to learn a lot about development in Myanmar, the way citizens Myanmar face their future, challenges within the field of water management but also Myanmar culture, the education system and a lot more. Also a small thank to the Marc van Eekeren funding for their financial support. It was a privilege to work on this project and I look back on it with great satisfaction. It was a wonderful experience to do this as part of my studies.

SUMMARY

Development in Myanmar is going relatively fast, but this increasing development probably also negatively impacts the countries environment and water quality. Unfortunately, there is very little data available about the water quality, which makes it hard to monitor the changes that are taking place. To be able to study large-scale patterns in the environment, like for example the change of water quality, a constant amount of data over an array of locations and time is required. A relative new and cheap way of obtaining and collecting data is the use of *citizen science* or *participatory monitoring*. Therefore this project investigates if there is any support among the citizens of Myanmar to join participatory monitoring projects and to find out more about the different underlying motivations for people to participate. Chapter 1 gives a extended introduction on the relevance of the research, the problem definition and the research questions.

This research is done by making use of an interview method based on Q methodology. Q Methodology, also known as Q-sort, is a research method used in psychology and social science to study people's viewpoint on certain topics. Q-sort is based on the fact that participants have to rank a group of questions in such a way that it reflects their viewpoint the best without giving them the option to rank all questions equally important (see chapter 2). In total 405 participants filled in the Q-sort and all these participants were living in the city of Mandalay, the surrounding area or in the city of Yangon. A clear overview of the participants of the Q-sort is further explained in chapter 2.3 'Responses on Q-sort'. Besides the collection of Q-sorts, also some additional interviews are taken with villagers and people that already were familiar with participatory monitoring.

Chapter 3 gives an answer to the research question 'How can citizens in Myanmar be motivated to participate in participatory monitoring?'. To start with, an overview of all possible reasons for people to participate in participatory monitoring about measuring water quality is given. This resulted in 16 different reasons. Furthermore it is checked whether the motivations of people differ for different groups in society. A distinction in age, education level, geographical location within the country and interest is made.

Chapter 4 discusses the method and the validity of the outcome. There have been some challenges during the project, for example according to the difference in culture and the language barrier and not all responses were valid for the research.

Chapter 5 consists of the conclusions and the recommendations. The overall view is that people in Myanmar are open towards joining projects like this. Many young people seemed interested in the concept of participatory monitoring, since this relative new method for collecting information also clearly involves normal people like them within projects that they normally wouldn't get involved in that easily. The implementation participatory monitoring does not need to cost a lot, since most citizens add little value to receiving payment or certificates in return for collecting measurements for the project. When there is enough attention for the social importance of the research for which participatory monitoring will be used and the 'duty of being a citizen', must it be possible to find a sufficient amount of volunteers that are willing to participate. But while the outcome seems quite positive, there are still a lot of questions that need to be answered, so future research is recommended.

TABLE OF CONTENTS

1. INTRODUCTION

1.1. RELEVANCE OF THE RESEARCH / CURRENT SITUATION IN MYANMAR

Myanmar is a developing country in the South-East of Asia, formerly known as Burma. Since 2010 Myanmar has started to change from a military dictatorship to a more democratic country. Sanctions have been dropped and Myanmar has opened more towards the international world.

The increasing development of Myanmar results in some positive changes in the country like an increase of growth in GDP (Index of economic freedom, Burma, 2017). But at the same time, this increasing development and the growth of industries has a negative impact on the country's environment. Myanmar currently hasn't many laws and regulations about waste water treatment and discharge, which results in limited restrictions for industries and agriculture to discharge waste water directly on surface water. The increasing amount of chemicals and pollutants present in this waste water can form a danger for the environment and people's health towards the future.

Even though there is not much data available about the water quality situation in Myanmar, it is realistic to say that the water quality probably is decreasing. Unfortunately it is unknown how fast this is change in water quality is taking place. With the water quality as example, the following three topics will be discussed: the importance of monitoring the water quality, the data gap in Myanmar, and the low awareness among citizens.

1.1.1. IMPORTANCE OF MONITORING

Myanmar is rich in fresh water in the form of lakes, wetlands and rivers, of which most of these even are national rivers that find their origin within Myanmar, like the Ayeyarwady River, the Chindwin River and the Sittoung River. These rivers but also the lakes and wetlands provide enormous economic and cultural values for the country (Myanmar government, Freshwater ecosystems, ND). They are not only used for transport of people and goods, but also for industries, agriculture and irrigation, fishery and more. Also a significant amount of people is still depending of drinking water that comes from uncontrolled sources, including rivers. A decrease of the water quality can harm people's health and it will have a negative impact on the water species populations, agriculture and the environment. As was studied by Dr. Thazin Lwin, Yangon University, water from the Ayeyarwady River is sometimes so polluted and beyond EPA water quality standards that it should not even be used as potable water or for bathing. (Global New Light of Myanmar, From Yangon University to Ayeyarwady river, 26/11/2017) Therefore, water quality monitoring is of utmost importance.

1.1.2. DATA GAP

In Myanmar scientists can speak of a 'data gap' when they want to say something about the change of water quality throughout the country. The rivers and lakes are widespread and there is no system existing through which it is possible to collect information about the water quality. The available data is very limited. This shortage of data about water quality makes it very difficult for scientists to visualize the problem of water quality degradation in Myanmar. To be able to monitor water quality, more information about the current water system and access to more data is of great importance. But currently, there is no system available in Myanmar that makes it possible to monitor and collect data about the water quality in an easy way everywhere in the country.

1.1.3. AWARENESS

The awareness of citizens in Myanmar about water quality and waste is very low. Both in cities and villages a lot of waste is thrown on the streets ends up in the water channels or next to the streets. Citizens are not enough aware of the water system, it's functionality and how their own actions can affect the water cycle and the water quality. At the same time, also the government is lacking to take responsibility. Even though the governmental organisations are aware of the current problems, they are not taking enough action to solve this.

1.2. PROBLEM DEFINITION

To be able to study large-scale patterns in the environment, like for example the change of water quality, a constant amount of data over an array of locations and time is required. At the moment this is not possible due to the shortage of available data. With a surface area of 676 578 km^2 and many thousands km of rivers, it is challenging to collect the necessary information about the water quality all over the country. From a traditional point of view, the installation of monitoring stations used for characterising chemical and ecological status of water bodies can supply in the collection of data (Watersam, Monitoring stations, ND). Unfortunately, building new monitoring stations all around Myanmar could become very expensive solution.

A relative new and cheaper and still effective way of obtaining and collecting data is the use of *citizen science* or *participatory monitoring*. Since there is not much known about the attitude towards this new technique in Asian countries, this research will investigate the drivers to use of participatory monitoring in Myanmar. What would be the underlying motivation for citizens to participate in participatory monitoring and would there be enough support to use this technique for the purpose of monitoring the water quality within Myanmar.

One must understand that the underlying problem in Myanmar and many other countries in the world, is the lack of available data that scientists and the government face when they want to study large-scale patterns in the environment. Other examples besides the decrease of the water quality that have to deal with limited available data are soil settling, coast erosion and many more.

1.2.1. PARTICIPATORY MONITORING

Participatory monitoring, or in other words citizens science, is the involvement of the public in scientific research. The Oxford English Dictionary recently defined citizens science as: "scientific work undertaken by members of the general public, often in collaboration with or under the direction of professional scientists and scientific institutions" (Citizens science center, Definition citizens science, ND). Another word for citizens science , which is more preferred by some people and also is used within this research, is participatory monitoring.

As can be understood from the definition above, the use of participatory monitoring is not specifically bounded to one type of project. There are numerous projects all over the world that show that participatory monitoring is an effective way of collecting data. These projects vary from coastal erosion, rainfall and animal observations; as long as the project focus on monitoring, participatory monitoring can be used (Citizen science portal Scotland, Current projects, 2017).

Also the way in which the public is brought in contact with the scientist differs per project, but most projects make use of a phone application like for example the project of 'Smart Phones 4 Water' about rainfall in Kathmandu, Nepal (Smart Phones 4 water, SmartPhones4Water, 2013). By filling in the measurements in a special application, the information gets send to and collected into a database which can be used by scientists and others. The great benefit of using a mobile phone application is the low threshold in use and the fact that more and more people own a mobile phone nowadays.

1.2.2. PARTICIPATORY MONITORING IN MYANMAR

In Myanmar the percentage of inhabitants that owns a smart phone has increased rapidly during the last 6 years, from only 3 or 4 million to 45 million active SIM subscriptions, of which about 60% to 80% of those are for smart phone use in 2016. This rapid and sudden increase in smart phone owners opens the possibilities for a platform for participatory monitoring in Myanmar (Forbes, Myanmar: 45 Million Mobile Phones And The $19 3G Smartphone, 2016). Also when the household access to ICTs and ICT connections in Myanmar (figure 1) is taken into account, the mobile phones (58%) seems much more interesting than computers (about 1-2%). The use of a mobile phone application for the collection of data would therefore be favourable.

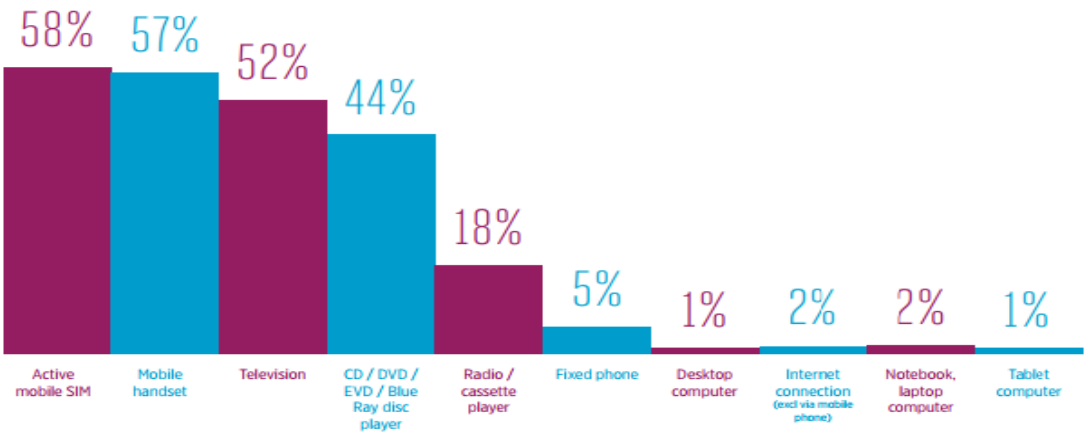


FIGURE 1 - HOUSEHOLD ACCESS TO ICTS AND ICT CONNECTIONS (% OF MYANMAR HOUSEHOLDS)

1.3. GOAL

The goal of this research is to investigate if there is a support among the inhabitants of Myanmar to join participatory monitoring and to find out more about the different underlying motivations for people to participate. It would be interesting to see if these motivations differ strongly by age, background, education level or location throughout the country.

1.4. RESEARCH QUESTIONS

The objectives of this research will be achieved by answering the following research question:

How can citizens in Myanmar be motivated to participate in participatory monitoring?

Sub-questions:

I. What are possible motivational factors?
II. Do the motivational factors differ for different groups within the society of Myanmar?
    a) Different age groups; school children, students, adults
    b) Geographical location; living in a city or on the countryside, living in the middle of the country or at the cost line.
    c) Education level; lower education, higher education, university education
    d) Relevance of the research for their daily lives/interest; connection with the research topic; farmers, fisherman, hotel owners, teachers, interested in science (or not).
III. What keeps citizens motivated to continue participation to participatory monitoring for a longer period?
    a) Importance of feedback
    b) Participatory monitoring as part of education?
    c) Payment

1.5. BOUNDARY CONDITIONS

For this project it will be very important to explain every single person that is interviewed about participatory monitoring since most people will not be familiar with this. To make the project easier for them to understand and to be able to give clear examples of how it works, this project will only focus on participatory monitoring related to monitoring the water quality. Any other topics for which participatory monitoring could be used, are not taken into account during the research. However, at the discussion the general use of participatory monitoring will be discussed.

2. METHOD OF RESEARCH

2.1. INFLUENCE OF CULTURE

The problem and research questions defined in the first chapter are very much related to the way people in Myanmar think, act and the culture they live in. Therefore it will not be possible to use previous research about motivational factors related to participatory monitoring projects in western countries, since the culture in Myanmar is very different compared to western countries.

The difference between western countries and non-western countries is also explained by the social pyramids of Pinto and Maslow, figure 2. They make a distinction in cultures based on the degree in which people are focused on the individual or on the group. For a tights structure (F-structure) which equals a group oriented culture, the pyramid of Pinto shows the order of the human needs very well. In such a culture the position of the group in society is very important. A more loose structure (G-Structure) is the opposite and equals a more individualistic culture like the one that can be found in western countries. This structure is visualised by the pyramid of Maslow (Piramide van Pinto, Management platform, 2015). The Netherlands is a good example of a G-structure, where self development and the freedom of choice are very important. Myanmar on the other hand, has a culture that is closer related to the F-structure. Tradition and family are of greater importance and this different culture is also visible in the way of communication. There is more respect for hierarchy and people are more serving and always trying to do the things exactly as they are asked for. This is different compared to a G-structure in which people have a clear own opinion that they easily share with others.

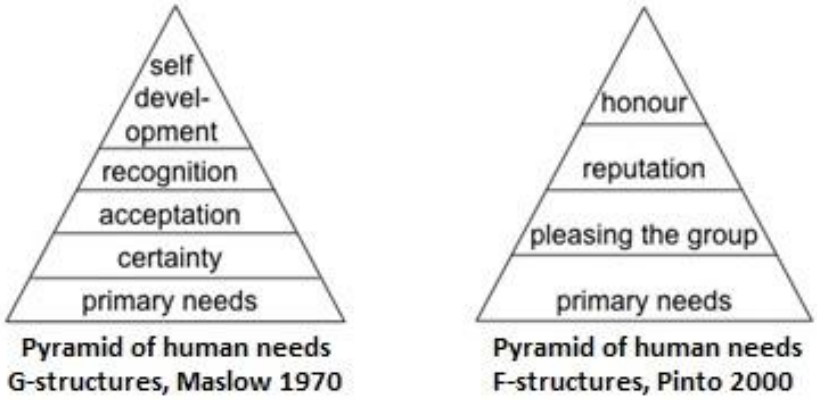


FIGURE 2 - PYRAMID OF MASLOW AND PINTO

This difference in culture must be taken into account when designing a method of research for this project in Myanmar. Based on an earlier study on citizen science in Nepal, which also is an Asian country, it is decided to use the Q methodology for this project (Citizen science for hydrological measurements in Nepal, 2017).

2.2. Q METHODOLOGY

Q Methodology, also known as Q-sort, is a research method used in psychology and social science to study people's viewpoint on certain topics, developed by psychologist William Stephenson. It is particularly useful to understand and describe different viewpoints on one topic (Q method, ND).

Q Methodology is used to investigate the perspectives of participants, by making them rank and sort a series of statements. After collecting all these perspectives, the Q methodology looks for correlations to reduce the many individual viewpoints of the topic down to a few motivation factors, by doing a factor analysis. These

motivation factors represent a group of people who are sharing the same viewpoint and a certain way of thinking (Better evaluation, Q methodology, 2014).

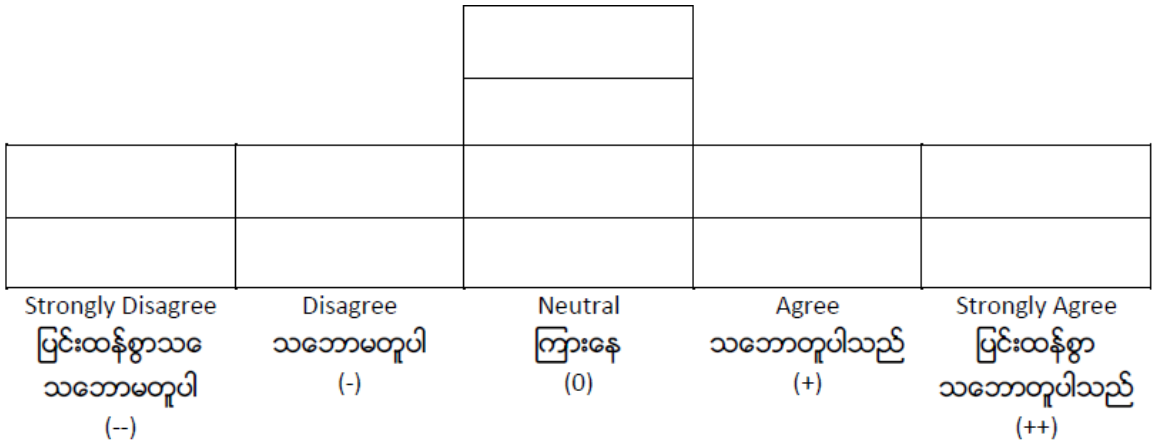


FIGURE 3 - Q-SORT TABLE

Since people are forced to make choices and compare different statements, this method is very well suitable for non-western countries like Myanmar. People from a F-culture tend to give the most social-accepted answer, but within Q methodology they can only choose between different positive formulated statements. This forces people to make a choice that meets their thought the most, without giving them the possibility to be positive about all statements. Q methodology always makes use of a Q-sort table in which partiticipants have to fill in the different statements. The shape of this table can be chosen by the scientist (forced-choice or free-sort) and maily has a quasi-normal distribution, with a rating range from -3 to +3, -4 to +4, depending of the number of statements (Q method explanation, Stephenson, 2005). For this project the Q-sort table given in figure 3 is used. This table gives place to 12 statements to get filled in. Due to the linguist scale only two of the 12 statements can be filled in at 'strongly agree' and participants only can choose two statements on which they 'strongly disagree'.

