Knowledge gaps are the climate's worst enemy

How climate knowledgeability of Dutch students can improve national climate response

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ABSTRACT

In the past decades researchers have found that knowledge about climate change will positively impact climate policy support. This support for policy is vital for policy success and implementation. Recent literature suggests more effort has to be put into making information more widely available, with a view to drastically reducing existing misconceptions and gaps in knowledge about climate change. This research conducted a survey to find a correlation between climate knowledgeability of Dutch high school students and their support for climate policy. Analysis of the sample (n=185) found knowledge gaps regarding nuclear energy, ozone, and climate policy awareness. It found misconceptions regarding nuclear energy, ozone, temperature rise, and most notably saw a high overestimation of Dutch progress on transitioning towards renewable energy. Statistical analysis of the sample found a significant relation between age and climate knowledge, older students tend to have higher knowledgeability. Similarly the research found a significant relation between gender and climate knowledge, boys tend to have higher knowledgeability than girls. On average students scored a 4.7 on the knowledge questions, which they tend to slightly overestimate both beforehand and after. Policy support among students is generally high, but most find the Dutch government should do more regarding climate change response. The research found no correlation between knowledge and policy support in the sample.

INTRODUCTION

Climate change is real, it's growing worse, and it seems more and harder to stop - if that's even still a possibility (IPCC, 2021). In order for politicians and the general public to respond and act in a sufficient manner to climate change, academics have emphasized the significance of climate knowledge and awareness (Stoutenborough & Vedlitz, 2014; Drews & van den Bergh, 2015; Wang et al., 2018). The results of survey research over time do not show that any large-scale national or multinational attempts have significantly increased general knowledge of climate change. These studies, which have been carried out over the past few decades in a number of nations, do not demonstrate an increase in knowledge over time, per country, or among different age groups (Leiserowitz et al., 2011; Tobler et al., 2012; Stevenson et al., 2018; Fischer et al., 2019). Even though media coverage about climate change, its consequences and mitigation options has advanced in recent years, this has failed to improve know-how in the countries of research (Thaller & Brudermann, 2020). This media coverage has improved awareness, but without the knowledge to understand the impact, effect and reasons behind mitigation or policy it will impede widespread approval from the general public (Lorenzi et al., 2007; Vignola et al., 2012; Shepard et al., 2018). Policy in particular is important to an adequate climate change response (Drews & van den Bergh, 2015). Correct policy has to be proposed, written, executed and more importantly approved by people, who have the ability to chance their vote or obstruct policy implementation (Drews & van den Bergh, 2015). Thus success of policy is often linked to policy support. Climate change policy is expected to improve significantly with a more accurate understanding of climate change (Zahran et al., 2006).

One could ask why laypeople do not just search for more knowledge themselves if climate change knowledgeability is so important to make justified decisions. This question has been partially covered in previous research as well, and often is blamed on overconfidence and/or relatively high perceived knowledgeability of respondents (Fischer et al., 2019; Thaller & Brudermann, 2020). Most people think they know a lot about climate change and how it works. They especially often think they know more about climate change than other people. This perceived knowledge is most often higher than actual knowledge (Hannibal & Vedlitz, 2018; Thaller & Brudermann, 2020).

The importance of improving climate change knowledge has been established in literature. But although adequate knowledge on the subject is important for the general public's support of climate policy, knowledge must also be improved in political bodies as well. Policy support does not mean anything when there is inefficient or incorrect policy. For most people it might look like climate change and politics are not 'that' connected, any climate change measure in the form of law, policy, or fund has to come from or via a governmental body, which is often the national government. Previous literature shows climate change action and politics have a surprisingly strong connection, so much in fact

that political affiliation has been statistically linked to climate knowledge and policy support (Dietz et al., 2007; McCright, 2008; Jamison, 2010).

