STOCKHOLM JUNIOR WATER PRIZE: SOUTH AFRICA
2022

INVENTION

“THE DROP SAVER”

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SOUTH AFRICA, WESTERN CAPE

PROJECT SUMMARY:

In 2016-2018 The Western Cape experienced the worse recorded drought in History which had Cape Town days away from reaching “Day Zero”. This horrifying period reminded the entire World that water is a scarce and nature commodity and in order to ensure the long term water availability and supply we would have to start making water wise changes today.

Through many behavioural changes to contribute to water conservation, we are always looking for ways to make small changes, as they say “ it only takes 21 days for something to become a habit”. And at our school, Heatherlands High we observed that since the drought intervention all of the outside taps have been closed off/ locked meaning they are non-operational, except for one tap. This tap is constantly being used by learners of our school during the school day.

Unfortunately we have realised that many of the Learners are not aware of the importance of water conservation. We have seen how many learners drink water from the tap and just walk away without closing it, expecting the next person to do it. This has led to hundreds of litres of water being wasted every single day from one leaking tap.

Our aim for this project was to invent a device that could be attached to the tap, that would help save the vast amount of water that is wasted by our learners every day. By doing this we would not only help ~~to~~ save water, but also help our school to minimize the school’s Municipal water bill.

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LIST OF ABBREVIATIONS:

DWS	Department of Water and Sanitation
WC	Western Cape
SA	South Africa
SAYWP	South African Youth Water Prize
LM	Local Municipality
SANS	South African National Standards
HHS	Heatherlands High School
SJWP	Stockholm Junior Water Prize
WSA	Water Service Authority
CPUT	Cape Peninsula University of Technology

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- Our parents for helping us and guiding us through the difficult task of making our invention.

- Our teacher, Ms. Marissa Murphy, for helping us put our project together, answering all our many questions and giving advise on how to reach our goals.

- The principal of Heatherlands High School, Mr. Salomo Moses, for allowing us to test and implement our invention at the School.

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- Professor Verushka and the entire team at CPUT for their continued support and mentorship.

- The community of George and our peers at HHS, for supporting and participating in the data collection process.

BIOGRAPHY:

2.1 Biography of learners:

Unam Halam is 15 years old and lives in George in the Western Cape with her mother, Khunjuzwa Halam who works at Checkers delivery, and father, Mzwanele Halam, who owns a driving school. She has three brothers and she is the second eldest.

Unam attends Heatherlands High School. She is in grade 10 and enjoys her subjects Physical Sciences, Life Sciences, Computer Application Technology and Mathematics. She is a RCL member and takes part in various other school projects. Her favourite sport is netball.

During her spare time, Unam enjoys watching movies, educational documentaries and football. She is a Man City fan. She also enjoys going to the gym.

Ever since she was a little girl, she's always enjoyed working with her hands. Since she was in primary school, she always wanted to work in the engineering field, hence she works so hard when it comes to her school work because she sees herself working as an engineer full time in a few years.

Having a dream of working in a male dominated field, she aspires to be an influence to other girls to show them that they can also reach success no matter what their community or society say.

Faith Claasen is 17 years old. She was born and raised in George. Faith has two sisters and a brother. Her father was a paramedic and her mother is the senior salesperson of Bidfood, George.

Faith is a learner at Heatherlands High School in George. Her favourite subjects are Physical Sciences, Mathematics and Life Sciences.

In her spare time, she likes to read and draw. Faith also enjoys learning about how objects and systems function. Her dream is to one day be in an occupation where she can help and improve people's lives and she is considering becoming a mechanical engineer.

Faith is a bubbly person with a very positive outlook on life and she works hard to reach her goals.

2.2 Biography of school and community:

Heatherlands High School is a secondary school located on the East side of George in the Western Cape. The school used to be a special skills school called The Bult school, but was changed to an academic school in 2016 and was also renamed then. Our school has two rugby fields, two netball courts, one basketball court, a pool and a single squash court. It also has a hostel that accommodates 160 learners. The school has 662 learners and 20 teachers.