2.2.1. COLLECTION OF STATEMENTS (Q-SET)

In figure 4 the steps of Q methodology are given. When the research question is defined, a list of statements must be made that cover all possible motivations to join participatory monitoring. Normally this starting list can get very long and easily exists of 50 till even 100 statements. This list of statements can for example be compiled after organizing a brainstorm with different people about the topic or by doing observational research. This comprehensive collection of statements is also called the concourse. This rough selection of statements forms the base for the Q-set that finally is needed.

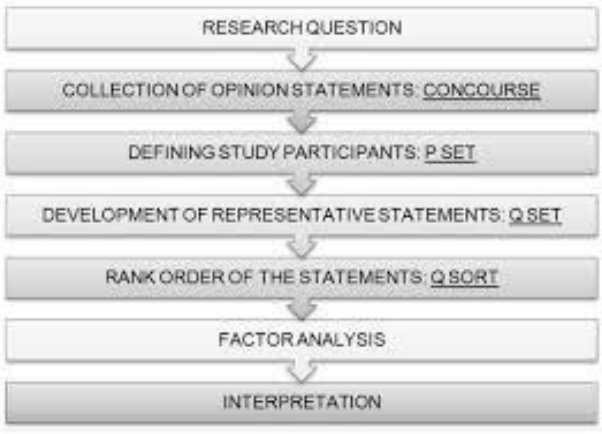


FIGURE 4 - STEPS OF A Q METHODOLOGY

For this project it was chosen to continue with the statements that have been earlier developed for a comparable project in Nepal (Citizen science for hydrological measurements in Nepal, 2017). This was possible because Nepal and Myanmar are both South-Asian countries and both projects are about defining the motivational factors of people to participate in participatory monitoring related projects.

Out of the concourse, a selected amount of representative statements (the Q-set) is chosen. This Q-set must cover all possible motivations. The final amount of statements can differ, but to keep it doable for people to fill in the Q-sort within a reasonable time, a final set of 12 statements was chosen.

The 12 statements are given below and they all start with:

"I would participate in this project ... "

1. ... because I think it will make a difference.
2 ... to get a certificate of participation.
3. ... to develop my scientific research skills.
4. ... because success of this project depends on citizen scientist like me.
5. ... if I could access the data collected.
6. ... because a better water quality would directly have a positive impact on my life.
7. ... because it is my job to care for water as a resource.
8. ... even though I am not a trained scientist.
9. ... if I receive payment for my measurements.
10. ... because citizen science sounds fun to me.
11. ... if my friends would.
12. ... because I understand what participatory monitoring is all about.

Compared to the project about citizen science in Nepal, some adjustments on the Q-set were made. One of the statements from the project in Nepal was 'I would participate in this project so I can be part of an international project'. This statement did not seem relevant for this project, because the goal of participatory monitoring in Myanmar is to start monitoring within the country itself for the purpose of local scientists. It would be nice that when participatory monitoring seems to become a working solution for Myanmar, scientists in Myanmar can set up their own participatory monitoring projects to do more research about their own country and environment. In this way, there will be no need for foreign scientists to participate in the future and definitely not all participatory monitoring projects will have a international focus.

Within the existing list there was no statement that focused on the effect and relevance of the research project on people's daily lives. Therefore a new statement was added: 'I would participate in this project because a better water quality would directly have a positive impact on my life'. When people agree on this statement they show that they understand the importance of good water quality on their own life, for example their health. For fisherman the water quality could for example directly influence the fish population and so their income and lives. On the other hand, people that disagree on this statement maybe don't feel so much dependent of the water quality during their daily lives. It is interesting to see what other reasons would motivate them to participate.

2.2.2. Definition of participants (P-set)

The set of participants (P-set) that is chosen has a strong influence on the results that can be obtained. To be able to answer the research question stated in chapter 1, the P-set must cover different age groups, different geographical locations and different education levels. At the same time it is better for the validity of the project to do a lot of interview, because more data will often result in more reliable findings.

Schools and universities were favorable, since it is possible to explain the project and interview several people at once and the level of English is expected to be sufficient. Therefore it was chosen to focus on pupils from High School and students from University in both Mandalay and Yangon. Mandalay and Yangon are both big cities with more than million citizens and several universities and both located along the Ayeyarwady river, which means that water is always close by. At the same time these cities are very different and almost 600 km (9 hours traveling) apart from each other. Yangon was the former capital of the country and it is the largest

metropolis in Myanmar. It is located near the river mouth of the Ayeyarwady river as it is very close to the sea. Mandalay on the other hand is located in the middle of the country. Where people from Yangon form a diverse collection of the nation, Mandalay remains an urban expression of Burmese ethnic identity. To see if there are any differences in motivation based on geographical location within the country, the same interview is done in both Mandalay and Yangon.

The final overview of respondents consisted of mostly pupils (age 11-18) and students (age 17-25) but also some adults (25+) joined the interview.

2.2.3. THE Q-FORM

The Q-form, the questionnaire that everyone had to fill in, consisted of 3 pages (See Appendix 1 for the Q-form). On the first page, people had to fill in some general information about themselves like their age, city, education level, favourite course/interest, if they have a smart phone. They did not need to write their name, the form was anonymous. On the second page, the twelve statements were written and the box in which they had to fill in all twelve numbers rating them from 'strongly disagree' to 'strongly agree'. On the third page participants were asked to explain their choices and write down if they thought a statement was missing.

Only on the first two schools (M.K.L. Private High School and Myat Say Tanar Private High School) English Q-forms were used, since the form was not yet available with a Burmese translation. To prevent the waste of too much paper, the English forms that were left were only used on universities, where the English level of the participants was sufficient. On all the other and universities Q-forms in both languages, English and Burmese, were used.

2.2.4. EXPLANATION OF THE PROJECT TO PARTICIPANTS

Before letting the people fill in the form it is very important that they understand the purpose of the research project and that they understand what participatory monitoring is all about. Every group (school children and students) therefore got the same explanation prior to filling in the form. When it was possible to use a projector, a power point presentation about the project was used to explain more about the project with the use of pictures. When there was no projector available, the same explanation is given, but then without the visual aid of projecting. During the explanation, first the importance of clean water and the current date gap are explained. Afterwards explaining participatory monitoring, the participants were asked to fill in the form.

2.3. RESPONSES ON Q-SORT

2.3.1. TOTAL RESPONSES AND RELIABILITY

For this research a total of 405 people filled in the Q-sort. The Q-sort is filled in by people living in the city of Mandalay and surrounding area (301 responses of which 258 valid responses) and people in the city of Yangon (96 responses of which 91 valid responses). Table 1 gives an overview of the total amount of interviews.

	Group / Education Level	Total responses	Of which valid responses
Mandalay Area	Grade 6	24	21
	Grade 7	18	18
	Grade 8	45	40
	Grade 9	26	25
	Grade 10	102	85
	Grade 11 (does not exist)	3	0
	Students	69	57
	Adults	16	12
Yangon Area	Grade 9	14	14
	Grade 10	35	32
	Students	47	43
Others	Villagers	8	8
	Citizen scientists	3	3
		410 (total)	**358 (total)**

TABEL 1 TOTAL RESPONSES ON Q-SORT

As also can be understood from table 1, not all responses are taken into account for this research since they gave an invalid outcome. Appendix 2 'Reliability of the responses' gives an overview of the invalid responses and also gives an explanation about why these responses were judged invalid.

Of some interviews it is doubtful if the person understood the questions correctly. This, for example, becomes visible when students gave a confusing explanation for their choice or when it seems that they have copied answers from each other. We can't say that their answers are wrong, because it is of course possible that they share the same thoughts. Appendix 2 also gives an overview of these doubtful responses.

2.3.2. IDENTIFICATION CODE

During the interview pupils, students and other people had to fill in a paper form with questions. To make it possible to work with the results, all the information of the paper forms had to be digitalized. This was done by filling all the information in into an excel sheet. To make it possible to easily trace all the different interviews, every interview got its own identification code (ID). This identification code is also necessary for the PQ Method program that was used to process the Q-sorts. The ID is build up of maximum 8 characters. Below an explanation of all characters is given:

- **First character: Background**
  High School pupils (S), University students (U), Adults (A), Volunteers of citizen science (V).
- **Second character: Education level**
  Grade 6 (6), Grade 7 (7), Grade 8 (8), Grade 9 (9), Grade 10 (10), Grade 11 (11) *, Bachelor (B), Master (M), People that are currently not following any education in one of the earlier mentioned levels, for example adults, get no second character.

  *Grade 11 does not exist at all schools in Myanmar. There were only a few persons that filled this in, but all of their forms were already judged invalid because of another reason. (See Appendix 2).

- **Third character: Gender**
  Male (M), Female (F)
- **Forth character: Location**
  City of Mandalay and surrounding (V), City of Yangon and surrounding (Y), Countryside/others (X).
- **Fifth character: Number**
  Personal number, 1 till 410.

Below an overview of the identification codes related to the different schools/universities /others is given.

S6MV_1 to S8MV_61	M.K.L. Private High School
S8FV_62 to S9FV_110	Myat Say Tanar Private High School
AFV_111 to AMV_113	Ingon Village
AFX_114 to AFX_118	Son Ye Village
VFV_119 to VFV_120	Citizen Science volunteer in Mandalay
UBMV_121 to UBMV_216	P.E.S. Monastry school for English in Mandalay
UBMV_217 to UMMV_221	Sibling English School
S10FV222 to S10MV311	Aung Myae Oo Monastery School
VBFX_312	Citizen Science volunteer in Pyay
UMFY_313 to UMFY_322	Yangon Technological University (Water Resources Engineering)
S9FY_323 to S10MY373	Mercury Educational Centre
UBMY_374 to UBFY_410	Myanmar Maritime University (Marine Engineering and Port and Harbour)

2.3.3. Responses in the area of Mandalay

In the area of Mandalay in total 301 participants filled in the Q-sort. To collect these interviews the following schools were visited:

- M.K.L. Private High School
- Myat Say Tanar Private High School
- P.E.S. Monastery school for English in Mandalay
- Sibling English School
- Aung Myae Oo Monastery School

Private High Schools were preferred over Governmental High Schools since the English level on Governmental High Schools is significantly lower of both pupils and teachers compared to Private High Schools. Especially during the start of the project it was better to visit schools with a higher English level, since the form was not yet translated into Burmese and it was important that they were able to understand the project. Even though there was often a translator present, it is preferred if people understand you directly.

Due to the end of the semester, it was not possible to visit the Mandalay University, since the University was not going to start again before the first week of December. Instead of visiting the Mandalay University, the P.E.S. Monastery school for English was visited, since many students take extra English lessons during that period. This resulted in 69 responses from university students from many different study directions.

Table 2 gives an overview of the amount of responses per group/education level. On the first school that was visited, M.K.L. Private High School, the Q-sort was filled in by pupils from grade 6 - 8 (age 11-14). Due to the good translation given by Nyein Thandar Ko, it was possible to explain the project and the Q-sort to the pupils, and most of the responses were valid. But after a short evaluation, it was decided that pupils of grade 6 and 7 are a bit too young to fully understand the project, also partly due to their low level of English. Therefore, after this first visit, the chosen set of participants (P-set) was adjusted and will focus more on pupils from grade 8, 9, 10 and university students.

	Group / Education Level	Total responses	Of which valid responses
Mandalay Area	Grade 6	24	21
	Grade 7	18	18
	Grade 8	45	40
	Grade 9	26	25
	Grade 10	100	85
	Grade 11 (does not exist)	3	0
	Students	69	57
	Adults	16	12
		301 (total)	**258 (total)**

TABLE 2 RESPONSES IN THE AREA OF MANDALAY

2.3.4. RESPONSES IN THE AREA OF YANGON

In the area of Yangon in total 96 participants filled in the Q-sort. To collect these interviews the following schools/universities were visited:

- Mercury Education Centre (Private High School)
- Yangon Technology University (YTU)
- Myanmar Marine University (MMU)

In Yangon it was more difficult to get entrance to the High Schools compared to Mandalay. It was not possible to visit any Governmental High Schools since they asked for an official approval document of the Ministry of Education. Therefore only Private High Schools were contacted for a visit. Unfortunately, many schools had a tight schedule due to exam period and the many holidays in December. However it was possible to visit the Mercury Education Centre (Private High School) were the Q-form was filled in by students of grade 9 and 10.

Both the MMU and YTU were visited to get responses of students. At these universities the Q-form was filled in by students from three different study tracks: Water Resources Engineering (YTU), Marine Engineering (MMU) and Port and Harbours (MMU).

Table 3 gives a clear overview of the total of participants in Yangon area and the amount of valid responses.

	Group / Education Level	Total responses	Of which valid responses
Yangon Area	Grade 9	14	14
	Grade 10	35	32
	Students	47	43
		96 (total)	**89 (total)**

TABLE 3 RESPONSES IN THE AREA OF YANGON

2.3.5. OTHER RESPONSES

Next to the Q-sort that are filled in by High School pupils and University students, some other groups got interviewed about participatory monitoring to create a more complete view of the thoughts of people in Myanmar about this method of monitoring and collecting.

The following other people filled in the Q-sort:

- Villagers of Ingon Village and Son Ye Village
- Volunteers of citizen science

The result of these Q-sort and the additional interviews that are done is more in depth evaluated at chapter 3 'Results' and chapter 5 'Conclusions and recommendations'.

2.4. PQ METHOD PROGRAM

To process all Q-sorts by making use of the Q methodology, a special software program is used: PQ Method. (Software, Qmethod.org, ND)

2.4.1. EXPLANATION OF PQ METHOD PROGRAM

PQ Method is a free available software package created by Peter Schmolck that is designed for the processing of Q-sorts by using Q methodology (PQMethod, The QMethod Page, 2014). An explanation of how to use this software package is added in Appendix 3 'Using PQ Method software'. PQ Method is easy to use, but also time-consuming since you have to import all single Q-sorts manually in the program.

After starting up the PQ Method application, you have to design your own research project and give it a short but clear name. Afterwards, PQ Methods gives you the choice between 8 different steps, some are obligatory, others are free to choose. A short explanation of the steps is given below, see Appendix 3 for a more extended manual.

- **Step 1 - STATES**

At step 1 enter all twelve statements in the program. This is done by creating a STA file.

- **Step 2 - QENTER**

At step 2 the shape of the Q-sort table has to be defined before it is possible to insert all Q-sorts. The program asks about the total amount of statements and the way the table is build up. When this information is given, it is possible to insert all Q-sorts one by one. To do so, every Q-sort must get its own identification code.

After step 1 and 2 you have to chose what kind of factor analysis you want to perform. Chose between step 3 or step 4, a Centroid factor analysis or a Prinicipal Componant factor analysis.

- **Step 3 - QCENT - Perform a Centroid factor analysis**

PQ Method makes use of the 'Horst 5.5 Centroid factor analysis with iterative solutions for communalities instead of the method described in Brown (1980)'. Chose how many centroids you wish to extract, up till a maximum of 8. The amount of centroids you choose influences the average squared residual correlation that the program can find. When the average squared residual correlation gets below 0.02 the program will give an error.

- **Step 4 - QPCA - Perform a Principal Components factor analysis**

Instead of a centroid factor analysis you can also choose to do the Principal Components factor analysis. When you choose number 4 the program will give an overview of all factors that are found, their eigenvalues, as. percentages and their cumulative percentages. Especially the eigenvalues are of interest, since only factors with an eigenvalue of more than 1.00 are extracted. Those with a lower value are regarded as insignificant and of too little interest to further investigate (Q method explanation, Stephenson, 2005). PQ Method will always take 8 factors as output when doing a Principal Components factor analysis.

After step 3 or 4 you have to choose what kind of factor rotation you want to perform. You have the choice between step 5 (manual rotation) or step 6 (Varimax rotation),but a combination is also possible:
- Apply only a manual rotation
- Apply only a VARIMAX rotation
- Apply first a VARIMAX rotation and additional manual rotation
(- Applying manual rotation before VARIMAX is not possible, since the VARIMAX will always overrule the manual rotation)

- **Step 5 - QROTATE - Perform a manual rotation of the factors**

In Q factor analysis, the correlations between persons are factored. Each factor determines which sets of people cluster together because of their shared viewpoint. Q methodology extracts factors using the centroid

method, but it also allows additional manual rotation. In this way the researcher is able to pursue his own rotational solution. A purpose for this can be to account for as many of the sorts as possible in as few factors as possible. (Q method explanation, Stephenson, 2005)

- **Step 6 - QVARIMAX - Perform a varimax rotation of the factors**

The VARIMAX rotation is strictly mathematical and rotates the factors in such a way that they are always at right angles to each other. This results in uncorrelated factors. Through an iterative process, the degree of association on the factors is determined. The purpose is to maximise the number of Q sorts on the number of factors extracted initially. (Q method explanation, Stephenson, 2005)

- **Step 7 - QANALYZE - Perform the final Q analysis of the rotated factors**

This is the last step before you can view your results. The program performs the final analysis.