In the Netherlands there has been some research on climate change awareness or acceptance (NJi, 2022), but preliminary research for his thesis has not found existing research on climate change knowledge and/or policy support in the Netherlands yet, which makes it an interesting case to look at and compare with other countries. The Netherlands has also been one of the slowest countries to respond to climate change and adapt to clean energy sources (Dongen, 2019). This could be the result of the political 'polder' culture. This 'polder' culture is a process of decision making based on consensus, of solving problems via dialogue with every party having an equal say. This results often in a lengthy procedure, which might or might not conclude with a solution or consensus (De Vries, 2014). The Dutch house of representatives is fractured into many parties, which are very divided on many fronts, among which climate change and climate policy. Meanwhile, general consensus among the public completely contrasts actual numbers. The majority of people think that the country is doing quite well, regarding the national climate response (Van Dam, 2021). This could be attributed to the (often unintentional) framing of media, common use of skewed statistics and the nationally introduced solution of 'doing your part' (Kaal & Damhuis, 2020). An example of such skewed statistics is that national news and talk shows often use the numbers for Dutch energy production to show national progress or lack thereof**.** These statistics show a significant increase in Dutch clean energy production, which is now about 28% renewable energy, of which 11% biomass (CBS, 2021b), which still emits a lot of CO_2, so can not be counted as green energy (CBS, 2021a). However when looking at the Dutch energy consumption, about 8% is renewables (CBS, 2022). This is due to the fact that a lot of Dutch green energy is exported and more and more energy has to be imported due to slowing gas extraction in the north of the country (Rijksoverheid, 2020). Often this is overlooked or left out in the media or by politicians, unintentionally or otherwise. That is one of many examples where the public is not being well informed about climate change. This is an important issue, because with the thought that we are making progress, and without the sense that we are doing very badly compared to other countries, the general public has a reduced sense of urgency (Lorenzoni et al., 2007; Fesenfeld & Rinscheid, 2021). And without a sense of urgency, there are less questions asked, which results in a lower percentage of people trying and willing to improve knowledge, which can be a problem for policy support when actual improvement is tried to be made (Thaller & Bundermann, 2020; Fesenfeld & Rinscheid, 2021).

This research is built on a strong hypothesis of a climate change knowledge gap among the Dutch general public hampering the climate response. By not knowing the current state of things and not knowing they lack the knowledge to respond better, these people unknowingly slow down the general climate response. A better informed general public should push Dutch climate response into a better direction, letting them catch up with the many countries which have already exceeded them. This research will focus on

adolescent students, because previous research has followed similar samples, giving more room for comparison over time and borders (Leiserowitz et al., 2011; Stevenson et al., 2014; Stevenson et al., 2018; Thaller & Bundermann, 2020) and have identified this group to be the most interesting for improving climate knowledge (Stevenson et al. 2018). This research will look at how climate knowledge is defined; how previous research has shown a knowledge gap within climate change; and how climate knowledgeability connects to policy support. Based on lessons learned from that, it will construct a research of its own to try and prove the hypothesis of a knowledge gap among the Dutch public. If proven correct, and change can be made in the knowledge of the general public and consequently in the climate response, this research could have great political and societal relevance to the Dutch and hopefully be of environmental relevance to the world.

The main objective of this research is to establish the level of importance of public knowledgeability in the pursuit of policy support and thus a good climate response in the Netherlands. Simultaneously the thesis aims to develop a well-structured, easily expandable and replicable research template for further research. Past research has not produced such a research template. In the single case a survey was reused it was not used for similar research or comparison with the other research (Stevenson et al., 2014). The lack off a research template or rather a survey might be the result off multiple factors. Researchers might not have seen benefit in replicating their research some time or some where else and did not include their survey in their papers. Researchers might have had varying aims or methods for their research and thus had different needs for surveys. This survey takes inspiration of a survey by Leiserowitz et al. (2011), but in many aspects differs from it. Although the survey produced by this thesis will be hard to replicate outside of the Netherlands, because of specific questions about the country, it could be replicated on a larger scale or in different parts of the country. With some modification to the survey, it might also be useable outside of the Netherlands.