Learners that attend our school are mostly from communities that fall in the lower or middle income class. We have quite a few challenges with learners that use drugs, as these are also the challenges faced in our surrounding communities.

Although our school is situated in town, many of our learners have to travel or walk far to get to school, using mainly taxis or buses as a means of transport. Poverty is still a challenge in many of our learner's lives and many of them also come from communities where crime is very evident.

1. INTRODUCTION

1.1 BACKGROUND:

It is every South Africans Constitutional Human Right in terms of Section 27 of the Constitutional of the Republic of South Africa [1994], to have access to clean and safe drinking water and in South Africa Water Service Authorities (WSAs) are regulated in terms of the Water Services Act [No. 108 of 1997] South African Government to ensure the provision of basic water supply and basic sanitation services according to the National Norms and Standards. These WSAs are governed by the National Department of Water and Sanitation (DWS) who are the custodians of water resources

South Africa (SA) has an average rainfall of approximately 450 mm per annual and due to Climate Change we continue to be faced with harsh and extreme weather conditions leading to catastrophic effects such as droughts.

As per the 2020 Census conducted , George Local Municipality (LM) services just over 157, 391 in population that continues to increase meaning the provision of basic services increases too thus putting pressure on the current service infrastructure and resources as the water demand increases it impacts the water supply due to the lack of equilibrium.

The Western Cape (WC) in 2016-2018 experienced the worse recoded Drought in History , with Cape Town days away from day zero there was a an immediate need for interventions such as corporate responsibility, change in human behaviour and strict management of water resources/ water availability,

We all know that water has become a very scarce commodity all around the world. It is sad to see even one drop of water being wasted these days. At our school all the outside taps have been closed off, except for one. This tap is constantly being used by learners of our school during the school day.

We have noticed that many of learners at Heatherlands High School (HHS) were not aware of the importance of water conservation. We have seen how many learners drink water from the tap and just walk away without closing it, expecting the next person to do it. This has led to hundreds of litres of water being wasted daily.

As we watched this scenario happen every day, we became more aware of the fact that we needed to do something about this problem. We all have a responsibility towards saving our precious water resources.

1.2 Problem Statement:

An outside tap at our school is constantly being used by our learners, especially during and after break time. Unfortunately, many learners do not close the tap properly, expecting the next person to do this. This has led to many litres of water being wasted unnecessarily.

Before we started looking at inventing a water saving device, we first wanted to do research on what already exists.

1.3 Aim:

The aim of our project was therefore to invent a device that could fit onto a tap and would prevent unnecessary water being wasted.

1.4 HYPOTHESIS:

The cost effective drop saver will save water by preventing leakages from operational taps.

1.5 Literature Review:

(Bhagwat. R, 2020) explains in an article called “Water saving devices at home”, that taps or showers with flow fixtures or aerators help in minimising the use of fresh water and reduce load on wastewater systems. These fixtures provide the same effect as conventional flow fixtures, whilst reducing the volume of water flowing through the system. Bhagwat further mentions that these accessories have advantages such as higher water savings, but also have disadvantages including higher energy requirement for sensor, timer based taps, showers and the possibility of clogging.

Figure 1 and 2: Faucet splash head filter mouth.

AliExpress (2022) online ordering services also advertises the "Faucet splash head filter mouth kitchen household tap water purification water saving device extension water filter".

Figure 3: Another type of filter head for kitchen taps.

After a lot of research we realised that there was no existing device that would solve our problem. It seemed that the only solution to our problem would be to put a lock on the tap.

Figure 4: Taps locked due to water restrictions during the 2016-2018 Drought.

Why could none of the existing mechanisms solve our problem?

1. We needed a mechanism that would stop the water flow immediately.
2. It had to be cost-effective.
3. It had to be easy to install and replace.

2 MATERIALS AND METHODS

In this section we will cover the material we used, the method used to design and invent our device, the experiments conducted and lastly discuss the results that we gathered.

2.1 MATERIALS:

Our first ideas about a solution came from studying a caulk gun.

Figure 5: An old glue gun found at home.