- **Step 8 - VIEWLIST - View output file <name>.lis**

After step 8 a file with all the output is created. This file gives a clear and extended overview of the results and includes also the correlation matrix, the un-rotated and rotated factor matrix, the factor loadings and the different factors and statements. By analysing these results a better understanding of the different factors and/or viewpoints can be obtained.

2.4.2. METHOD OF ANALYSING THE Q-SORTS

The PQMethod program is able to process up to 299 Q-sorts within one analysis. Since there were 358 valid Q-sorts collected, it was not possible to assimilate them all at one time. Therefore it was decided to split up the total number of Q-sorts in different smaller groups and analyse them before comparing and discussing the differences and similarities in the outcome. While processing the different groups of Q-sorts, one of the two available factor analysis and method of rotation had to be chosen.

For all analyses within this project Principal Component Analysis (PCA) was used. The PCA gives an overview of the eigenvalues which gives information about the number of factors that might be interesting to investigate more. PQ Method will always take 8 factors as output when doing a Principal Components factor analysis, but later on it is possible to reduce the amount of factors. The Centroid factor analysis was also tried. The outcome was quite comparable with PCA, but since you have to define the number of factors that you want on forehand, PCA was preferred.

The VARIMAX factor rotation was chosen for all analysis because this is a strictly mathematical solution and as a researcher you cannot influence the outcome. Since the results of the different groups get compared after doing the full analysis of the factors, it is important to use the same procedure for each group. Every VARIMAX rotation is based on the same mathematical model and this is therefore more objective than doing a hand rotation.

While analysing the different groups of Q-sorts, one can choose the number of factors that are desired. Although software for Q methodology typically extracts seven to eight factors to ensure enough variance in the factor, as a rule only three to four factors have any value. (Q method explanation, Stephenson, 2005) A lower number of factors as outcome makes it also more easy to compare different groups. Since this project is more interested in wether differnt groups have a different viewpoints than the total number of different viewpoints that can be found with each group, it was chosen to get not more than 3 to 4 factors as outcome per group.

2.4.3. ANALYSING GROUPS (1-5)

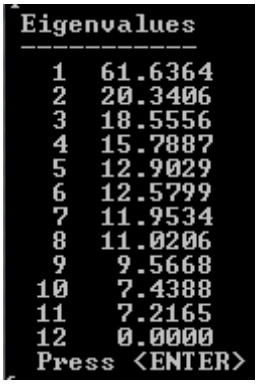
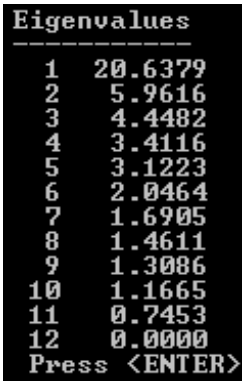
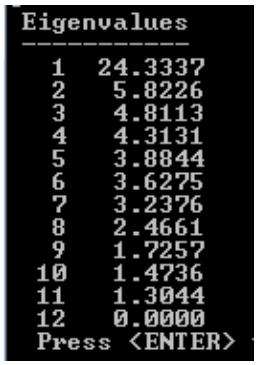
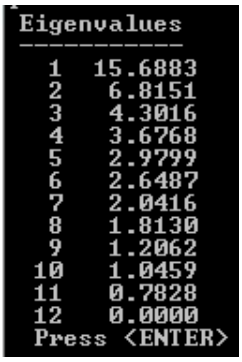
The 358 Q-sorts were split into four smaller groups. These groups were chosen in such a way that it was be possible to compare their outcomes and answer the different research questions at the same time.

The following groups were analysed:

A. **School Pupils from the area of Mandalay (PM_SM)**
   PCA with VARIMAX rotation; 4 factors as output
B. **University students from the area of Mandalay (PM_UM)**
   PCA with VARIMAX and hand rotation; 3 factors as output
C. **School Pupils from the area of Yangon (PM_SY)**
   PCA with VARIMAX rotation; 4 factors as output
D. **University students from the area of Yangon (PM_UY)**
   PCA with VARIMAX and hand rotation; 3 factors as output

A comprehensive overview of all the different factors and the way these people sorted the statements is given in Appendix 4 'Analysis of group A-E'.

For the analysis of the school pupils 4 factors were chose as output, but for the students only 3 factors were chosen. This had to do with the eigenvalues within these groups and the number of people that belong to the number of factors that are chosen, see table 4. A minimum of 3 Q-sorts on one factor is chosen. If this is not possible, the number of factor is reduced.

 **PM_SM (School pupils Mandalay)**	 **PM_SY (School pupils Yangon)**	To make it still possible to compare the different groups, a number of 4 factors is chosen for both the school pupils from the area of Mandalay as for the school pupils from the area of Yangon.
 **PM_UM (University students Mandalay)**	 **PM_UY (University students Yangon)**	One factor has a much higher eigenvalue than the others. When running the analysis with 4 factors only 2 people belong to the fourth factor. This is too little, therefore a total number of 3 factors is chosen.

TABEL 4 EIGENVALUES AND NUMBER OF FACTORS

3. RESULTS

At the start of this project the research question 'How can citizens in Myanmar be motivated to participate in participatory monitoring?' was formulated. This chapter will present the results that belong to the different sub-questions.

3.1. REASONS TO PARTICIPATE

In the attempt to understand the way of thinking by people in Myanmar, the first sub-question was related to possible reasons for people to participate in participatory monitoring. Sub-question I: 'What are possible motivational factors?'.

By setting up the Q-sort, a list of statements was created (see 2.2.1. Collection of statements (Q-set)). To check whether these 12 statements covered all possible motivations to join participatory monitoring, all participants were asked in the open questions of the Q-form if they missed any statements.

The following missing statements, which can be divided in four topics, were written down by the participants:

Caring about others:

- I want to save all the people. (S8FV_72)
- I would participate in this project because of to protect people health. (UBMV_178)
- Because almost pure water can save many people life in the world and there are millions of people die because of the impure water. (S10MY_358)
- Because a better water quality would make all people in the environment safe and free from danger. (S10MY_363)
    - **I would participate in this project because I care about other people's health.**

Being a good example and increasing awareness:

- I want to be a good example for the village and take care of the people. (AMX_117)
- To promote and share knowledge about water quality in Myanmar (UMFY_314)
    - **I would participate in this project because I want to be an example to others and increase the awareness about the importance of water quality.**

Care about the environment (worldwide):

- because we should protect aquatic animals in the Ayarwaddy river, especially Ayarwaddy Dolphin. (UMMV_132)
- because water is important for animals, trees and natural resources. (UBMV_133)
- You can change the water quality all over the world. (AFV_175)
- If we don't take care of our water resource, our world will go astray and many plants and animals that depend on water will disappear soon. (S9MY_336)
    - **I would participate in this project because I care about the environment and all living animals and plants.**

Receiving compliments (external motivation):

- Because my father and mother would be proud of me. (S8MV_83)
    - **I would participate in this project because I think it will make other people proud of me.**

The above stated reasons are different from the 12 statements that were part of the Q-form and should therefore get added to the existing list of statements. This means that there are in total 16 reasons for people in Myanmar to join participatory monitoring about measuring water quality.

3.2. DIFFERENCES IN MOTIVATION BETWEEN DIFFERENT GROUPS IN SOCIETY

The second sub-question focussed more on how the motivations of people in Myanmar can differ for different groups in society. A distinction in age, education level, geographical location within the country and interest is made:

II Do the motivational factors differ for different groups within the society of Myanmar?

a) Different age groups; school children, students, adults
b) Geographical location; living in a city or on the countryside, living in the middle of the country or at the cost line.
c) Education level; lower education, higher education, university education
d) Relevance of the research for their daily lives/interest; connection with the research topic; farmers, fisherman, hotel owners, teachers, interested in science (or not).

By comparing the outcome of the different groups that filled in the Q-sort, a better understanding of the differences and similarities in viewpoints can be created. This chapter will give an overview of the collected results and the interpretation.

3.2.1. DIFFERENCE IN AGE

To see if there are differences in motivation for people of different age groups, the results of school pupils and university students in Mandalay were compared. Group A "School pupils from the area of Mandalay" exists of 4 factors and Group B "University students from the area of Mandalay" exists of 3 factors. In table 5 a summary of the explanation of the different factors per group is given. For the full analysis of the different groups, see Appendix 4.

	SCHOOL PUPILS MANDALAY
Factor 1	They understand the impact of water quality and feel responsible to improve the situation. These children are mainly a bit older (grade 9 and 10).
Factor 2	They are eager to learn about science because it sound fun to them. Optimistic, but they don't see it as their job to care for water and they are not interested in accessing the data. These children are mainly a bit younger (many pupils from grade 6).
Factor 3	They are interested in science and improving their skills. They also feel the responsibility to participate. They are not negative about receiving a certificate. These children are mainly a bit older (grade 10)
Factor 4	*Invalid*

	UNIVERSITY STUDENTS MANDALAY
Factor 1	They understand the impact of water quality on their lives and they feel responsible to improve the situation. They are not interested in receiving any payment, a certificate or joining with friends.
Factor 2	They are interested in science and want to access the data as well. They believe the project can make a difference but they do not participate because they think it is fun or to receive any payment.
Factor 3	They understand the impact of water quality on their lives and are interested in science and getting access to the data. This group is neutral against receiving any payment or a certificate.

TABLE 5 SUMMARY OF FACTOR EXPLANATION FOR SCHOOL PUPILS AND UNIVERISY STUDENTS IN MANDALAY

There are some interesting differences visible when comparing the results of the school pupils with the results of the students. The youngest pupils (factor 2, school pupils Mandalay) are quite optimistic and they eager to learn mostly because they think it sounds fun. This is clearly different from older pupils and the students, because when they have an interest for science, they also want to access the data and often they also see it as their job to participate, while the younger pupils do not mention this as one of their motivations to participate.

When the pupils get a little older (grade 8, 9 and 10) their motivation gets very similar to the motivation of students. They are either interested in science or they feel responsible to care about the water in their country and they seem aware of the fact that water quality can impact their lives.

Another difference related to age is whether the participants are negative or neutral about receiving payment and/or a certificate. For the school pupils in Mandalay receiving payment was sorted at strongly disagree for all of the factors (this is a consensus statement). But when looking to the university students in Mandalay, some participants are also neutral about receiving payment or a certificate. These participants belong to factor 3 of the university students in Mandalay. This gives the impression that money and certificates are of bigger value for people with a higher age or those that get closer to starting on the job market.

3.2.2. DIFFERENCE IN GEOGRAPHICAL LOCATION

To see if there are any differences in motivation for people due to their geographical location, the results from school pupils from Yangon and Mandalay need to be compared. Group A "School pupils from the area of Mandalay" and Group C "School pupils from the area of Yangon" both exist of 4 factors. In table 6 a summary of the explanation of the different factors per group is given. For the full analysis of the different groups, again see Appendix 4.

	SCHOOL PUPILS MANDALAY
Factor 1	They understand the impact of water quality and feel responsible to improve the situation. These children are mainly a bit older (grade 9 and 10).
Factor 2	They are eager to learn about science because it sound fun to them. Optimistic, but they don't see it as their job to care for water and they are not interested in accessing the data. These children are mainly a bit younger (many pupils from grade 6).
Factor 3	They are interested in science and improving their skills. They also feel the responsibility to participate. They are not negative about receiving a certificate. These children are mainly a bit older (grade 10)
Factor 4	*Invalid*

	SCHOOL PUPILS YANGON
Factor 1	They feel responsible (needed/it is their duty) to participate and to improve the situation. They also understand the impact of water quality on their lives. They are not very optimistic, don't think it will make a difference.
Factor 2	They are interested in science and want to access the data as well. They also understand the impact of water quality on their lives.
Factor 3	*Invalid*
Factor 4	They understand the impact of water quality and feel responsible to improve the situation. These children are not negative about receiving any payment.

TABLE 6 SUMMARY OF FACTOR EXPLANATION FOR SCHOOL PUPILS FROM MANDALAY AND YANGON

While looking at the results, no big differences can be found. The participants that belong to factor 1 in Mandalay are mostly interested because they feel responsible and needed. This is comparable with the participants from Yangon that belong to factor 1. People that belong to factor 3 in Mandalay have an interest in science which makes them participate. This is comparable with factor 2 in Yangon which factor also exists of people that in the first place are interested in science.

Factor 2 of the group of school pupils from Mandalay is special because relatively many young people (grade 6, age 11-12) belong to this factor. The motivation of these people does not match any of the factors that were found in Yangon. This could be explained by the fact that this factor is depending on age and not on geographical location as already was noticed and explained in 3.2.1. 'Difference in age'.

Also the group that belongs to factor 4 from Yangon is remarkable, since the people that belong to this factor sorted the statement about receiving payment as neutral. This is very different from the outcome of the school pupils in Mandalay, since receiving any payment was a consensus statement in Mandalay which was sorted negative. In Mandalay all school pupils (factor 1-4) sorted the statement 'I would participate if I receive payment for my measurements' at strongly disagree.

3.2.3. Difference in education level

The difference in education level is very much comparable with the difference in age, since the education level increases by age. This difference is already explained at 3.2.1. 'Difference in age'.

3.2.4. Difference in Interest

To see if there are differences in motivation for people due to different interest, the results from university students in Mandalay and Yangon are compared. This is possible since the field of study chosen by these people is known.

In Mandalay the Q-form was filled in by students from many different fields of study. This was because the university was closed and the Q-forms were filled in by students that followed extra English lessons. These students had many different fields of interest and were studying the following subjects: Law, Mathematics, History, Philosophy, English, Physics, Computer science, International Relations, Zoology, Health and Chinese. In Yangon the Q-form was filled in by students from three different study tracks that all have to do something with water and technical science: Water Resources Engineering (YTU), Marine Engineering (MMU) and Port and Harbours (MMU).

Table 7 gives an overview and summary of the factors of Group B "University students of the area Mandalay" and Group D "University students of the area of Yangon". Both groups exist of 3 factors.

	UNIVERSITY STUDENTS MANDALAY
Factor 1	They understand the impact of water quality on their lives and they feel responsible to improve the situation. They are not interested in receiving any payment, a certificate or joining with friends.
Factor 2	They are interested in science and want to access the data as well. They believe the project can make a difference but they do not participate because they think it is fun or to receive any payment.
Factor 3	They understand the impact of water quality on their lives and are interested in science and getting access to the data. This group is neutral against receiving any payment or a certificate.

	UNIVERSITY STUDENTS YANGON
Factor 1	They are interested in science and want to improve their scientific skills. They also feel needed, the success depends on people like them. Most of these students study Water Resources Engineering.
Factor 2	*Invalid*
Factor 3	They believe this project can make a difference and they understand the impact of water quality, but they don't see it as their job to care for water as a resource. Only students from Marine Engineering and Port and Harbours belong to this factor.

TABLE 7 SUMMARY OF FACTOR EXPLANATION FOR UNIVERSITY STUDENTS OF MANDALAY AND YANGON

There is a consensus statement for the university students from Yangon; they all strongly agree on statement 6, "I participate in this project because a better water quality would directly have a positive impact on my life". Moreover almost all students of Water Resources Engineering are interested to participate in the project to improve their scientific skills. Some of the students also explained that they don't have many practical assignments at the university and that this project sounds as a nice way to practise a bit more with monitoring. The students of Marine Engineering and Port and Harbours also would like to participate, but more because

they agree that water quality is important for them and because they believe something can change. Maybe this also contributes to the fact that they are negative about receiving any payment.

In Mandalay, most students are interested because they feel responsible and they understand the impact of water quality on their lives. But there are also some students that are interested in participating this project, because they have an interest for science while they study something very different.

3.3. ADDITIONAL VIEWPOINTS ON PARTICIPATORY MONITORING

Besides the Q-forms that were filled in by High School pupils and University students, some other groups got interviewed about participatory monitoring to create a more complete view of the thoughts of people in Myanmar about this method of monitoring and collecting.

3.3.1. EXPERIENCED CITIZEN SCIENTISTS

For the research project of Thatoe Thanda Thatoe Nwe Win (Phd, TU Delft), nine volunteers living spread throughout Myanmar were chosen to collect data about the water quality in the Ayeyarwady River. They have been monitoring the water quality on regular base for a relative long period, varying between 1 till 3 years. The data they collected is, for example, used for scientific purpose. These people are in a way examples of future citizen scientist, with the only difference that these people are now working for a governmental organization that already cares for water; DWIR (Directorate of Water Resources and Improvement of River Systems). These 'volunteers' get paid for their work and are therewith no real volunteers. But because of their experience with monitoring water quality on a regular base for a longer period of time, it is interesting to learn more about their viewpoint on the potency of participatory monitoring in their country.

To get a better understanding of their viewpoints these people were interviewed and also asked to fill in the Q-sort. In total it was possible to meet two of these experienced citizens scientist: one living in Mandalay and one living close to Pyay. A more extended version of the interview is given in Appendix 5 'Interview with volunteers of citizen science'.