Research Questions

Considering the above, this research is based on the following research question: *To what extent can knowledgeability about climate change among Dutch students improve or contribute to the national climate change response by the state and the public itself?* This research question produced 5 sub-questions.

Sub-question 1: *How is climate knowledgeability conceptualized in contemporary literature and its general influence on support for public policy theorized?*

Sub-question 2: *What empirical evidence is there of a link between climate knowledge and policy support?*

By way of a literature review this research found there are many concepts linked to climate knowledgeability. These include the importance of climate change knowledge in

peoples decision making, lifestyle and support for politics and policy. But the improvement of knowledge is often obstructed by the inability of researches to covert their knowledge to usable knowledge for people and politicians alike. The media have not been able to improve knowledge either, but did improve general awareness.

Sub-question 3: *Which positive trends, knowledge gaps and misconceptions regarding climate change are present among Dutch high school student?*

By conducting a survey research among a sample of high school students (n=185), this research found multiple positive trends, knowledge gaps and misconceptions. Some positive results include: 94.1% of the students believe that climate change is a real thing. According to the Dutch Bureau for Statistics, CBS 94% of Dutch adults think climate change is real. It showed the students had a general understanding of fossil fuels and CO2 and its role in climate change. 9 out of 10 students could identify the most prominent fossil fuels; 95.7% of the students identified CO2 as a greenhouse gas and 78.4% know CO2 is mainly emitted by burning fossil fuels. 89.7% of students know that stopping emissions now won't stop climate change.

By looking specifically at the proportion of students who fill in don't know can give us an insight into where significant knowledge gaps might be found. The survey found namely knowledge gaps in nuclear energy, the ozone layer and in knowledge about the current climate policy of the government.

By looking specifically at the proportion of students who fill in the incorrect answer can give us an insight into where significant misconceptions might be found. The survey namely found knowledge gaps in the impact of humans, the rise of temperature, the ozone layer and the current state of the Dutch progress in energy transition and it's position compared to other EU nations.

Sub-question 4: *How does perceived knowledge of students compare to their actual knowledge about climate change?*

By conducting a survey research among a sample of high school students (n=185) and further statistical analysis by use of SPSS, this research found that students generally estimate their knowledge to be higher than their actual knowledge. Perceived knowledge was asked both before and after the survey. After the survey the perceived knowledge dropped from 6.6 > 5.6. The actual average score of students was a 4.7.

Sub-question 5: *To what extent does climate knowledge of Dutch students correlate with changes in policy support?*

By conducting a survey research among a sample of high school students (n=185) and further statistical analysis by use of SPSS, this research found a negative correlation between high school students' climate knowledge and policy support. This contradicts

findings by past research on the subject (SOURCE). Knowledge is thus not a factor for policy support in this sample. This difference between past research and this one might be the result of adolescents having a less strong opinion on policy. It might also be the result of the difference in questions in this research and past research.

LITERATURE REVIEW

To answer sub-question 1: *How is climate knowledgeability conceptualized in contemporary literature and its general influence on support for public policy theorized?,* and sub-question 2: *What empirical evidence is there of a link between climate knowledge and policy support?* this research reviewed existing literature on the subject of climate change and policy support. There has been some survey research on the subject of climate knowledge already (Bostrom et al., 1994; Leiserowitz et al., 2011; Tobler et al., 2012; Stevenson et al., 2014; Hannibal & Vedlitz, 2018; Fischer et al., 2019; Thaller & Bundermann, 2020). This research conducted large scale surveys to capture how knowledgeable the respondents are on the subject of climate change. Most of these papers concluded there are many misconceptions about climate change, more people know fragments and when presented with open questions struggle to answer. Further research has explored the importance of climate change knowledge, the relation between policy support and climate knowledgeability, the role of politics, the problems with knowledge distribution and the contribution of the media.