We started thinking of how we could use almost the same mechanism to implement into our invention.

We also looked at this trigger unit on a household cleaning bottle.

Figure 6: A top of a spray bottle found at home.

We knew that we had to invent a device with a trigger that would stop the water flow as soon as the learners let go of the trigger.

Brainstorming:

We started to make sketches of our ideas.

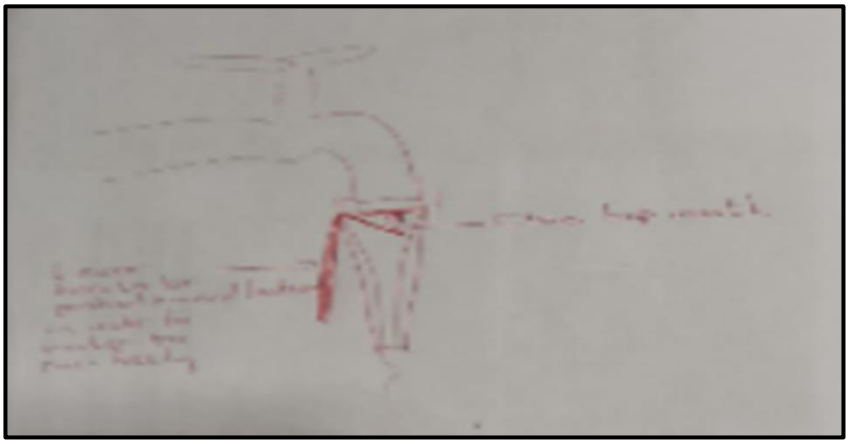


Figure 7: (Sketch 1) Faucet unit with trigger.

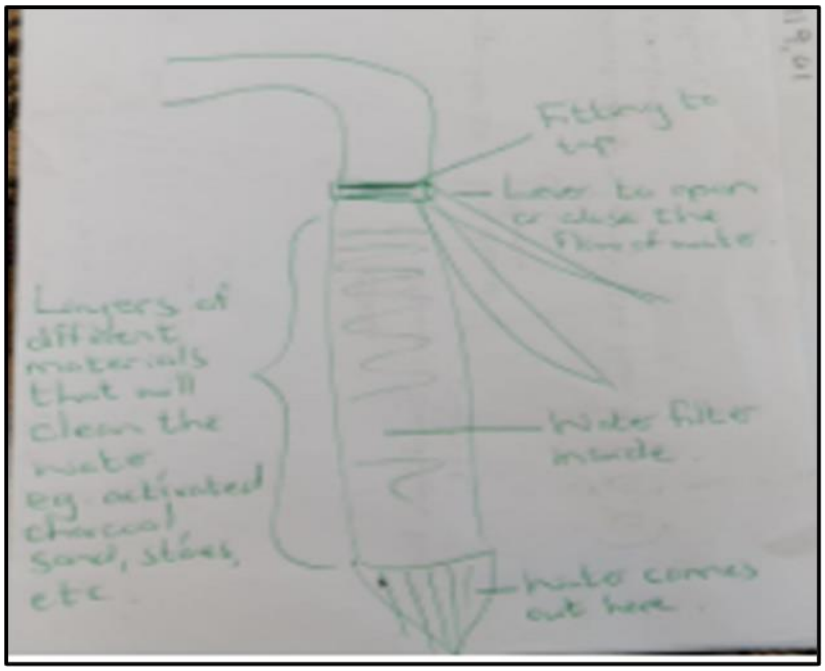


Figure 8: (Sketch 2) Fitting to tap with a trigger and a water filter.

Then we found this butterfly valve on the internet, but we knew it would not be long before a unit like this would be stolen and it was far too expensive to use.

Figure 9: Finally we found these at our local Agri store.

Figure 10: Handheld wish triggers.

Our invention: "The drop saver!":

Figure 11: Our device installed at the leaking tap at our school.

2.2 METHOD:

We set out to design a device that would uphold to the following specifications and standards:

2.2.1 Market:

Our market would be schools and communities where there are also outside taps that are being used by many people. For this we would include different municipalities to identify the main areas where our device could be installed.