Below an overview of some interesting comments given by these two volunteers is given:

- Both volunteers state that doing the measurements is not difficult and anyone can do it. No additional education is needed, although some basic knowledge about science and chemistry is preferred since that will make it more interesting for people to do the measurements and increases their understanding of the project and results. (The measurements they do include monitoring of PH, nitrate, nitrite, temperature, electrical conductivity, phosphate, iron and transparency.)
- They are very positive about learning away their skills to others like their colleagues or school children. This might be interesting when experienced citizen scientist are needed to promote participatory monitoring in a later stage.
- They would also do the measurements if they did not got paid for it. Although the fact that someone they know asked them to do it, also contributed to their willingness to participate.
- When they were asked to define groups of people that would be fit to join participatory monitoring they both mention students as the number one most fit, because they feature scientific knowledge. On number two and three they also chose people that have a direct link with working on water related topics due to the job they have.
- When they were asked to sort 5 groups (schoolchildren grade 9, university students, fisherman, housewife's and farmers) from being the most fit to join participatory monitoring to the less fit, they sorted the groups very differently.
    - Person 1 sorted the groups mainly related to the way in which water quality impacts these people's health with housewife's on position 1. They take care of their families and the health of every family member is for them of greatest importance. They use water every day for

cooking, drinking and washing and the water quality has a big influence on the health of the users. Improving health is therefore the best reason to participate in monitoring water quality.

- Person 2 was more focussed on the way in which these people are able to learn new things and techniques, which made the students and school pupils score the highest. These people already have a lot of knowledge about science or they are the most eager to learn.

The overall opinion about participatory monitoring by these volunteers of participatory monitoring is quite positive. They believe participatory monitoring is a low threshold method to collect data and it can be done by many different groups of people. Even though the tests are simple to do and people don't need additional education, they suggest to involve people with knowledge and/or interest in water related topics, like students and people that already work in the field of water resources. Another reason why they think people would participate is when they understand the importance of clean water and how it can impact their lives and health. They are positive about promoting this method to others and sharing their knowledge on this topic.

3.3.2. People from small villages

The project focuses in the first place on younger people living in the main cities and urban areas in the region of Mandalay and Yangon. To get a better understanding of the viewpoint of people living in suburban areas, the villages Ingon and Son Ye were visited. In these villages 10 villagers were asked to join the one-on-one interviews in which they were asked to fill in the Q-sort. Full translation of English to Burmese was needed, because the level of English was insufficient.

The people that joined the interview were between 24 and 55 in age and had different jobs; student, housewife, fisherman, trader and one person was the Head of the village. Most people living in these villages provide in their livelihood by farming and fishing in the lake that was very close by.

In the beginning of the conversation they often seemed surprised by the topic and they did not seem to understand why we were interested in water quality. 'The water quality is okay here.' But later on, after explaining that the water quality can change over time, they mentioned that they actually observed the fish population going down and that there had been an increase of industries in the area the last ten years. They did not know if there was a relation between these two, but they started to understand the importance of water quality and monitoring it.

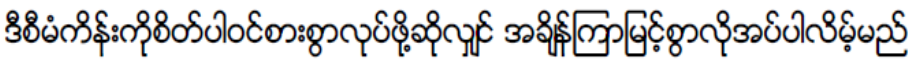
When asking them about what would motivate them to participate the project they were mostly agreeing on statement 5 and 6; 'because a better water quality would have a positive impact on my life' and 'if I could access the data collected'. In their explanation they told they want to care about their families and the people in their village. This was also a statement that they were missing in the list. Caring about people and being a good example for others was a important reason for them to participate. Most of them were not interested in receiving any kind of certificate or payment, even though the housewife could use some more money for her children.

Not surprisingly, the feeling of responsibility was different for the different people in the village. The Head of the village, the fisherman and the younger people were more interested in caring about the water quality than the person that was a trader and did not had to work so much with water during his daily life. The housewife also mentioned the social importance of clean water and health.

All people that participated the interviews had their own mobile phone. But the older people explained that they only use the phone to call with. They had never installed and used new applications before. This should be taken into account when designing a working application for participatory monitoring in Myanmar. It should not only be easy to use, but during the promotion extra attention to how to install and use the application should also be added.

3.4. WHAT KEEPS PEOPLE MOTIVATED FOR A LONGER PERIOD OF TIME?

To understand better about what is needed for people in Myanmar to keep them motivated to participate the project for a longer period of time the following question was added to the Q-form:

- This is needed to keep me enthusiastic about this project for a longer period of time:
  With Birmese translation:
  

Unfortunately the translation seemed to be incorrect, since it asks people how long they think the project will take. People that answered this question wrote down the following: 'We need a long time to improve the water', 'I think it will take 3 years' or 'we should do it all our lives'.

Nobody mentioned something about the importance of getting feedback, if it would get more interesting it you can collect points or maybe get an upgrade when you have participated for a longer time. But even though they did not mentioned this by themselves, it would still be interesting to look at these possibilities as well as making it part of the education system for example.

4. DISCUSSION

This chapter will discuss the chosen method and the validity of the outcomes.

4.1. LANGUAGE AND CULTURE BARRIER

During the project there have been some challenges related to the difference in culture and the language barrier. The English level on many High Schools was (very) low, which made it sometimes difficult to explain the project in a way that all participants were able to understand it. To clarify the project the best as possible, a Power-point presentation was used which contained many pictures to visualise the project. Unfortunately it was not always possible to use this Power-point presentation, because not all schools had a projector available. The explanation was therefore not exactly the same at every school/university.

The English level varied a lot between the school pupils and the students. The English level at High Schools was significantly lower than at Universities and the level also seemed lower in Mandalay than in Yangon. At the PES Monastery School there was a big difference in English level between the students, since they were learning English here. Some attended the school already for several years, while others only started for some months ago. Sometimes it was difficult to say whether participants didn't understand the project or that they had a hard time writing down their own opinion and thoughts in English. Luckily at most of the schools there was always someone available to translate to Burmese.

For many school pupils the reading and understanding of English seemed okay, but formulating their opinion and explanation of their choice in English at the open questions on the form, was often very difficult for them. Therefore, at some schools the children were allowed to explain their answers in Burmese. Unfortunately it was not possible to get all these answers translated to English, but with help of a Burmese girl, sample-wise some of the answers were checked to see if the children had understood the questions. This sample-wise testing of the group gave more information about if en how good the group had understood the explanation, but it did not tell so much about the individual understanding of the participants. Therefore Q-sorts were only made invalid when participants had made mistakes by completing the form or when information was missing, but not so often because of an unclear explanation. It had been better to do translate each single comment, but unfortunately it was difficult to find people who had time to do this.

At the first two schools the Q-form was only available in English, but because of the low English level, a Burmese translation was added as soon as possible to the existing form. Unfortunately the last one of the open questions was translated incorrectly which made it impossible to use the answers on this question later on in the project. Luckily, the rest of the translation worked out to be correct.

After involving the children of grade 6 and 7 (age 11 to 13) participate in filling in the Q-form on the first school, it was decided that these children actually were too young to understand and master the project. Because of the good explanation of Nein Thandar Ko and because they seemed to have understood most of the project, their results were not made invalid. But it was decided to not spent more time on interviewing anymore students of that age afterwards.

Besides the language difficulties, it was also interesting to see that many pupils and students in Myanmar are very shy and only a few students dared to ask questions. This is very typical for the children in Myanmar. The education system does not focus so much on learning the children to be critical about what they learn and they are not pushed to explore new things. Normally they just copy what the teacher teaches them and they are not very used to doubt what they get told and ask questions. It seemed that the children in Yangon were less shy and asking more questions than the children in Mandalay, but overall it was difficult to find out if they were honest with you or just giving the most social accepted answer when you asked them if they understood everything.

4.2. Interview with use of Q-form

To check whether the 12 statements that were part of the Q-set covered all possible motivations for people to participate, one open question asked the participants if they missed any statements. In total 4 new reasons to participate/missing statements were found (see chapter 3.1 Reasons to participate), which means that the Q-set was not extended enough to cover all possible motivations. What would have happened to the way people sorted the statements if these 4 statements were added to the 12 existing statements? Would this have caused different solutions? For future research this must be taken into account.

For Q methodology the way how people sort the statements is crucial. In the most optimal way, people start making a course selection by sorting the statements between disagree, neutral and agree. After this they can continue by doing a finer-grained ranking. Even though the participants got explained about how they could start sorting the statements, not everyone did this in the correct way. Some participants filled in several numbers in one box (which made their Q-form invalid) or they already started filling in the numbers of the statements during the explanation. It would have been the best to do the selection one by one with the participants, but this would be impossible with regard to the available time and the amount of people that got interviewed. Using a web-based system, like provided by q-assessor.com (Q-assessor, 2010), would have been a nice solution, because a system like this leads the participants through the different steps in the best way. A digital form would also have decreased the processing time, since by using paper forms all data had to be transferred to a computer before it was able to use it. This was a very time-consuming process. Unfortunately the internet connection and access to electricity in Myanmar was not good enough to rely on and therefore paper forms were chosen over a digital form.

4.3. Validity of the analysis

During this project a total of 358 valid Q-sort responses was collected, but the program PQ Method was not able to process more than 299 Q-sorts at a time. Therefore it was decided to split up the total of 358 in 4 different groups; high school pupils in Mandalay, high school pupils in Yangon, university students in Mandalay and university students in Yangon. Of every group an analysis of the Q-sorts was made to get a better understanding of the different viewpoints within one group, to compare these outcomes with other groups afterwards.

Probably the method of first splitting up in groups, analyse and then compare is less objective then when all Q-sorts were analysed together. If the Q-sorts got analysed and compared by the PQ Method, no human interpretation is needed until the result are given by the programme.

4.4. Q-methodology

Since the maximum amount of Q-sorts that PQ Method could process was reached during this research, the following question raised: *was Q-methodology really the best method to use for this project and why was there this limit?*

Q-methodology was chosen because it is particularly useful to understand and describe different viewpoints on one topic and it forces people to make choices and compare different statements, which made this method especially well suitable for non-western countries like Myanmar (See chapter 2.2). After collecting all these perspectives, the Q methodology looks for correlations to reduce the many individual viewpoints on the topic down to a few motivation factors, by doing a factor analysis. These motivation factors represent a group of people who are sharing the same viewpoint and a certain way of thinking.

However, Q-methodology research emphasizes the qualitative *how* and *why* people think the way they do; the methodology does not count *how many* people think a certain way. The goal of Q-methodology is, first and foremost, to uncover different patterns of thought (not their numerical distribution among the larger

population). This is also the reason that Q-methodology typically is used for small sample sizes. The results of these studies are less influenced by low response rates compared with the results of survey studies. (Q-methodology, Definition and Application in Health Care Informatics, 1997)

To be able to check whether q-methodology actually fitted this project, one should look again to the formulated research question of this project: Do the motivational factors differ for different groups within the society of Myanmar?

It seems that this research question is not defined clear enough, since it is possible to answer this question in two different ways:

1. Uncover the different viewpoints that belong to one group and compare these viewpoints with the viewpoints that belong to another group.
2. Investigate which viewpoints represent one group the best by checking if most people belong to that viewpoint, and compare these viewpoints with the viewpoints that belong to another group.

Q-methodology seems to fit the best to answer number 1 and that is also how this method is used within this research. For answering number 2, a normal R factor analysis had probably also been possible to use.

5. Conclusions and Recommendations

5.1. Conclusion

By making use of Q methodology a better understanding of the underlying motivation for citizens in Myanmar to participate in participatory monitoring was visualised. One must realise that this project has focussed on participatory monitoring projects that are related to monitoring water quality. This means that not all conclusions can be related to reasons for people to join participatory monitoring projects in general. However, the increased understanding in the viewpoints of Myanmar citizens on projects like this, can help by understanding how they will face other comparable projects.

There are many different motivations for people to participate in participatory monitoring projects. In this project 16 different reasons for people in Myanmar to participate a project about water quality were found of which some clearly were more popular than others. Without making any distinction in age, background or interest, some general conclusions can be made.

The two main reasons for people in Myanmar to participate are (1) because they are interested in the topic and/or the science related to this, and (2) because they feel it as their duty to care about their country and its resources because they are Myanmar citizens. Especially the second reason is an interesting one since it meets very much the perspective of F-structured cultures in which the collective and pleasing the group are important. A explanation given by a participant that shows this very clearly is the following: *"I think that I have the duty to care for water as a resource since I am a citizen of Myanmar. We need to help the scientists doing research, without expecting any profits or anything in return. As a citizen I should do something good for my country".* This argument to participate has rather to do with meeting the social expectations within the society, than participating because of own interest, which is a more individualistic perspective on motivation. A third reason (3) for people to participate is because they understand that a better water quality could directly have a positive impact their lives. As stated by one of the participants: *"I think it is very important for my life. If the water is not pure, we cannot drink and we cannot use it. We need pure water to have good health. We need to maintain water resources for the next generation."* Understanding that there is a direct relation between peoples life and the water quality could be a very strong reason for people to participate this project. Nevertheless this reason to participate seems to be of lesser importance than the two reasons mentioned above. It should be questioned if people already were aware of the link between water quality and their health before they got introduced with the project, or that the explanation of the project made them realise this. When looking at the way most people in Myanmar use water and treat waste, it is more likely that the explanation prior to filling in the Q-sort influenced their way of thinking. However, this was still the third most chosen reason to participate, so the effect of explaining the importance of the research topic to make people more aware and enthusiastic about it, must not be underestimated.

The reasons that were chosen the least were (1) about receiving any kind of profit like receiving a certificate and/or payment and (2) if friend also would participate. In a poor country like Myanmar, one might expect that receiving some payment would stimulate people to participate. Nevertheless this argument is in contrast with the fact that many see it as their duty to participate. It is a moral obligation or responsibility for which they don't want any money or certificate. Also those that want to participate because they are interested in the topic are rather more interested in obtaining new knowledge than in receiving any certificate or payment. For most participants the choice of joining the research project is in the first place not influenced by what people around them do and decide, but they make the choice by themselves.

Besides the general conclusion about motivation factors, some differences can also be found looking to differences in age, geographical location and interest of the participants.

Young people (age 11-12) are, compared to older people, quite optimistic and eager to learn mostly because they think the project sounds fun to do. This is clearly different from older pupils and students, because when these people have an interest for science, they also want to access the data and often they also see it as their job to participate, while the younger pupils do not mention this as one of their motivations to participate. Another difference related to age is whether the participants are negative or neutral about receiving payment and/or a certificate. The older the pupils and students get, and the closer they are to starting to work, the more interested they are in receiving money or a certificate in return for participating the project. This is understandable since the older these people get, the more independent and self-sufficient they have to become. But still, receiving payment is not a favourable reason to participate and most of the times it was sorted negative or neutral by the participants.

When comparing people from different geographical locations, in this research project a comparison between people from Mandalay (Central Myanmar) and Yangon (Southern Myanmar) is made, it is difficult to see any clear differences in motivation. The only, not very clear difference is the way people value receiving payment in return for participating the project. In Mandalay, both the pupils and the students were strongly negative about receiving money, while in Yangon some students had a more neutral view on this. This could be explained by the impression that people from Yangon, the former capital, are a bit more business oriented and they have a wider view on the world and opportunities in life than people from Mandalay, which on the other hand are a bit more traditional. But except of this, there are no clear differences visible.

No additional differences in motivation are found for people that have different education levels, than what already was found for people of different ages. This was not surprising since education level increases by age. To see if education level influences the way people get motivated to participate in participatory monitoring, further research is needed in which the age of the participants group is kept constant but they do have different education levels.

Instead of education level, the interest of people seemed to be of much greater influence on their motivation to participate. Students that chose a study in the field related to water quality were often mostly interested in participating to improve their scientific skills and because they understood the impact of better water quality on their and others lives. Other students are more willing to participate, not because they are very interested in the topic, but more because they feel the duty to do so.

5.2. RECOMMENDATIONS

The overall view is that people in Myanmar are open towards joining projects like this. Many young people seemed interested in the concept of participatory monitoring, since it is a new method for them of collecting information for scientific purpose which also clearly involves normal people like them. The implementation participatory monitoring does not need to cost a lot, since most citizens add little value to receiving payment or certificates in return for collecting measurements for the project. When there is enough attention for the social importance of the research for which participatory monitoring will be used and the 'duty of being a citizen', must it be possible to find many volunteers that are willing to participate.

When promoting projects that make use of participatory monitoring in Myanmar, the following things should be taken into account:

- Since the mobile smart phone has only lately made its entrance to Myanmar, many users are unknown with all the possibilities that mobile smart phones can offer. Many of the older people use their phone mainly for calling while the younger generation experiments with different applications and other options. This should be taken into account when designing a working application for participatory monitoring in Myanmar. It should not only be easy to use, but while promoting the research,

researchers must also realise that some of the citizens have never installed and used an application before.