Previous Research on Climate Knowledge

Tobler et al. (2012) already looked at and summarized past literature on climate knowledge. Their review unveils very similar trends all-over climate knowledge research, but also touches upon the source of these trends and the connection to climate change knowledge and media. Most papers discussed by the writers are written between 1990 and 2010, which already mention seeing a trend of similar results over time and across nations. Recurring misconceptions are connecting the ozone layer, skin disease and climate change. The concept of CO2 is somewhat familiar to respondents, but the exact workings and influence of the substance proved to be hard to explain by respondents. Besides the workings of climate change, the terms 'climate change' and 'climate' are often swapped or intertwined by respondents. The main trends seem to be a number of recurring misconceptions and knowledge gaps. Misconceptions include views, opinions and understanding of concepts which are incorrect, because of incorrect thinking or understanding of information. Knowledge gaps refer the actual lack of knowledge to form a view, opinion or answer in the first place. These trends also do not differ widely among gender, age or education level (Leiserowitz et al., 2011; Tobler et al., 2012; Stevenson et al., 2018; Fischer et al., 2019). Tobler et al. (2012) think the relationship between education level and climate knowledge is so weak, because many adults never learned about climate change in school. Most people are thus presumed to get their climate knowledge from the media, predominantly television. While teens mostly get their climate knowledge from the internet and school (Leiserowitz et al., 2011; Berbeco & McCaffrey, 2016). That would explain why climate knowledge seems to be more evenly spread among the general public, especially among the generation which had no to little

lessons on the subject in school. According to Leiserowitz et al. (2011) that does not necessarily mean teens are less likely to have misconceptions about the climate. Their research showed similar misconceptions among teens as in research in prior years. However, on pure knowledge, meaning the amount of correct answers, the teens do seem to have a small lead compared to the adults. Teens are also more likely to want to learn more about climate change.

However, the results of most research still show little knowledge on climate change and many misconceptions and knowledge gaps repeating over time. It is then curious to see most people think they know quite a lot about climate change. To better understand this phenomenon, various researchers have researched people's perceived knowledge and compared that with assessed knowledge. This was achieved by means of surveying or interviewing samples from varying populations. First asking them about how much they think they know and conclude assessed knowledge through knowledge questions (Stoutenborough & Vedlitz, 2014; Hannibal & Vedlitz, 2018; Thaller & Bundermann, 2020). With perceived knowledge these authors mean how people perceive their own knowledge level about climate change; how much they think they know and how much they think they know compared to other people. Assessed knowledge is how much people actually know, which is measured by a test about the main subject of climate change. All of the research discussed, saw that the significant majority of people estimate their climate knowledge higher than their actual knowledge. Research also found people who discuss more about climate change with others have a higher perceived knowledge, but this does not necessarily translate into higher assessed knowledge (Hannibal & Vedlitz, 2018).

Climate Knowledge and Policy Support

Many papers imply the need for, or ask for efforts to increase knowledge regarding climate change. More knowledgeable people would make more considerate choices in their lifestyle and political choices (Bostrom et al., 1994; Lorenzoni et al., 2007; Stoutenborough & Vedlitz, 2014). Most research on climate knowledge with regards to policy support suggests a relation between the knowledgeability of the general public and climate policy support or action (Tobler et al., 2012; Thaller & Bundermann, 2020). However, not all literature suggests a positive correlation. An analysis of previous research by McCright (2008) showed no correlation between climate concern and knowledge with policy support. Rhodes et al. (2014) found there is no statistical relation between policy awareness and policy support. Sarewitz (2011) claims the wide consensus that a relation between increased climate knowledgeability and policy support is very much debatable. Climate change has seen increased coverage in the media in the past three decades, but has not yet resulted in very noticeable changes in knowledgeability (McCright, 2008; Thaller & Bundermann, 2020). However we can not assume nothing has changed at all. Although research in the past few decades has again and again found