2.2.2 Expected results:

Our device had to be cost-effective and easy to install and replace if necessary. It had to be durable and be able to supply a constant flow of water. The trigger must also not break easily, in order to prevent unnecessary wastage of water.

We wanted to make sure our device was also environmental friendly and would also not harm our learners or anyone who would use it.

2.2.3 Budget:

- **Time:** Three months of research, planning, testing, retesting
- **Cost:** Handheld wish trigger – R 20.11

Two hose connectors - R 84.00

Small piece of hose - R 20 (estimated, as we already had a hose at home of which we just cut off a piece)

Water purifier with carbon Filter from Dischem – R 34.95

2.2.4 Functionality:

The device will serve to prevent the unnecessary wastage of water at the outside tap at our school that is used by learners right through the day. The trigger will allow water flow when pushed inwards, but will immediately stop the flow of water when a learner lets go of it.

2.2.5 *Appearance*:

The device is made of hard plastic, with pvc pipe. It ranges in colour from black to a white hose and blue and grey pipe fitting.

2.2.6 Materials:

The whole unit is made of plastic parts and pvc hose pipe. It also contains a small water purifier made from plastic, that contain carbon. All the parts are available from most hardware stores and is very affordable and has an expected high durability. Except for the trigger that is black, the other parts are also available in other colours, eg. green, yellow.

2.2.7 *Construction*:

It is easy to make the product. Most of the fittings just fitted together without a struggle.

2.2.8 Safety:

The product is very safe for use by learners. There are no parts that can harm anyone.

2.2.9 Water Quality:

Currently the water quality of George Local Municipality complies with the SANS 214 Regulation, and as per the data received from the Municipality for the period (March-May). The Device will in no way contaminate or degrade the current water quality status as the device as the material used is the existing material type used for water networks.

2.2.10 Lifespan:

Once the device is installed permanently, we consider the lifespan of the device to be operational for approximately 3 years, taking into account the external factors such as possible theft, vandalism, malfunction of trigger and/or replacement of filter.

2.3 EXPERIMENT:

In the tables below is the result of our experiment, we conducted a total of three trails on each protype but kept the time variant constant and the objective was to measure the total amount of water saved by using the drop saver. The leaking water was collected in a measuring water jug where the actual volume in Litres (L) could be recorded.

PROTOTYPE 1:

Test No:	Duration (Hours/minutes):	Amount of water Saved (Litres):	Total number of learners participated:
1	30 Min	65 Litres	100
2	3 Hour	195 Litres	40
3	8 Hour	346.7 Litres	30

PROTOTYPE 2:

Test No:	Duration (Hours/minutes):	Amount of water Saved (Litres):	Total number of learners participated:
1	30 Min	70 Litres	150
2	3 Hour	200 Litres	50
3	8 Hour	351 Litres	30

PROTOTYPE 3:

Test No:	Duration (Hours/minutes):	Amount of water Saved (Litres):	Total number of learners participated:
1	30 Min	72 Litres	150
2	3 Hour	212 Litres	50
3	8 Hour	355 Litres	30

2.4 PROCEDURE:

The data we collected was done in the following manner:

We decided to measure the amount of water wasted during one 30 minute break time.

We used a 25l bucket to catch up the spilled water. During the 30 minutes, we had to empty the bucket 3 times. This means that more or less than 75l of water is being wasted.

75l x 5 =375l wasted per week
375l x 4 = 1500l wasted per month
After we installed the Drop Saver, only about 10l of water was captured in the bucket during the whole 30 minute break session.
65 X 5 =325L PER WEEK
325L X 4 = 1300L PER MONTH

AND THESE ARE JUST FOR 30 MINUTE BREAK TIMES!!

Only about 200l of water are now being wasted, compared to 1500l per month.

Our Next step would be to install the device for a consecutive period of three months at the school and obtain access to the school water bills to do a comparison on the water used and saved during this period.