- Citizens, that in the first place are not very interested in the research topic, might join the project eventually if they feel needed or feel enough social pressure. Because of the F-structured culture, meeting the social expectations is more important in a country like Myanmar.
- The application and instructions must be available in Burmese. Many people are not familiar with doing research tests or collecting data, so they need clear instruction in a language they understand. The English level of most citizens is too low to only make the instructions available in English.
- People that are interested in the research topic often want to participate to improve their research skills and to access the data that is collected. To keep these people enthusiastic and motivated for a longer period of time, it is important to invest in feedback and a learning process during their involvement in the project.

For future research projects about participatory monitoring it would be interesting to investigate more on methods to make participatory monitoring part of the standard education system at governmental and private schools. Many students mentioned the shortage of practical assignments at school and they were very interested in further improving their scientific skills. It might be interesting to see what opportunities and possibilities the combination of participatory monitoring with the existing education system gives. This research has mostly focussed on the younger generations from the big cities, age 11-25, and therefore it would also be interesting to extend the research by interviewing more adults and people that live on the countryside.

Since this project has focussed on participatory monitoring projects that are related to monitoring water quality, the outcomes are not directly applicable on all participatory monitoring projects in general. Although the results contribute to a better understanding of the viewpoints of Myanmar citizens on project like this, it would be interesting to do more research about how they would face other projects. What other projects would be suitable for use of participatory monitoring? What makes one project better fit than other projects? Of course not all tests can be done by people that have no scientific background at all. What are limitations in difficulty and necessary equipment to make projects still fit participatory monitoring?

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PICTURES AND FIGURES

Figure 1, Household access to ICTs and ICT connections, Mobile phones, internet, and gender in Myanmar (page 7) accessed on 3/12/2017 from *https://www.gsma.com/mobilefordevelopment/wp-content/uploads/2016/02/Mobile-phones-internet-and-gender-in-Myanmar.pdf*

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Figure 3, Steps within the Q methodology, accessed on 29/11/2017 from https://peerj.com/articles/2522/

APPENDIX 1: Q-FORM

(page 1/3)

Participatory Monitoring Form

ပူးပေါင်းပါဝင်စစ်ဆေးမှုပြုလုပ်ပေးရန်ပုံစံ

Date (dd / mm / yyyyy) ရက်စွဲ (နေ့ / လ /နှစ်)	
Gender လိင်	Male / Female ယောကျ်ား / မိန်းမ
Address နေရပ်လိပ်စာ	
City မြို့	
Age အသက်	

Education Level ပညာအရည်အချင်း	
Class အတန်း	
Favourite Course ကြိုက်နှစ်သက်သော အတန်း	

Father's Job ဖခင်အလုပ်အကိုင်	
Mother's Job မိခင်အလုပ်အကိုင်	

Do you have an Android Smart phone? လက်ကိုင်ဖုန်းရှိလား?	Yes / No ရှိသည် / မရှိပါ

What do I want to be when I grow up? အသက်ကြီးလာလျှင်ဘာဖြစ်ချင်ပါသလဲ?	
I understand what participatory monitoring is about ပူးပေါင်းပါဝင်စစ်ဆေးမှုပြုလုပ်ပေးရန်	
Yes / No , because နားလည်ပါသည် / နားမလည်ပါ အဘယ်ကြောင့်ဆိုသော်	

Place the numbers in the right box. ပေးထားသော အကွက်ထဲတွင် နံပါတ်များထည့်ပေးပါ

Strongly Disagree ပြင်းထန်စွာသဘောမတူပါ (--)	Disagree သဘောမတူပါ (-)	Neutral ကြားနေ (0)	Agree သဘောတူပါသည် (+)	Strongly Agree ပြင်းထန်စွာသဘောတူပါသည် (++)

I would participate in this project ...

ဒီစီမံကိန်းတွင်ပါဝင်ချင်ပါသည်

1. ... because I think it will make a difference
   ကွဲပြားခြားနားမည်ဟု ထင်သောကြောင့် ပါဝင်ချင်ပါသည်
2. ... to get a certificate of participation
   ပူးပေါင်းပါဝင်ပေးခြင်းအတွက် အသိအမှတ်ပြုလက်မှတ်ရရှိရန်
3. ... to develop my scientific research skills
   သိပ္ပံဆိုင်ရာ သုတေသနစွမ်းရည်များတိုးတက်ရန်
4. ... because success of this project depends on citizen science like me
   ဒီစီမံကိန်း၏ အောင်မြင်မှုသည် ကျွန်တော်တို့နိုင်ငံသားများ၏ သိပ္ပံနည်းပညာပေါ်တွင် မူမူတည်နေသောကြောင့် ပါဝင်ချင်ပါသည်
5. ... If I could access the data collected
   အချက်အလက်များစုဆောင်းရရှိနိုင်သောကြောင့် ပါဝင်ချင်ပါသည်
6. ... because a better water quality would directly have a positive impact on my life
   အဘယ်ကြောင့်ဆုသော် ပိုမိုကောင်းမွန်သော ရေအမျိုးအစားတွက် ပိုမိုတိုး တက်သော အကျိုးသက်ရောက်မှု ရရှိနိုင်သောကြောင့် ပါဝင်ချင်ပါသည်
7. ... because it is my job to care for water as a resource
   အဘယ်ကြောင့်ဆိုသော် ရေအရင်းအမြစ်များ ထိန်းသိမ်းစောင့်ရှောက်ရန် တာဝန်ဖြစ်သောကြောင့် ပါဝင်ချင်ပါသည်
8. ...even though I'm not a trained scientist.
   ကျွမ်းကျင်ပညာရှင် မဟုတ်သော်လည်း ပါဝင်ချင်ပါသည်
9. ...If I receive payment for my measurements.
   ဆောင်ရွက်လေ့လာပေးမှုအတွက် ငွေပေးချေမည်ဆိုလျှင်လည်း ပါဝင်ချင်ပါသည်
10. ...because citizen science sounds fun to me.
    နိုင်ငံသားဆိုင်ရာ သိပ္ပံနည်းပညာတစ်ရပ်ဟု ထင်ရသောကြောင့် ပါဝင်ချင်ပါသည်
11. ...If my friends would
    သူငယ်ချင်းများပါဝင်လျှင်လည်း ပါဝင်ချင်ပါသည်
12. ... because I understand what participatory monitoring is all about.
    ပူးပေါင်းပါဝင်စစ်ဆေးမှုအားလုံးကို နားလည်နေသောကြောင့် ပါဝင်ချင်ပါသည်

I sorted statements ... the highest (++) because: ပြစုခဲ့သော အကြောင်းအရာများ ... အကောင်းဆုံး (+ +) တွေကတော့
I sorted statements ... the lowest (--) because: ပြစုခဲ့သော အကြောင်းအရာများ .... အဆိုးဆုံး (--) တွေကတော့
I think an important statement is missing: အရေးကြီးသော အကြောင်းအရာတစ်ခုလိုအပ်နေသေးတယ်လို့ထင်မိပါသည်
Yes / No, statement(s) ဟုတ်ပါသည် / မဟုတ်ပါ , အကြောင်းအရာကတော့
This is needed to keep me enthusiastic about this project for a longer period of time: ဒီစီမံကိန်းကိုစိတ်ပါဝင်စားစွာလုပ်ဖို့ဆိုလျှင် အချိန်ကြာမြင့်စွာလိုအပ်ပါလိမ့်မည်

APPENDIX 2: RELIABILITY OF THE RESPONSES

Reliability of the outcome

Some of the interviews are not taken into account because they had an invalid outcome. Below is explained why these interviews are seen as invalid for this research. In total 52 out of 410 Q-sorts was stated invalid, which is about 13% of the total amount of Q-sorts that was filled in.

S6MV_1	This student did not understand the form
S6FV_6	Wrong numbers were filled in/ the form was not completed
S6MV_16	Wrong numbers were filled in/ the form was not completed
S8MV_42	This student did not understand the form
S8MV_56	This student did not understand the form
S8FV_68	Wrong numbers were filled in/ the form was not completed
S8FV_73	Wrong numbers were filled in/ the form was not completed
S8MV_76	Wrong numbers were filled in/ the form was not completed
S9FV_110	Wrong numbers were filled in/ the form was not completed
UBMV_121	Wrong numbers were filled in/ the form was not completed
S10FV_125	This student did not understand the form
AFV_127	Wrong numbers were filled in/ the form was not completed
UBFV_128	This student did not understand the form
UBFV_139	Wrong numbers were filled in/ the form was not completed
UBFV_143	Wrong numbers were filled in/ the form was not completed
S11FV_151	This student did not understand and wrong numbers were filled in
S11FV_152	This student did not understand and wrong numbers were filled in
UBFV_153	Wrong numbers were filled in/ the form was not completed
AFV_157	Wrong numbers were filled in/ the form was not completed
UBMV_160	This student did not understand and a strange explanation was given
UBMV_161	Wrong numbers were filled in/ the form was not completed
AMV_162	Wrong numbers were filled in/ the form was not completed
UBMV_164	This student did not understand the form
UBFV_173	Wrong numbers were filled in/ the form was not completed
UBFV_187	This student did not understand the project
UBFV_194	This student did not understand all the statements
S11MV200	This person did not understand the project
S10MVM201	Wrong numbers were filled in/ the form was not completed
AMV_210	This person did not understand the form
UBFV_214	This student did not understand the project
UMFV_220	Wrong numbers were filled in/ the form was not completed
S10FV222	This person did not understand the project
S10FV225	Wrong numbers were filled in/ the form was not completed
S20FV227	Wrong numbers were filled in/ the form was not completed
S10FV232	This person did not given any explanation, while all her classmates did
S10FV246	This person did not given any explanation, while all her classmates did
S10FV247	This person did not given any explanation, while all her classmates did
S10FV250	Wrong numbers were filled in/ the form was not completed
S10FV251	Wrong numbers were filled in/ the form was not completed
S10FV274	Wrong numbers were filled in/ the form was not completed
S10MV292	This person did not given any explanation, while all her classmates did
S10MV293	Wrong numbers were filled in/ the form was not completed

S10MV299	Wrong numbers were filled in/ the form was not completed
S10MV308	Wrong numbers were filled in/ the form was not completed
UMFY_314	Wrong numbers were filled in/ the form was not completed
S10FY353	Wrong numbers were filled in/ the form was not completed
S10MY368	Wrong numbers were filled in/ the form was not completed
S10MY372	Wrong numbers were filled in/ the form was not completed
UBFY_386	Wrong numbers were filled in/ the form was not completed
UBFY_404	Wrong numbers were filled in/ the form was not completed
UBFY_406	Wrong numbers were filled in/ the form was not completed

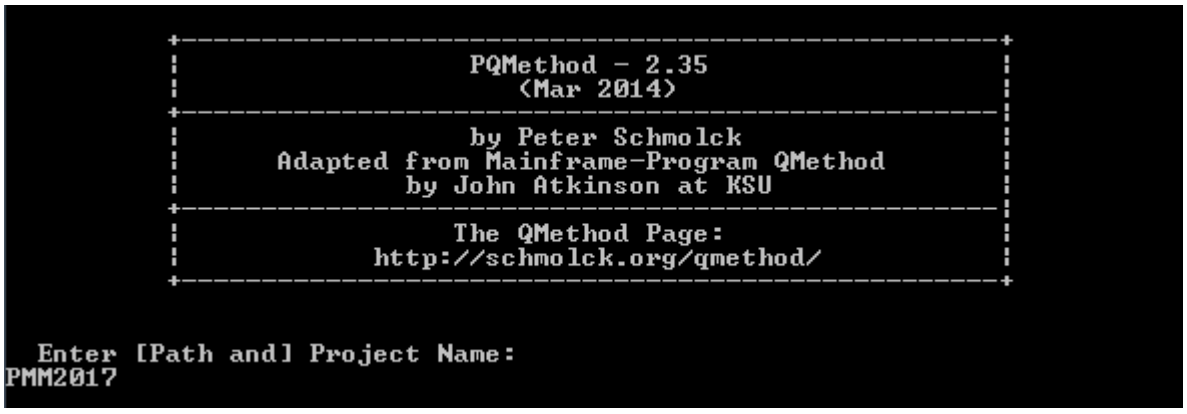
Of some interviews it is doubtful if the person understood the questions correctly. This can for example be seen by a confusing explanation or because students copy each other form. We can't say that their answers are wrong, because it is of course possible that they share the same thoughts. The following interview outcomes are doubt full:

S6MV_21	This student probably copied the form of S6MV_21
S7FV_31	This student probably copied the form of S7FV_30
S7MV_34	This student probably copied the form of S7MV_33
S8FV_44	This student gave a confusing explanation. It is not sure if she understood the question
S8FV_45	This student gave a confusing explanation. It is not sure if she understood the question
S8MV_52	This student probably copied the form of S8MV_51
S8FV_59	This student did not understand all statements
S8MV_60	This student did not understand all statements
S8MV_61	This student gave a confusing explanation. It is not sure if she understood the question
S8MV_80	This student probably copied the form of S8MV_79
S8MV_85	This student did not understand all statements
AMV_163	This student did not understand all statements
UBFV_170	This student did not understand all statements
UBFV_186	This student gave a confusing explanation. It is not sure if she understood the question
AMV_209	This student probably did not understand every statement
UBFV_213	This student probably did not understand every statement
S10FV241	This student probably did not understand every statement
S10MV297	This student probably did not understand every statement
S10MV298	This student probably did not understand every statement
S9FY_326	This student did not understand statement 1
S10MY356	This student did not understand statement 1
S10MY360	This student gave a confusing explanation for statement 9
S10MY373	This student gave a confusing explanation for statement 12

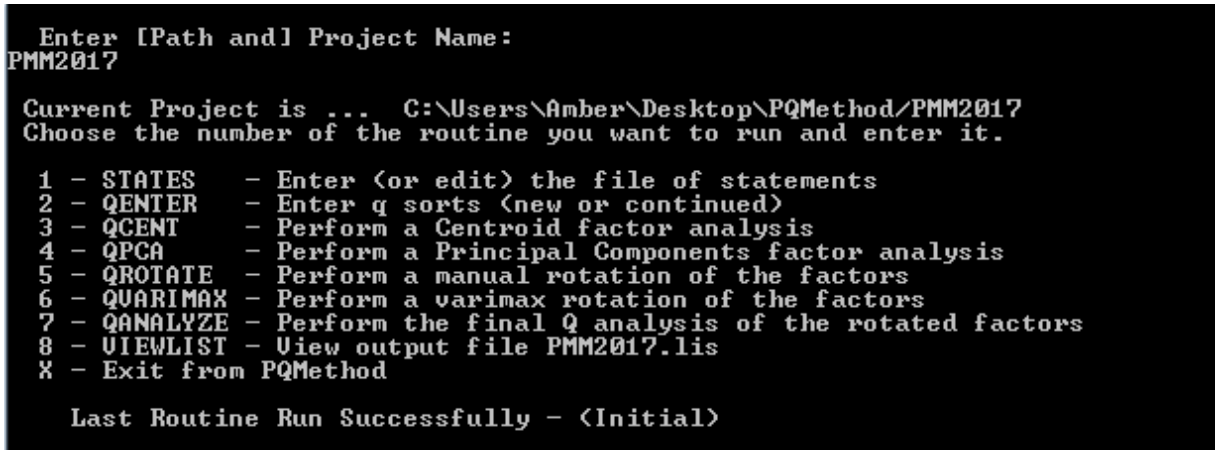
APPENDIX 3: USING PQ METHOD SOFTWARE

Start a new project

Define the title of the project: PMM2017 (Participatory Monitoring Myanmar 2017)

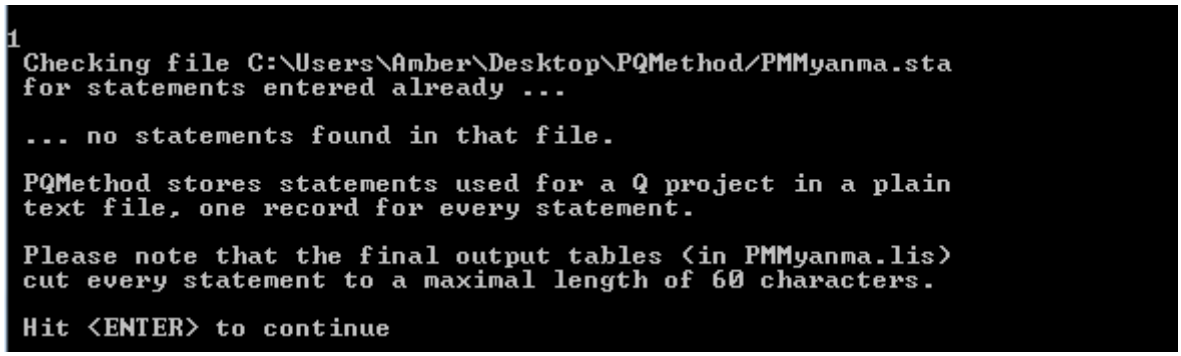


Chose to continue with one of the following steps (1-8).