similar misconceptions and knowledge gaps within their samples (Bostrom et al., 1994; Leiserowitz et al., 2011; Stevenson et al., 2018; Thaller & Bundermann, 2020). This does not necessarily mean that climate knowledge has not helped climate change action progress in any way. Knowledge is a strong factor, but in the case of policy support, awareness is an important factor as well (Drews & van den Bergh, 2015), which has significantly increased in the past few years (Stevenson et al., 2018; Thaller & Bundermann, 2020). Climate knowledge can also be the driver for positive change in climate awareness and perception, which can be enough to ensure policy support when presented correctly (Vignola et al., 2012; Drews & van den Bergh, 2015). The argument that knowledge has not improved at all can thus not be really supported with contemporary research. Furthermore, media coverage does not necessarily mean increased knowledge. More likely this will have more impact on awareness than on anything else (Shepard et al., 2018). Thinking that knowledge can be achieved through media alone is neglecting statements of various papers that media is also one of the most significant suppliers of misleading and false information (Lutzke et al., 2019). These various surveys over the past decades more than anything else prove the inefficiency of news media and current measures to correctly improve climate knowledge. It is therefore that we might have to look at different approaches, such as laying more focus on the subject in primary and secondary education, and special media programs focusing on improving knowledge. (Berbeco & McCaffrey, 2016). No previous research has mentioned any of these things to have taken place prior to their research. We expect change over years, while really nothing has changed. Therefore when doing research in this field one should not only try to determine knowledge, but also speculate on how to improve that knowledge or at least fix knowledge gaps and misconceptions determined in said research.

Policy Support and Politics

Whether climate knowledge is statistically relevant for policy support or not is thus not entirely agreed upon in the academic world, although it seems more contemporary sources suggest there is a connection. In contrast, most of the consulted literature did confirm a relation between political affiliation and climate knowledge and political affiliation and policy support (Dietz et al., 2007; McCright, 2008; Ryghaug, 2009; Drews & van den Bergh, 2015; Hannibal & Vedlitz, 2018). The literature suggest leftwing voters are generally more knowledgeable, have a higher level of concern and more often in favor of policy support, as opposed to rightwing voters (McCright, 2008; Hannibal & Vedlitz, 2018). The political variance weighs so much in fact that climate policy support can be directly linked to political affiliation (McCright, 2008; Hannibal & Vedlitz, 2018). The political aspect of climate policy support does have its drawbacks however. Some people might become more skeptical due to the political weight of climate policy, seeing climate change more as a political tool used by certain parties, rather than a universal problem

(Ryghaug, 2009; Sarewitz, 2011; Wang et al., 2018). The use of climate change as a tool in politics is indeed very common and is used by both left and rightwing parties to support other agenda points. Often this use as a tool, consists of nitpicking the facts and numbers, which are favorable for the parties narrative and is in no way limited to left or rightwing parties. Even outside politics, websites, corporations or organizations with a political affiliation or agenda might use and depict science in different ways scientists would (Jamison, 2010; Berbeco & McCaffrey, 2016). Because climate change is not the only factor considered in political affiliation, being part of or voting rightwing might also undermine existing climate concern (Hannibal & Vedlitz, 2018).

The highly politized nature of climate policy has been mentioned by various other authors as a significant obstacle to policy support and filling the knowledge gaps about climate change (Thaller & Bundermann, 2020). The political weight of climate change can also shine through in education as teachers might feel hampered in addressing the subject when they, other teachers, or parents uphold very different views (Berbeco & McCaffrey, 2016). Still, making people more aware of and knowledgeable about climate change may shift political support as well. But this will also ask political parties to stop using climate change as a political tool to support other agendas. Depoliticization of the subject would be the ideal solution (Unsworth & Fielding, 2014). But the politized nature of climate change will not easily change, thus trying to break this bond might not be something that should be the focus of research. Changing voting patterns with just knowledge might also prove difficult, as climate change is not the only factor considered when voting for parties on a multidimensional spectrum, and should not be the only factor either (Drews & van den Bergh, 2015). Either way more openness and truthful climate knowledge would help people make better decisions in their political support and everyday life (Lorenzoni et al., 2007).