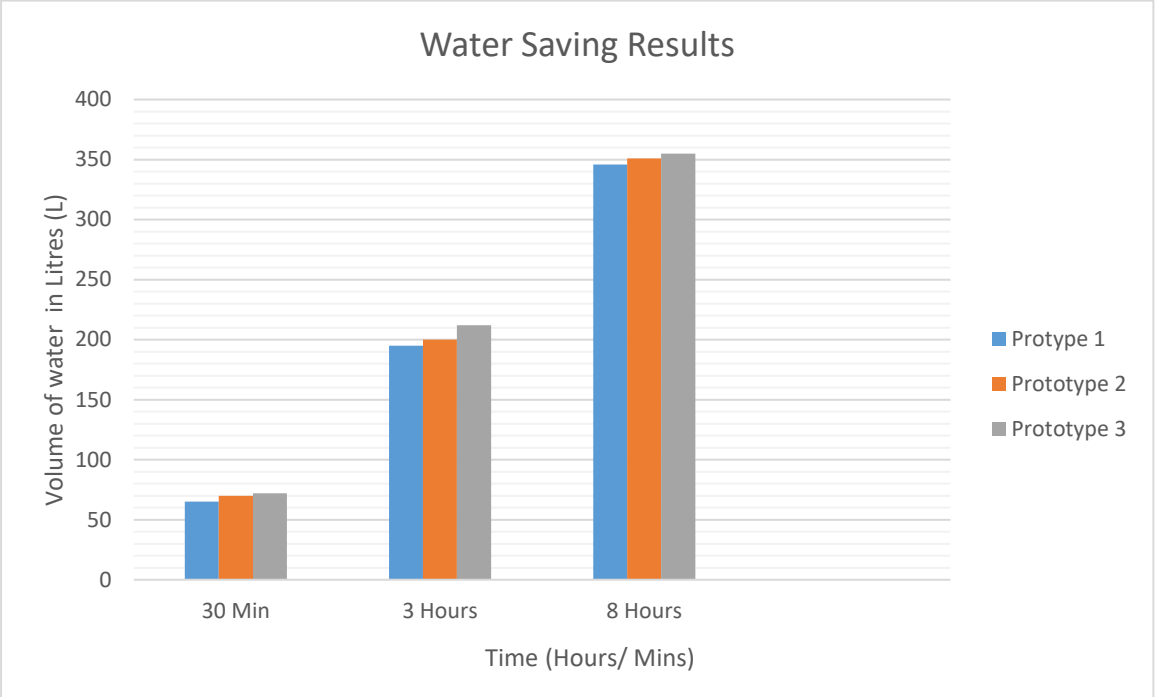
3 RESULTS AND DISCUSSION

3.1Results:

Table 1: Water saving results from three (3) Prototypes:

Duration	Prototype 1	Prototype 2	Prototype 3
30 Min	65 Litres	70 Litres	72 Litres
3 Hours	195 Litres	200 Litres	212 Litres
8 Hours	346,7 Litres	351 Litres	355 Litres

Graph 1: Water saving results



3.2 Discussion:

While using prototype (**1**)1 we saved an average of 65l of water. After adjustments were made to prototype (**1**), we saved on average 70l of water using prototype (**2**). It is clear from the above data that after adjusting the pipe to a longer length, even less water was wasted. This could be because learners did not have to bend over anymore, resulting in even more water being saved when prototype (**3**) was implemented.

4 LIMITATIONS

When we began to invent our device, the idea and the parts came from existing tools which we found in our households. This assisted us to limit the financial costing we required to invent/build a working device. Once we acquired all the tools, there were very few items left which we had to purchase as detailed above in the report.

Therefore, in terms of limitations we uncounted some challenges:

4.1 Due to the current economic crisis both in our area as well as Country, our school unfortunately falls victim to continued vandalism of the school's property which includes the theft of water infrastructure such as copper piping and taps.

4.2 When visiting neighbouring schools we had to remove the existing device at our school as it was needed for the demonstration, this meant that for a short period of time the device was not operational at Heatherlands High.