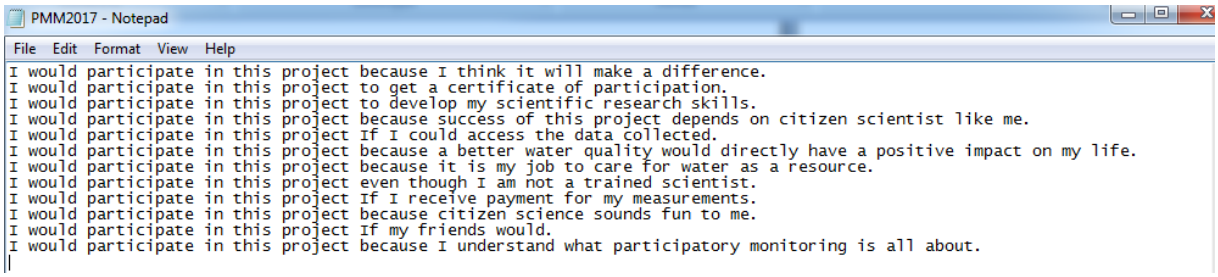
Step 1 - STATES - Define the statements

By pressing number 1 you will notice that the PQ-sort can't find any statements since the STA file is empty. By running a (new) project automatically a STA file is made. For this project the STA file needs to have the name PMM2017.sta.

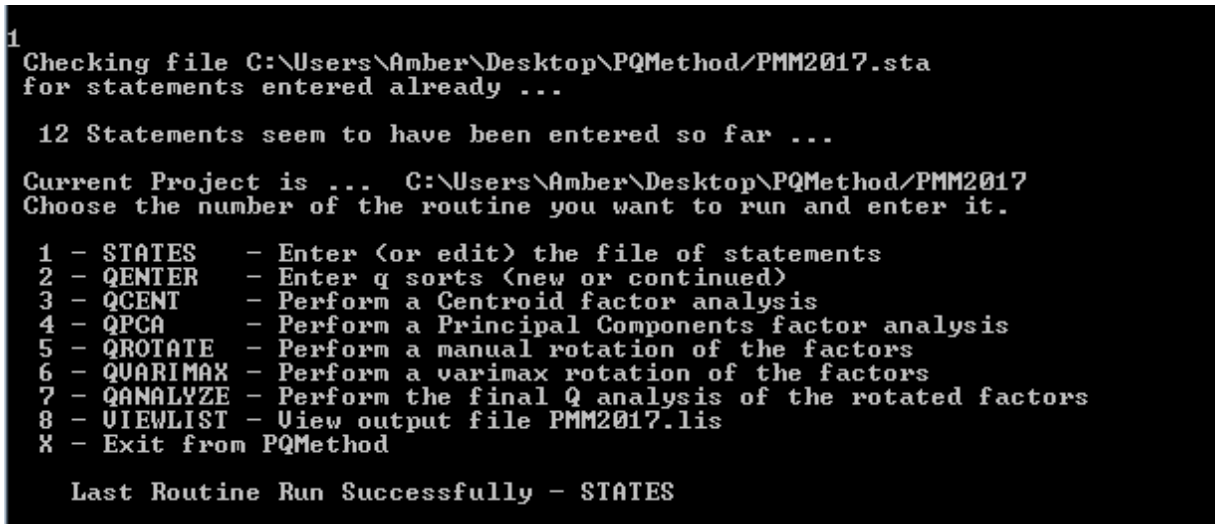


To make the Q-sort work you need to make the STA file yourself. This can be done by creating a notepad in which you write all statements. Make sure you write one statement per line and do not use numbers in front.

Make sure you safe the notepad file in the PQMethod map with the right name. In my case I had to take the following name: PMM2017

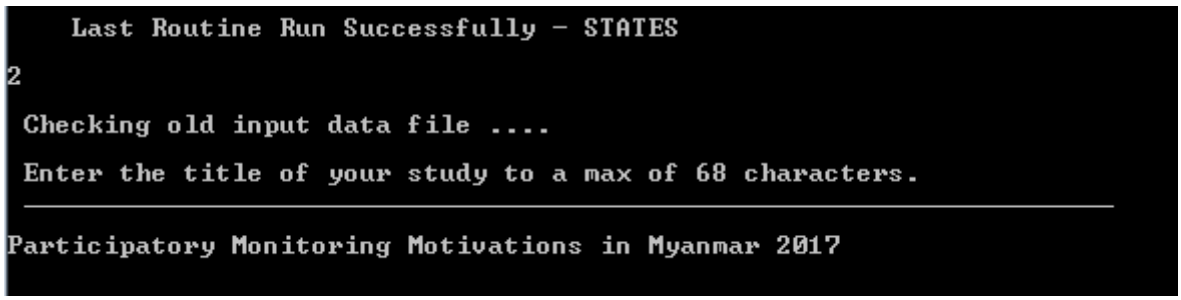


When the STA file is made you must restart the programme. Now by entering number 1 the programme show you that it found the number of statements that you filled in. In this case 12 statements are found, which is correct.

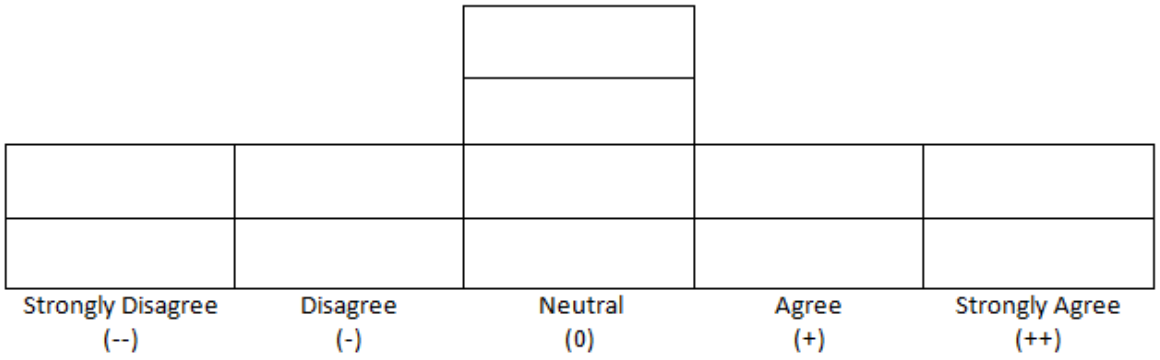


Step 2 (a) - QENTER - Define the Q sort

By pressing 2 you will be able to define the Q sort design, but first you have to enter the title of you study. I chose: Participatory Monitoring Motivations in Myanmar 2017



After defining the title of the project you are ready to create the design of the Q sort box. For this project the Q sort box looks like this:



This results in the following input in the Q sort programme:

```
Participatory Monitoring Motivations in Myanmar 2017

 How many q statements are there?
12

 Enter the leftmost column value (e.g. -5):
-2

 Enter the rightmost column value (e.g. 5):
2

 Enter the Number of Rows for each Column from -2 to  2.
  For Example:  2 3 3 4 4 4 3 3 2 :
2 2 4 2 2

 Ready to process another sort.
 Enter one of the following codes:

 A - to add a new sort
 C - to change a previous sort
 D - to delete a sort
 S - to show a previous sort
 Q - to query status of this study
 X - to exit QENTER (stop entering/changing sorts)
```

To check whether the sort was taken correctly you can press Q (to query status of this study. As you can see, no sorts are entered yet.

```
 Ready to process another sort.
 Enter one of the following codes:

 A - to add a new sort
 C - to change a previous sort
 D - to delete a sort
 S - to show a previous sort
 Q - to query status of this study
 X - to exit QENTER (stop entering/changing sorts)

Q

 Information on current study . . .

 Title of Study    --   Participatory Monitoring Motivations in Myanmar 20

 Column Range      --  -2   TO   2

 Depth of Columns --   2  2  4  2  2

 Sorts Entered     --    0

 Press <ENTER> to continue
```

Step 2 (b) - QENTER - Entering new sorts

The statements and the design of the Q sort are defined, therefore it is possible to fill in all different Q-sorts that were filled in during the interviews with pupils, students and adults. To enter these sorts choose 'A - to add a new sort'.

```
 A - to add a new sort
 C - to change a previous sort
 D - to delete a sort
 S - to show a previous sort
 Q - to query status of this study
 X - to exit QENTER (stop entering/changing sorts)

A

 Enter identification code for subject no.  1
 (A case label consisting of max. 8 characters)
S6MV_1

 Enter the Sort Values for Subject  1 S6MV_1

 Enter the Statement Numbers, Separated by Spaces,
   for Column -2:
10 8
 Enter the Statement Numbers, Separated by Spaces,
   for Column -1:
7 2
 Enter the Statement Numbers, Separated by Spaces,
   for Column  0:
11 12 9 6
 Enter the Statement Numbers, Separated by Spaces,
   for Column  1:
4 1
 Enter the Statement Numbers, Separated by Spaces,
   for Column  2:
5 3
                        -2   -1    0    1    2
                      ┌────┬────┬────┬────┬────┐
                      │ 10 │  7 │ 11 │  4 │  5 │
                      ├────┼────┼────┼────┼────┤
                      │  8 │  2 │ 12 │  1 │  3 │
                      └────┴────┴────┴────┴────┘
                                ┌────┐
                                │  9 │
                                ├────┤
                                │  6 │
                                └────┘
 SubjNo:  1  ID: S6MV_1

 The Sum is   0.00,  and the Mean is  0.00,  for Subject  1 S6MV_1
 The Sort is OK, Do You Want to Change It Anyway? (y/N):
N
 Do you want to enter another sort? (Y/n):
Y
```

It is very easy to change a sort and also if you make a mistake while filling in the Q-sort the program will tell you about the error and ask you to fill it in again.

When you are finished inserting all the Q-sorts in the program, you can ask for an overview by pressing 'Q - to query status of this study'. This is an easy way to check whether the program took all your Q-sorts and saved it correctly.

```
 Ready to process another sort.
 Enter one of the following codes:

 A - to add a new sort
 C - to change a previous sort
 D - to delete a sort
 S - to show a previous sort
 Q - to query status of this study
 X - to exit QENTER (stop entering/changing sorts)

q

 Information on current study . . .

 Title of Study   --   Participatory Monitoring Motivations in Myanmar 20

 Column Range     --  -2   TO   2

 Depth of Columns --   2  2  4  2  2

 Sorts Entered    --  299

 Press <ENTER> to continue
```

After step 1 and 2 you have to chose what kind of factor analysis you want to perform. Chose between step 3 or step 4, a centroid factor analysis or a prinicipal componant factor analysis.

Step 3 - QCENT - Perform a Centroid factor analysis

When you want to perform a Centroid factor analysis, choose '3 - QCENT'. PQ Method makes use of the 'Horst 5.5 Centroid factor analysis with iterative solutions for communalities instead of the method described in Brown (1980)'. Chose how many centroids you wish to extract, up till a maximum of 8. The amount of centroids you choose influences the average squared residual correlation that the program can find. When the average squared residual correlation gets below 0.02 the program will give an error.

Below is chosen to first see how many factors pass Horst's criterion, by pressing 0. This results in 2 factors as output and an average squared residual correlation of 0.072.

```
 Current Project is ...  C:\Users\Amber\Desktop\PQMethod/PMM2017
 Choose the number of the routine you want to run and enter it.

  1 - STATES   - Enter (or edit) the file of statements
  2 - QENTER   - Enter q sorts (new or continued)
  3 - QCENT    - Perform a Centroid factor analysis
  4 - QPCA     - Perform a Principal Components factor analysis
  5 - QROTATE  - Perform a manual rotation of the factors
  6 - QVARIMAX - Perform a varimax rotation of the factors
  7 - QANALYZE - Perform the final Q analysis of the rotated factors
  8 - VIEWLIST - View output file PMM2017.lis
  X - Exit from PQMethod

    Last Routine Run Successfully - QENTER

3
 Do you want to run the Horst 5.5 Centroid factor analysiswith iterative solutio
ns for communalities instead of the method described in Brown (1980) (y/N):
y

 How many Centroids do you wish to extract (max. 8)?
  Press <ENTER> if 3 is OK
 Or 0 if you at first wish to see how many factors pass Horst's criterion
0

 2 factors will be output to file C:\Users\Amber\Desktop\PQMethod/PMM2017.unr


Average squared residual correlation: 0.072

  Press <ENTER> to continue
```

Step 4 - QPCA - Perform a Principal Components factor analysis

Instead of a centroid factor analysis you can also choose to do the Principal Components factor analysis. When you choose number 4 the program will give an overview of all factors that are found, their eigenvalues, as. percentages and their cumulative percentages. PQ Method will always take 8 factors as output when doing a Principal Components factor analysis.

```
Current Project is ...  C:\Users\Amber\Desktop\PQMethod/PMM2017
Choose the number of the routine you want to run and enter it.

 1 - STATES   - Enter (or edit) the file of statements
 2 - QENTER   - Enter q sorts (new or continued)
 3 - QCENT    - Perform a Centroid factor analysis
 4 - QPCA     - Perform a Principal Components factor analysis
 5 - QROTATE  - Perform a manual rotation of the factors
 6 - QVARIMAX - Perform a varimax rotation of the factors
 7 - QANALYZE - Perform the final Q analysis of the rotated factors
 8 - VIEWLIST - View output file PMM2017.lis
 X - Exit from PQMethod

   Last Routine Run Successfully - QCENT

4
 Eigenvalues        As Percentages    Cumul. Percentages
 -----------        --------------    ------------------
   1 102.9461           34.4301             34.4301
   2  28.4092            9.5014             43.9315
   3  26.4045            8.8309             52.7625
   4  23.1982            7.7586             60.5211
   5  21.4122            7.1613             67.6823
   6  19.4490            6.5047             74.1870
   7  18.8614            6.3082             80.4952
   8  16.7940            5.6167             86.1119
   9  15.3247            5.1253             91.2372
  10  13.7096            4.5852             95.8224
  11  12.4911            4.1776            100.0000
  12   0.0001            0.0000            100.0000
 Press <ENTER> to continue


 8 factors will be output to file C:\Users\Amber\Desktop\PQMethod/PMM2017.unr
```

As you can see, for this high amount of Q-sorts 11 factors give an eigenvalues higher than 1.00. But since PQMethod is not able to take more than 8 factors as the output, the output is limited.

Although PQMethod normally extracts seven to eight factors to ensure enough variance in the factor, as a rule only 3 or 4 factors have any value. This can also be seen in the overview of eigenvalues of another project where mainly the first 3/4 factors are worth to further investigation:

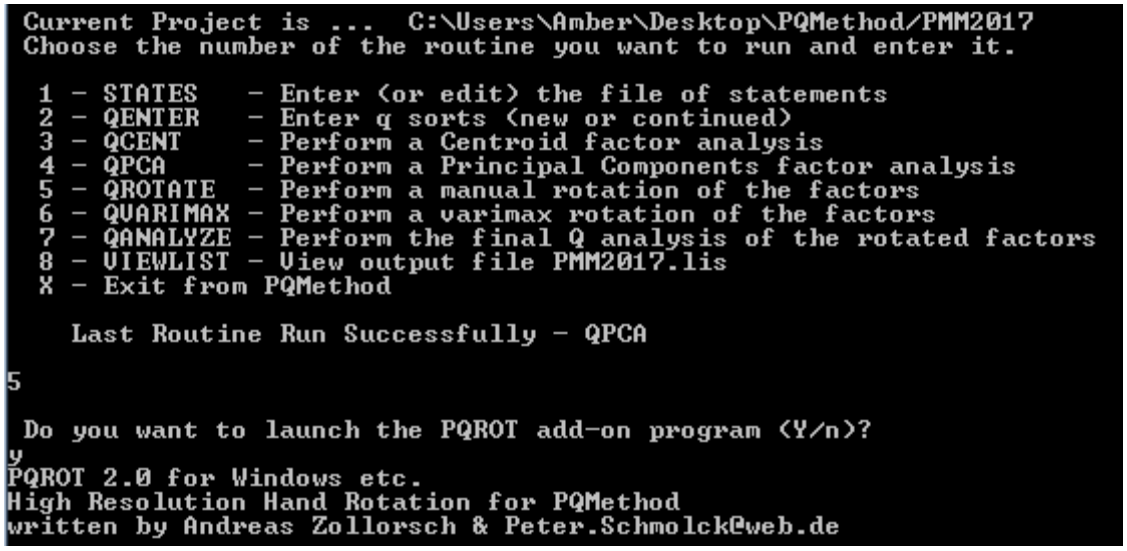
```
4
 Eigenvalues        As Percentages    Cumul. Percentages
 -----------        --------------    ------------------
   1  15.6883           36.4845             36.4845
   2   6.8151           15.8492             52.3337
   3   4.3016           10.0038             62.3375
   4   3.6768            8.5507             70.8882
   5   2.9799            6.9301             77.8183
   6   2.6487            6.1597             83.9780
   7   2.0416            4.7478             88.7258
   8   1.8130            4.2163             92.9420
   9   1.2062            2.8052             95.7472
  10   1.0459            2.4323             98.1795
  11   0.7828            1.8205            100.0000
  12   0.0000            0.0000            100.0000
 Press <ENTER> to continue


 8 factors will be output to file C:\Users\Amber\Desktop\PQMethod/PM_UY.unr
```

After step 3 or 4 you have to chose what kind of factor rotation you want to perform. You have the choice between step 5 (manual rotation) or step 6 (Varimax rotation).