Knowledge Transfer and Media

Various researchers also identify the media to be part of the problem (McCright, 2008; Thaller & Bundermann, 2020). In the US, news agencies have chosen sides and more often than in other countries question the correctness and importance of climate change and climate policy (McCright, 2008). Furthermore, information presented by scientists has proven to more often fall on deaf ears. When presented with the same knowledge from famous or trusted people, channels or sources, people are more often inclined to trust those familiar voices (Lorenzoni et al., 2007; Brulle et al., 2012; Rhodes et al., 2014). Thus sometimes making the right people more knowledgeable seems more impactful in changing policy support than educating everyone. We cannot expect everyone needs a familiar trusted source to accept or discuss new knowledge, but for those who do we can determine where this trust lies just by asking the question what the primary origin of their climate knowledge is. The problem of misused or skewed information about climate change in media, politics or other sectors is often not blamed

on them in contemporary literature. The problem is often blamed on scientists' inability to convert scientific knowledge into comprehensible and usable knowledge (Porter & Dessai, 2017; Loehr & Becken, 2021). Throwing report after report and research after research out in the world will often fall on deaf ears. The information is not fitted for specific use. Often reports have global or international results, which are not relevant for local or regional policy (Loehr & Becken, 2021). The relevant knowledge just does not reach (all) the people who it is meant for or who need it (Dilling & Lemos., 2011). Climate science is difficult and struggles with lots of jargon and intricate processes, which are hard to understand, but maybe even harder to explain. Especially when the need of the recipient is neglected or not considered. The role of a scientist is not only to provide usable knowledge (Lemos, 2015; Loehr & Becken, 2021), but to understand and listen to the needs of stakeholders (Porter & Dessai, 2017). Communication is key and the common conclusion is that this communication is lacking and that is mostly to blame on the scientists themselves.

Multiple authors have tried to introduce a system of co-creation in climate knowledge and policy. Working with various stakeholders to mobilize knowledge in an effective way, closing the barriers between science and policy (Howarth et al., 2022). This will ask for a transdisciplinary approach where climate scientists both get support from other scientists, but also effectively communicate with the various sectors of stakeholders (Porter & Dessai, 2017). Although, some research suggests that there is no such thing as a plan for effective co-creation in climate policy, but rather should be viewed as a process which forms by itself (Meehan et al., 2018). Science communication has been found as one of the main contributors to poor climate knowledge and poor policy design. And although it seems to be a hot topic nowadays in the field of climate policy, it has been established as a problem since at least 2009 (Ryghaug, 2009). All the while there has not been drastic change in the matter and the same problems in climate knowledge deficits and poor climate policy still exist today.

METHEDOLOGY

To answer sub-question 3, 4 and 5, the research will use a quantitative research method in the form of a survey and accompanying data analysis.

Past and contemporary research have adopted varying forms of research to determine climate knowledgeability and its impact on policy support. Some research adopts open questions for more complete and individual answers (Bostrom et al., 1994; Vignola et al., 2012; Rhodes et al., 2014). Other research adopts a method of true-false statements (Tobler et al., 2012; Hannibal & Vedlitz, 2018; Fischer et al., 2019; Thaller & Bundermann, 2020). Though the most conclusive research with the most complete results seem to have a mix of multiple choice, statements, and few open questions (Lorenzoni et al., 2007; Leiserowitz et al., 2011; Stevenson et al., 2014). It is the latter which also seems more applicable in the time frame and goal of this research. The aim for a high number of questions and high number of respondents asks for a relatively simpler method and data output. Contemporary research on the subject also seems to put a focus on statements and multiple choice, instead of open questions (Hannibal & Vedlitz, 2018; Stevenson et al., 2018; Fischer et al., 2019; Thaller & Bundermann, 2020). Besides that, the research that does make use of open questions, most often generalize answers into simpler data as well. Therefore this research will adopt the multiple choice/statements strategy. This manner of questioning could come with some bias in respondents' knowledge level however, as someone who does not know the correct answer might guess correctly when given multiple choices. The amount of questions, respondents and the unlikelihood that respondents guess right all the time, will mostly prevent any major bias in the overall result (Tobler et al., 2012). The respondent will also have the opportunity to enter 'I don't know' as an answer. This will be counted as a wrong answer during the evaluation, following the observations made by Tobler et al. (2012): The aim is to measure knowledge and 'I don't know' is considered lack of knowledge and will thus be counted as a wrong answer. This option is included to prevent respondent's having to guess. The amoun of 'I don't know' responses can also shine light on whether there are knowledge gaps rather than misconceptions in some instances.