5 FUTURE IMPROVMENTS

As we were able to conduct the experiment at our school by installing the device on the outside tap our hope as future improvements would be the following:

Firstly as we have now installed the device permanently at the school we would like to over the next three months conduct further research by conducting an assessment of the Municipal monthly bills and compare that to the Municipal water bills before our invention of the drop saver.

This would give us an opportunity to conduct a comprehensive assessment on the data and begin to compare water savings in real-time data based on the readings done on the Municipal water meter.

Secondly, part of our next phase of the project would be to replicate the device and introduce & install it at neighbouring Schools in and around George.

This would be beneficial as it will strengthen the efforts taken to reduce the amount of water losses and promote measures of water conservation.

Lastly, we have introduced our device to the Local Municipality, George and have presented not only the device but the results we were able to gather over time.

Our objective is to strengthen the support for the invention and then assist our Local and Provincial schools to install the device as well.

6 AWARENESS AND EDUCATION

We began our awareness campaigns once we realised that our invention not only worked, but was able to save more than 100 Litres over a per of a school week.

The following steps were taken towards education and awareness:

- *Awareness Talks:*

  we asked permission from our Principle to address the entire school where we were given a time slot during the assembly where we could talk to the learners, demonstrate the functioning of the device, the importance of the device and how we can all save water.

- *Education:*

  We asked permission from the educators to visit the classes once again to demonstrate how the device works, this was to ensure that learners did not break the device when using it and contribute to the lifespan of the actual device.

- *Campaigns:*

  We visited the neighbouring schools to conduct awareness about our invention and the tremendous contribution it makes towards saving water, this initiative was warmly welcomed by other schools and we discovered water saving is something of great concern to all.

- Media and Marketing:

  Once we won the South African Junior Youth Water Prize (SAJYWP), Provincially in preparation for the National competition we reached out to the local media outlets to conscientize the local communities within the Eden District Municipal Areas.

- *Notices:*

  We distributed water conservation pamphlets at the school to further promote the education of water conservation and put up posters around the school. The most inventive notice was painting the wall where the device is installed, the notice was painted by the learners of the green club and ensures that every time the tap is used the notice is read.

Picture 12: the water conservation notice painted on the wall where the device is installed at the tap.

7 RECOMMENDATIONS

Based on the research conducted it is evident that there are many water saving devices already on the market, however due to the continued economic crisis and the inequality of service delivery to our Communities it is upon society at large to contribute to the initiatives and measures taken towards water conservation to secure water supply beyond 2030:

With our invention saving more than that of an individual's basic water usage we can now confidently make the following recommendations:

7.1 Form partnerships and collaborations within the water sector to replicate the devices across schools within the Western Cape.

7.2 Develop an user manual that can be used to equipped other water ambassadors to install, operate and maintain the device.

7.3 Install the device Locally throughout Primary and High Schools in and surrounding the George Municipal Area.

7.4 Gain additional supporting media attention to market and advertise the innovative drop saver across the Province.

7.5 To Partner with industrial companies within the water sector to support bulk manufacturing.

8 CONCLUSION

On average an individual uses approximately 1250 litres daily as their basic need, this is used without thought of using water sparingly, and with many interventions and measures to reduce this amount all it takes is a change in Human behaviour and social responsibility to change Humanities careless ways of the pressure place on natural resources.

Saving water is everyone's business, and with many attempts and research we are able to invent a device that could really make a difference and contribute to water conservation daily.

From the above data it is evident that our Drop Saver is really making a difference and saving water with an estimated 1300 litres of water bring saved per month at our school with just one device installed.

If one device can save more than the free basic human consumption imagine if the device is replicated and installed on a larger scale.

Most of the learners also like the idea of using this device. It is also creating an awareness amongst our learners of how important it is to save our precious water resources.

Our future improvements includes the installation of our device at more taps at our school and introducing this concept to our neighbouring Primary and High Schools so that collectively we contribute to the water savings of George Local Municipality annually.

Based on our result and experiments conducted once the drop saver was invented, we hereby accept our Hypothesis.

9 REFERENCES

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