VARIMAX and/or Hand rotation
After doing a factor analysis, the following methods of factor rotation are possible:
- Apply only a manual rotation
- Apply only a VARIMAX rotation
- Apply first a VARIMAX rotation and additional manual rotation
(- Applying manual rotation before VARIMAX is not possible, since the VARIMAX will always overrule the manual rotation)

Step 5 - QROTATE - Perform a manual rotation of the factors

When you chose to perform a manual rotation you have to chose to launch the PQROT add-on program. Within this new program you first chose how many factors you want to use and you can rotate them by hand. It is also possible to manual flag additional Q-sorts.



Step 6 - QVARIMAX - Perform a varimax rotation of the factors

When you chose to perform a VARIMAX rotation you are asked how many factors you want to rotate. The amount of factors you chose will also be the output of the rotation. After the VARIMAX rotation additional manual rotation is always possible. To do this, again you use the PQROT add-on program.

```
 Current Project is ...  C:\Users\Amber\Desktop\PQMethod/PMM2017
 Choose the number of the routine you want to run and enter it.

  1 - STATES    - Enter (or edit) the file of statements
  2 - QENTER    - Enter q sorts (new or continued)
  3 - QCENT     - Perform a Centroid factor analysis
  4 - QPCA      - Perform a Principal Components factor analysis
  5 - QROTATE   - Perform a manual rotation of the factors
  6 - QVARIMAX  - Perform a varimax rotation of the factors
  7 - QANALYZE  - Perform the final Q analysis of the rotated factors
  8 - VIEWLIST  - View output file PMM2017.lis
  X - Exit from PQMethod

     Last Routine Run Successfully - QROTATE

6
 Performing VARIMAX rotation...
 How many factors do you wish to rotate?
 (Press <ENTER> to rotate all  8 unrotated factors)
4
 4 Varimax factors will be output to file C:\Users\Amber\Desktop\PQMethod/PMM201
7.rot


 Next, varimax factors will be displayed for additional rotations [optional]
 and for adding flags [required] - Do you wish to use the
 PQROT add-on program for that (Y/n)?
y
PQROT 2.0 for Windows etc.
High Resolution Hand Rotation for PQMethod
written by Andreas Zollorsch & Peter.Schmolck@web.de
```

When you are satisfied with the rotation of the factors it is important to safe the rotations before leaving the PQROT program and return back to the PQMethod program. If you forget to do this, all your rotations disappear and you have to rotate again.

Step 7 - QANALYZE - Perform the final Q analysis of the rotated factors

After the factor rotation choose 7 to perform the final Q analysis. The program will ask you if you want to change the number of lines/page, but choose N (no).

```
  1 - STATES    - Enter (or edit) the file of statements
  2 - QENTER    - Enter q sorts (new or continued)
  3 - QCENT     - Perform a Centroid factor analysis
  4 - QPCA      - Perform a Principal Components factor analysis
  5 - QROTATE   - Perform a manual rotation of the factors
  6 - QVARIMAX  - Perform a varimax rotation of the factors
  7 - QANALYZE  - Perform the final Q analysis of the rotated factors
  8 - VIEWLIST  - View output file PMM2017.lis
  X - Exit from PQMethod

     Last Routine Run Successfully - QVARIMAX/QROTATE

7

  PQMethod is going to write the report into the file
          C:\Users\Amber\Desktop\PQMethod/PMM2017.lis
  with max. 132 chars/line and          52  lines/page
  Do you want to change no. lines/page? (y/N):
n
```

Step 8 - VIEWLIST - View output file <name>.lis

You have now finished all steps of PQ Method. By choosing 8 a .lis-file is made which you can find in you documents. If your computer is not able to open a .lis-file, install a program like notepad2. When you open this file, you get a clear and extended overview of the correlation between all Q-sorts, the un-rotated and rotated factor matrix, the factor loadings and the different factors and statements.

Now you are finished with using the PQMethod program and you can start analysing your results.

APPENDIX 4: ANALYSIS OF GROUP A-E

A. SCHOOL PUPILS FROM THE AREA OF MANDALAY (PM_SM)

PCA with VARIMAX rotation; 4 factors as output

General findings:
- Factor 1 represents 26% of the total pupils. Factor 2 represents 14%, factor 3 represents 8% and factor 4 represents 11%.
- 75 out of 189 persons (40%) is not placed within one of the four factors. The viewpoints of these people for example rely as much on one factor as on another factor which makes it difficult to place them.
- All factors sorted statement 9, I would participate in this project if I receive payment for my measurements, at strongly disagree. This means that statement 9 is a consensus statement for the school pupils from the area of Mandalay.

Factor 1 - School pupils Mandalay (50 of 189 persons = 26%)			
Position	No.	Statement	Z-SCORES
2	6	I would participate in this project because a better water quality would directly have a positive impact on my life.	1.646
2	7	I would participate in this project because it is my job to care for water as a resource.	1.293
1	4	I would participate in this project because success of this project depends on citizen science like me.	0.626
1	8	I would participate in this project even though I am not a trained scientist	0.428
0	5	I would participate in this project If I could access the data collected.	0.366
0	10	I would participate in this project because citizen science sounds fun to me.	0.076
0	12	I would participate in this project because I understand what participatory monitoring is all about.	0.069
0	1	I would participate in this project because I think it will make a difference.	-0.101
-1	3	I would participate in this project to develop my scientific skills	-0.283
-1	11	I would participate in this project If my friends would.	-1.082
-2	2	I would participate in this project to get a certificate of participation.	-1.402
-2	9	I would participate in this project If I receive payment for my measurements.	-1.636

Factor 1: The school pupils that belong to factor 1 are mainly the older children from grade 9 and 10 (age 14-18). They understand that a better water quality will impact their lives positively and they already feel a certain responsibility for the situation in their country and want to change it. They know they are the future generation and they also feel needed for the project to make sure it will become a success.
Pupil (S9MV_89) explains why the water quality is important: *"I think it is very important for my life and my country. If the water is not pure, we cannot drink and we cannot use it. So I want to participate this project."*
And (S10FV_129) is a clear example of a pupil that feels the responsibility and wish to improve the current situation: *"I chose statement 7, because water is very important, so I need to take care of my country water. It is my job and our job. I chose statement 6, because I think it can improve our country."*
The children that belong to this factor are clearly not interested in any kind of profit like a certificate or money in return for their work. As stated by (S8FV_72): *"I don't want money. I don't want certificate. They are not important. They are not help saving the world."*

Factor 2 - School pupils Mandalay (27 of 189 persons =14%)			
Position	No.	Statement	Z-SCORES
2	3	I would participate in this project to develop my scientific skills	1.565
2	6	I would participate in this project because a better water quality would directly have a positive impact on my life.	1.233
1	1	I would participate in this project because I think it will make a difference.	1.022
1	10	I would participate in this project because citizen science sounds fun to me.	0.819
0	4	I would participate in this project because success of this project depends on citizen science like me.	0.069
0	12	I would participate in this project because I understand what participatory monitoring is all about.	-0.099
0	8	I would participate in this project even though I am not a trained scientist	-0.256
0	11	I would participate in this project If my friends would.	-0.272
-1	5	I would participate in this project If I could access the data collected.	-0.355
-1	7	I would participate in this project because it is my job to care for water as a resource.	-0.740
-2	2	I would participate in this project to get a certificate of participation.	-1.376
-2	9	I would participate in this project If I receive payment for my measurements.	-1.610

Factor 2: A surprising big part of the pupils that belong to factor 2 is relative young (grade 6, age 11-12). This group seems to be interested in science, since they sorted statement 3 the highest. On the other side they are not interested in getting access to the collected data. This can be explained by the low age of these children. They are very eager to learn new thing, but they don't understand yet why entering data could be interesting for them and what they could do with it. Some short explanations are: *"I like science"*, *"I think it is fun"* and *"I want to know about the animals under the water"*. This last statement belongs to a child that also got explained about measuring the water quality by using 'bio monitoring' for which you need to count small insects in a water sample. Different than factor 1, these children don't see it as their job to care for water, they would rather participate because it sounds fun to them.

Factor 3 - School pupils Mandalay (15 of 189 persons = 8%)			
Position	No.	Statement	Z-SCORES
2	3	I would participate in this project to develop my scientific skills	1.611
2	7	I would participate in this project because it is my job to care for water as a resource.	1.126
1	4	I would participate in this project because success of this project depends on citizen science like me.	0.673
1	2	I would participate in this project to get a certificate of participation.	0.591
0	1	I would participate in this project because I think it will make a difference.	0.480
0	6	I would participate in this project because a better water quality would directly have a positive impact on my life.	0.292
0	5	I would participate in this project If I could access the data collected.	0.257
0	11	I would participate in this project If my friends would.	-0.482
-1	12	I would participate in this project because I understand what participatory monitoring is all about.	-0.572
-1	10	I would participate in this project because citizen science sounds fun to me.	-1.092
-2	8	I would participate in this project even though I am not a trained scientist	-1.284
-2	9	I would participate in this project If I receive payment for my measurements.	-1.597

Factor 3: The children that belong to this factor are mainly a bit older, grade 10 (age 16-17). Just like the pupils that belong to factor 2, these children also are interested in improving their scientific skills, which probably means that they have an interest for science. Besides, they also feel a certain responsibility, like the pupils that belong to factor 1, since they believe it is their job to care for water as a resource. So factor 3 seems to be a mix of both factor 1 and 2, but there is one interesting difference: the people of factor 3 are the only one that are positive about receiving a certificate of participation, while getting any payment is also for this group not

important. Probably they want something to be proud of or to show others. It is also possible that they hope it will help them to get a job or better entrance to next education. Unfortunately they did not explain why they value a certificate.

Factor 4 - School pupils Mandalay (20 of 189 persons = 11%)			
Position	No.	Statement	Z-SCORES
2	4	I would participate in this project because success of this project depends on citizen science like me.	1.548
2	8	I would participate in this project even though I am not a trained scientist	1.483
1	12	I would participate in this project because I understand what participatory monitoring is all about.	0.633
1	6	I would participate in this project because a better water quality would directly have a positive impact on my life.	0.522
0	3	I would participate in this project to develop my scientific skills	0.463
0	2	I would participate in this project to get a certificate of participation.	0.280
0	10	I would participate in this project because citizen science sounds fun to me.	-0.226
0	5	I would participate in this project If I could access the data collected.	-0.514
-1	1	I would participate in this project because I think it will make a difference.	-0.622
-1	7	I would participate in this project because it is my job to care for water a resource.	-0.638
-2	9	I would participate in this project If I receive payment for my measurements.	-1.333
-2	11	I would participate in this project If my friends would.	-1.598

Factor 4: This factor is assumed to be not valid for this project. Most of the pupils that belong to this factor only match this factor for 60%. Their viewpoints still differ a lot and the explanations that are given are not good enough to get a clear impression of their overall viewpoint.

B. UNIVERSITY STUDENTS FROM THE AREA OF MANDALAY (PM_UM)

PCA with VARIMAX and hand rotation; 3 factors as output

General findings:
- Factor 1 represents more than half of the group, 36 out of 57 persons (63%). Factor 2 and 3 represent a much smaller part of the group (only 7 and 3 persons).
- 11 out of 57 persons (11%) is not placed within one of the three factors. The viewpoints of these people for example rely as much on one factor as on another which makes it difficult to place them.

Factor 1 - University students Mandalay (36 of 57 persons = 63%)			
Position	No.	Statement	Z-SCORES
2	6	I would participate in this project because a better water quality would directly have a positive impact on my life.	1.460
2	7	I would participate in this project because it is my job to care for water as a resource.	1.443
1	10	I would participate in this project because citizen science sounds fun to me.	0.744
1	4	I would participate in this project because success of this project depends on citizen science like me.	0.576
0	3	I would participate in this project to develop my scientific skills	0.218
0	1	I would participate in this project because I think it will make a difference.	0.072
0	8	I would participate in this project even though I am not a trained scientist	0.068
0	5	I would participate in this project If I could access the data collected.	0.042
-1	12	I would participate in this project because I understand what participatory monitoring is all about.	-0.669
-1	2	I would participate in this project to get a certificate of participation.	-0.983
-2	11	I would participate in this project If my friends would.	-1.419
-2	9	I would participate in this project If I receive payment for my measurements.	-1.553

Factor 1: People that belong to factor 1 feel the responsibility to improve the water quality in their country. In the first place they believe that a change in water quality will have a direct impact on their lives, since statement 6 is placed at strongly agree. UMFV_145: *"We need pure water to have good health. We need to maintain water resources for our generation."* But they clearly also feel responsible to take care of the water and they want to improve the situation by contributing to this project (statement 7 and 4*). UBFV_184: "I like new things that support our country's development and to succeed a project, we need people's interest and participation. I myself am also interested in science."* However this student is interested in science, the majority of this group is not directly interested in participating the project because they have a scientific background or because they want to develop their scientific skills; these statements (3 and 8) are sorted neutral. This is not very surprising since the group of students in Mandalay that was asked to fill in the form had very different backgrounds. They were studying many different subjects like Law, Mathematics, History, Philosophy, English, Physics, Computer science, International Relations, Zoology, Health and Chinese. The participation of this group clearly does not depend on offering any payment, a certificate or because friends would join. These external motivation factors are not of importance. Students give the following explanation for their choice: (UBFV_140) *"Even if my friends will not participate, I will participate. It depends on me"*, (UBFY_184) *"If I start doing it, my friends will also follow me to do this"*, (UBFV_190) *"Because this is about our country's budget. I don't need to get a certificate of participation. I want to participate only to develop our country."*

Factor 2 - University students Mandalay (7 of 57 persons = 12%)			
Position	No.	Statement	Z-SCORES
2	8	I would participate in this project even though I am not a trained scientist	1.554
2	3	I would participate in this project to develop my scientific skills	1.152
1	5	I would participate in this project If I could access the data collected.	0.985
1	1	I would participate in this project because I think it will make a difference.	0.578
0	11	I would participate in this project If my friends would.	0.515
0	6	I would participate in this project because a better water quality would directly have a positive impact on my life.	0.142
0	7	I would participate in this project because it is my job to care for water as a resource.	-0.181
0	4	I would participate in this project because success of this project depends on citizen science like me.	-0.412
-1	2	I would participate in this project to get a certificate of participation.	-0.492
-1	12	I would participate in this project because I understand what participatory monitoring is all about.	-0.953
-2	10	I would participate in this project because citizen science sounds fun to me.	-1.176
-2	9	I would participate in this project If I receive payment for my measurements.	-1.712

Factor 2: This group has a clear interest for science since they placed statement 3 at strongly agree. However, this does not mean they all have a scientific background. Some of these students do study chemistry or physics, but others study language and international relations. Their interest in science is also clarified by their explanations: (UBFV_135) *"I am interested in science. I would like to try on the project."*, (UBFV_174) *"I chose number 8 and 5 because I have knowledge about this project, I'm interested in this, I want to keep the natural beauty of our country."* In line with their interest in science it also gets more important for this group to access the data collected. Comparable with factor 1, also this group is not interested in any payment or certificate, *"Certificate is just for show"*(UBFV_135). But different from factor 1 they sorted statement 10 very negative. For this group participating the project has not to do with fun, but with improving their knowledge and skills.

Factor 3 - University students Mandalay (3 of 57 persons = 5%)			
Position	No.	Statement	Z-SCORES
2	6	I would participate in this project because a better water quality would directly have a positive impact on my life.	1.682
2	3	I would participate in this project to develop my scientific skills	1.451
1	5	I would participate in this project If I could access the data collected.	0.655
1	4	I would participate in this project because success of this project depends on citizen science like me.	0.610
0	2	I would participate in this project to get a certificate of participation.	0.417
0	7	I would participate in this project because it is my job to care for water as a resource.	0.038
0	9	I would participate in this project If I receive payment for my measurements.	-0.000
0	11	I would participate in this project If my friends would.	-0.655
-1	1	I would participate in this project because I think it will make a difference.	-0.803
-1	12	I would participate in this project because I understand what participatory monitoring is all about.	-0.879
-2	10	I would participate in this project because citizen science sounds fun to me.	-1.065
-2	8	I would participate in this project even though I am not a trained scientist	-1.451

Factor 3: The viewpoint of the people in factor 3 is quite comparable with factor 2 when looking to the statements that they sorted positive. For this group also developing their scientific skills and getting access to the data is important. But different from factor 2 their main reason to participate is not to improve their own knowledge and skills, but because they believe a change in water quality would directly impact their lives. It is interesting to see that the people belonging to factor 3 sorted statement 9 (receiving payment) and statement 2 (getting a certificate) neutral. This makes these people different from others, but unfortunately they did not explain this choice. It is important to realise that only a few students belong to factor 3 (5% of the total group).

C. SCHOOL PUPILS FROM THE AREA OF YANGON (PM_SY)

PCA with VARIMAX rotation; 4 factors as output

General findings:
- Factor 1 represents 35% of the total pupils. Factor 2 represents 17%, factor 3 represents 7% and factor 4 represents 15%.
- 12 out of 46 persons (26%) is not placed within one of the four factors. The viewpoints of these people for example belong as much on one factor as on another factor which makes it difficult to place them.

Factor 1 - School pupils Yangon (16 of 46 persons = 35%)			
Position	No.	Statement	Z-SCORES
2	7	I would participate in this project because it is my job to care for water as a resource.	1.803
2	4	I would participate in this project because success of this project depends on citizen science like me.	1.117
1	6	I would participate in this project because a better water quality would directly have a positive impact on my life.	1.051
1	8	I would participate in this project even though I am not a trained scientist	0.551
0	5	I would participate in this project If I could access the data collected.	0.235
0	3	I would participate in this project to develop my scientific skills	-0.112
0	10	I would participate in this project because citizen science sounds fun to me.	-0.197
0	11	I would participate in this project If my friends would.	-0.360
-1	12	I would participate in this project because I understand what participatory monitoring is all about.	-0.656
-1	1	I would participate in this project because I think it will make a difference.	-0.761
-2	2	I would participate in this project to get a certificate of participation.	-0.959
-2	9	I would participate in this project If I receive payment for my measurements.	-1.711

Factor1: The first and main reason to participate citizen science for school pupils that belong to factor 1 is the fact that they see it as their task to care for water in their country. S9FY_326: *"I think that I have duty to care for water as a resource since I am a citizen in Myanmar."* and S9FY_330: *"As I am a Myanmar citizen, I really want to control and protect the sources of water of my country."* Besides this feeling that they are needed to make the project successful, they also are aware of the impact of water quality on the people and their own health. S10MY_365: *"I think it can make our country more develop and it can reduce water pollution so that all the citizens in our country will more healthy."*
At the same time they are not convinced by the difference this project will make on the current situation. S9FY_329: *"I think this project will only make a little difference."* A certificate and/or money in return is not important for this group.

Factor 2 - School pupils Yangon (8 of 46 persons = 17%)			
Position	No.	Statement	Z-SCORES
2	5	I would participate in this project If I could access the data collected.	1.445
2	3	I would participate in this project to develop my scientific skills	1.299
1	6	I would participate in this project because a better water quality would directly have a positive impact on my life.	1.080
1	4	I would participate in this project because success of this project depends on citizen science like me.	0.842
0	1	I would participate in this project because I think it will make a difference.	0.154
0	10	I would participate in this project because citizen science sounds fun to me.	0.032
0	8	I would participate in this project even though I am not a trained scientist	-0.397
0	2	I would participate in this project to get a certificate of participation.	-0.438
-1	12	I would participate in this project because I understand what participatory monitoring is all about.	-0.439
-1	7	I would participate in this project because it is my job to care for water as a resource.	-0.606
-2	11	I would participate in this project If my friends would.	-1.451
-2	9	I would participate in this project If I receive payment for my measurements.	-1.520

Factor 2: The pupils that belong to factor 2 have a great interest in science. They want to access the other data collected and they want to develop their scientific skills. The explanation of the pupils about their choice is very clear: S10MY_371: *"I chose 3 and 5, because I want to be a scientist and I want to collect more information in the future."*S10MY_373: *"I chose statement 3, because I want to attend physics major and this major is related to science. I chose 5, because I believe that this data will give me a lot of knowledge."*
These pupils are able to think in a broader way and they also understand that a poor water quality can have an effect on the environment they are living in. S10MY_360: *"Because we all need to repair the water pollution. Because the data gives knowledge about surrounding environment."* Receiving any payment and the participation of their friends is also for this group not of any importance.

Factor 3 - School pupils Yangon (3 of 46 persons = 7%)			
Position	No.	Statement	Z-SCORES
2	1	I would participate in this project because I think it will make a difference.	1.660
2	8	I would participate in this project even though I am not a trained scientist	1.217
1	10	I would participate in this project because citizen science sounds fun to me.	0.886
1	3	I would participate in this project to develop my scientific skills	0.387
0	11	I would participate in this project If my friends would.	0.387
0	5	I would participate in this project If I could access the data collected.	0.187
0	6	I would participate in this project because a better water quality would directly have a positive impact on my life.	0.069
0	4	I would participate in this project because success of this project depends on citizen science like me.	-0.256
-1	12	I would participate in this project because I understand what participatory monitoring is all about.	-0.574
-1	7	I would participate in this project because it is my job to care for water as a resource.	-1.273
-2	9	I would participate in this project If I receive payment for my measurements.	-1.286
-2	2	I would participate in this project to get a certificate of participation.	-1.404

Factor 3: This factor is assumed to be not valid for this project. Only three pupils belong to this factor of which one has a negative relation to the factor, which means that this person is the opposite of this viewpoint. Because too few pupils rely on this factor, it is not possible to see it as a valid outcome.

Factor 4 - School pupils Yangon (7 of 46 persons = 15%)			
Position	No.	Statement	Z-SCORES
2	6	I would participate in this project because a better water quality would directly have a positive impact on my life.	1.638
2	7	I would participate in this project because it is my job to care for water as a resource.	1.226
1	8	I would participate in this project even though I am not a trained scientist	0.663
1	10	I would participate in this project because citizen science sounds fun to me.	0.404
0	3	I would participate in this project to develop my scientific skills	0.226
0	9	I would participate in this project If I receive payment for my measurements.	0.215
0	5	I would participate in this project If I could access the data collected.	0.166
0	4	I would participate in this project because success of this project depends on citizen science like me.	0.096
-1	12	I would participate in this project because I understand what participatory monitoring is all about.	-0.538
-1	1	I would participate in this project because I think it will make a difference.	-1.024
-2	2	I would participate in this project to get a certificate of participation.	-1.434
-2	11	I would participate in this project If my friends would.	-1.638

Factor 4: The people that belong to factor 4 in the first place look alike the people that belong to factor 1. Also these people see it as their job to improve the water quality and they think that a change in quality will directly impact their lives. S10FY_432: *"I chose 6 and 7, because it is important to get the pure water that will make us*

healthy and every citizen has the job to keep the water clean." However, there are some interesting differences with the viewpoint of people that belong to factor 1. The people that belong to factor 4 are the only one that are not negative about receiving payment for their participation (they sorted statement 9 neutral). Also they don't feel as needed for the success of project as people from factor 1 did. Except of these differences, the other statements are a bit the same as for the other pupils. Also these pupils are not interested in joining the project with their friends or getting a certificate. S9FY_331: *"Participating in this project is my desire only. As for me, I don't need that to get a certificate of participation."*

D. UNIVERSITY STUDENTS FROM THE AREA OF YANGON (PM_UY)

PCA with VARIMAX and hand rotation; 3 factors as output

General findings:
- Factor 1 represents almost half of the group, 19 out of 42 persons (45%). Factor 2 and 3 represent a much smaller part of the entire group (5 and 7 persons).
- 11 out of 42 persons (26%) is not placed within any of the three factors since their viewpoints matches more than one factor.
- All factors (factor 1, 2 and 3) sorted statement 6 on strongly agree: I would participate in this project because a better water quality would directly have a positive impact on my life. This means that this is a consensus statement.

Factor 1 - University students Yangon (19 of 42 persons = 45%)			
Position	No.	Statement	Z-SCORES
2	6	I would participate in this project because a better water quality would directly have a positive impact on my life.	1.307
2	3	I would participate in this project to develop my scientific skills	1.299
1	4	I would participate in this project because success of this project depends on citizen science like me.	1.111
1	1	I would participate in this project because I think it will make a difference.	0.632
0	7	I would participate in this project because it is my job to care for water as a resource.	0.514
0	5	I would participate in this project If I could access the data collected.	0.153
0	12	I would participate in this project because I understand what participatory monitoring is all about.	0.075
0	2	I would participate in this project to get a certificate of participation.	-0.547
-1	9	I would participate in this project If I receive payment for my measurements.	-0.871
-1	10	I would participate in this project because citizen science sounds fun to me.	-0.946
-2	8	I would participate in this project even though I am not a trained scientist	-1.310
-2	11	I would participate in this project If my friends would.	-1.417

Factor 1: Besides the consensus statement (statement 6), people that belong to factor 1 are interested in improving their scientific skills. UMFY_317: *"I want to be a proficient water resources engineer. And I would like to advance my related skills and get more knowledge. I also chose statement 7 because I am a water resources engineer."* UMFY_315: *" I am really interested in the water resources subject."* But they also believe that their contribution to the project will make it possible to make a difference and some even mention that it will change the awareness of citizens of Myanmar. UMFY_393 : *"If citizen get involved in this project, they can feel the responsibility of being part of the nature."* and UMFY_397: *"Most of the Myanmar people don't know well about the water condition that they are using. So, as a benefit of this project they can get more knowledge about water quality and healthier lives."* People that belong to factor 1 are positive/neutral about getting access to the data collected and if it is their job to care for water as a resource. They are not interested in receiving any payment or the involvement of their *friends. Some of the explanations are: "It is the duty of human beings to participate", "It's not good to expect some kind of payment.", "I have to make the decision by myself", "You need to help the scientist making research. Without expecting any profits or anything in return. As a citizen I should do something good for my country".* It is very clear that these people act out of a certain feeling of responsibility towards their country. The people that belong to this factor are both students of Water Resources Engineering (YTU) and students of Ports and Harbours (MMU).

Factor 2 - University students Yangon (5 of 42 persons = 12%)			
Position	No.	Statement	Z-SCORES
2	6	I would participate in this project because a better water quality would directly have a positive impact on my life.	1.700
2	11	I would participate in this project If my friends would.	1.128
1	7	I would participate in this project because it is my job to care for water as a resource.	0.801
1	1	I would participate in this project because I think it will make a difference.	0.568
0	8	I would participate in this project even though I am not a trained scientist	0.477
0	4	I would participate in this project because success of this project depends on citizen science like me.	0.240
0	12	I would participate in this project because I understand what participatory monitoring is all about.	-0.088
0	10	I would participate in this project because citizen science sounds fun to me.	-0.147
-1	3	I would participate in this project to develop my scientific skills	-1.039
-1	9	I would participate in this project If I receive payment for my measurements.	-1.049
-2	5	I would participate in this project If I could access the data collected.	-1.186
-2	2	I would participate in this project to get a certificate of participation.	-1.404

Factor 2: This factor is not valid since only some students (5 persons) rely on this factor and most of them are only relying a little on this factor (for about 60). So, even though they belong to the same factor, their viewpoints differ too much to be able to find a clear shared viewpoint and explain it.

Factor 3 - University students Yangon (7 of 42 persons = 17%)			
Position	No.	Statement	Z-SCORES
2	6	I would participate in this project because a better water quality would directly have a positive impact on my life.	1.346
2	1	I would participate in this project because I think it will make a difference.	1.223
1	12	I would participate in this project because I understand what participatory monitoring is all about.	0.903
1	8	I would participate in this project even though I am not a trained scientist	0.889
0	3	I would participate in this project to develop my scientific skills	0.492
0	10	I would participate in this project because citizen science sounds fun to me.	0.489
0	5	I would participate in this project If I could access the data collected.	-0.361
0	4	I would participate in this project because success of this project depends on citizen science like me.	-0.641
-1	2	I would participate in this project to get a certificate of participation.	-0.782
-1	7	I would participate in this project because it is my job to care for water as a resource.	-0.915
-2	11	I would participate in this project If my friends would.	-1.071
-2	9	I would participate in this project If I receive payment for my measurements.	-1.571

Factor 3: Different to factor 1, people that belong to factor 3 are less interested in developing their own scientific skills. They are, more than people of factor 1, convinced that this project is able to create some kind of difference; a better water quality and/or more awareness among the citizens. But they don't feel like it is their job to care for water and they are also not really interested in accessing the data. This is not surprising since almost all students that belong to factor 3 study Ports and Harbour (MMU) which is not directly linked to water quality. There are no students from Water Resource Engineering that belong to this factor.

APPENDIX 5: INTERVIEW WITH VOLUNTEERS OF CITIZEN SCIENCE

Appendix 5 gives a summary of the interviews that were taken with two volunteers of citizen scientists, one person living in the area of Mandalay and one person living close to Pyay. These volunteers were asked by Thatoe Thanda Thatoe Nwe Win (Phd, TU Delft) to contribute to her research project by collecting data about the water quality in the Ayeyarwady River. They have been monitoring the water quality on regular base for a relative long period of time, varying between 1 til 3 years and the data they collected is used for scientific purpose. These people are no real volunteers because they work for a company that already works with water related topics; DWIR (Directorate of Water Resources and Improvement of River Systems) and therefore they also get paid for their work.

Before starting the real interview, these people were given a short explanation of the project and about participatory monitoring. Below a selection of the questions are given together with the response of the volunteers:

Q: Is it difficult to do the measurements? Do you think education or knowledge about science is needed?

Both citizen scientists state that it is not difficult to do the measurements that are needed to say something about the water quality, no necessary education is needed. These measurements include for example monitoring of PH, nitrate, nitrite, temperature, electrical conductivity, phosphate, iron and transparency. On the other hand they mention that some basic knowledge about science and chemistry is preferred since it will increase the understanding of the project and the obtained results. Also some knowledge about English language is needed, since most of the explanation is in English.

Q: Would you also like to do the measurements if it was not part of your work/ if you didn't got paid for it? And why?

Both citizen scientists agreed on this statement. They like to do the tests and it is no problem to do it for free. One person states: 'I am interested in science and water. Doing these measurements makes me feel like a scientist. I think it is fun to do.' For the second person the expectations of others are more important. Even though she is willing to do it for free and in her free time she said: 'I will continue as long as Thanda <Phd student> asks me to continue. If she does not ask me to continue, I'll stop'.

Q: Would you like other people to do the same measurements/tests as well?

Both citizen scientists think that it would be good if more people participate in monitoring the water quality, but they are both not very much convinced of this. At the same time they think it is sufficient that they are measuring. Why should someone else also measure if they already collect the data?

Q: Would you like to learn other people how they can do the measurements?

They are very positive about learning away their skills to others. One already learned her colleagues how to do the measurements. But also the thought about learning schoolchildren about monitoring water quality is a good one. They were both interested in sharing they knowledge with others and one person even said: 'I think teaching is fun.' This might be interesting when experienced citizen scientist are needed to promote participatory monitoring.

Q: If you can chose 3 groups of people (for example different background/age/work/..) that can do citizen science with you, who would you chose and why?

Person 1

1. Students within the field of technology and science, because they know about PH, nitrate and all the other things they are measuring.
2. Water interested Companies, because water is important for them.
3. NGO's that are water related. For example NGO's that organise the distribution of water to citizens/people.

Person 2

1. Students, because they have knowledge about the subject.
2. Colleagues from DWIR, because DWIR is responsible for water resources.
3. People from another department within DWIR, because these people always stay close to the water/river.

It is interesting to notice that they both think students are the most useful group to bring in touch with participatory monitoring related to water quality. Also the groups for number 2 and 3 include people that already have knowledge about the topic. This suggests that it is very important to have a lot of knowledge about water quality and monitoring, but this is contradictory to the fact that they both stated earlier that no specific knowledge is needed for doing the measurements. Therefore it can be concluded that the interest in the topic is probably of greater importance than expertise and knowledge, but that you often find these together.

Q: I chose the following 5 groups: schoolchildren grade 9, university students, fisherman, housewife's and farmers. Who would be the best to do citizen science and why?

For this question the volunteers are asked to sort the given 5 groups. This forces them to make a choice. It is interesting to look at the results, since they sorted the groups very differently. Person 1 sorted the groups mainly related to the way water quality impacts people's health with housewife's on position 1. Person 2 was more focussing on the way in which they are able to learn new things and techniques, which made the students and school pupils score higher.

Person 1

1. Housewife's - They take care of their families and the health of every family member is of great importance. They use water every day for cooking, drinking and washing. Water quality has a big influence on the health of the users. Improving health is therefore the best reason to participate in monitoring water quality.
2. Farmers - They work with agriculture and the production of crops. A better water quality means less bacteria and better food. Again the health aspect is important. But farmers will probably not find the time to do the measurements every week, they will maybe do it every 2 weeks or once in a month.
3. Fishermen - The amount of fish they catch depends directly on the water quality. So because their income and life directly depends on the water quality they will also be interested in monitoring the water.
4. University students - They will easily be able to participate because they already have knowledge about the topic and how to do the measurements.
5. Schoolchildren - They have not enough knowledge and the 4 above mentioned groups have better reasons to participate in monitoring water quality.

Person 2

1. University students - They have a lot of knowledge about science, so they are the best to do the tests.

2. School children - It is easy to learn them new things like how to do the measurements and how to monitor the water. They will be eager to learn and they will do the measurements when they are asked to do.
3. Fishermen - They are always near the water, but in the beginning they will probably not be interested in participating science. But when they are explained about the importance and impact of water quality they will probable get very interested in participating. More effort is needed to make them included in the project, but they will be of importance afterwards.
4. Farmers - More good water will give better and more crops, so if the farmers understand this, they will participate. On the other hand, for most farmers the quantity is more important than the quality. Most of the farmers therefore don't care about the quality, they only want access to enough water for irrigation.
5. Housewife's - Housewife's have a busy life. They live close to the river and all people use the water for cooking, washing etc. Because they use the water every day they know very well when the water is good or bad.

The overall opinion about participatory monitoring is quite positive. They believe participatory monitoring is an easy method to collect data and it can be done by many different persons. In the first place they expect people with a water related background to be more willing to participate, but also other groups are possible to include within participatory monitoring. They are positive about promoting this method to others and sharing their knowledge on this topic.