To ensure the validity and trustworthiness of the results, the questioning in this research will mostly follow existing trends and try to cover the most notable aspects of previous and contemporary research on climate knowledge and policy support as is identified in the literature review. This includes the way knowledgeability is measured (Leiserowitz et al., 2011; Tobler et al., 2012) and the inclusion of the more recent relevance of the subject of perceived and assessed knowledge (Hannibal & Vedlitz, 2018; Fischer et al., 2019; Thaller & Bundermann, 2020). Questions will be structured in a way that does not push people to give a certain answer. Questions will be clear and without jargon. The survey has been tested two times on two different sets of laypersons before the survey

week. This ensured no unclear words, unclear questions or spelling errors remained in the survey. The methodology and analysis will be as clear as possible to ensure replicability.

Sampling & Survey construction

Following similar populations measured by several previous studies (Leiserowitz et al., 2011; Stevenson et al., 2014), this research will question high school students as respondents. This group has been identified by said research as the most interesting in knowledge expansion. Besides that repeating similar research in different countries or over time with similar samples and populations gives more room for comparison. This might be interesting to figure out if there are any differences between the populations between countries or over time. The survey makes use of non-probability sampling as it is considered to effective to use when taking a sample from a school (Acharya et al., 2013) It must be noted that this study has been conducted in one school and should thus not per se be generalized or regarded as representative for all Dutch high school students. So when talking about students in the analysis this paper specifically talks about the respondents.

The biggest possible drawback of this strategy is that high school students are not fully representative of the greater Dutch populace regarding age distribution, education, income, etc. nor have they any large voice in politics or policy. However, previous research has not found significant differences in climate knowledge between age and education level either (Leiserowitz et al., 2011; Tobler et al., 2012; Stevenson et al., 2018; Fischer et al., 2019) By comparing some existing statistics of the Dutch population to the students sample we can determine the correctness of comparing the sample to the Dutch population. Students would be the easiest group to improve climate knowledge in, as school is mandatory for this group, making it possible to cover large groups at once. Teens most often have families which they can inform when they are informed, while not all adults have the same reach within their household (Berbeco & McCaffrey, 2016). Thus it is deemed more favorable for further research and intervention to focus on this group as opposed to others , which is why this research will focus on them. Several papers argue that media might be the biggest source of climate information (McCright, 2008; Thaller & Bundermann, 2020), which would then not per se justify more focus on climate education in school, as that does not seem to be the biggest source of information. However, it has been clear from the persisting knowledge gaps and misconceptions (Leiserowitz et al., 2011; Tobler et al., 2012), that media can only do so much and will more likely impact awareness rather than actual large scale knowledge improvement or knowledge distribution (Sarewitz, 2011; Thaller & Brudermann, 2020). Thus more climate education in school might yield better results than expanding climate 'education' via media. The survey itself consists of 24 multiple choice questions and 13 statements, which the respondents have to answer to the best of their knowledge. Google Forms will

be used to take the survey, because it fits the needs of the questions, number of uses and safety requirements. The program is easy to use for respondents and researchers, has no limit in the number of questions or submissions and produces clear, usable data output. Furthermore the use of two factor authentication to access the Google forms ensures a high level of security for the results.

Questioning and Measuring Knowledgeability

The questions in the survey are designed to identify knowledge gaps, misconceptions and well known subjects within the theme of climate change. The full list of questions can be found in *Appendix 1*. Most of the questions have drawn inspiration from previous research. The question list used by Leiserowitz et al. (2011) and Fischer et al. (2019) is often used as a source, because their research belongs to some of the few who included a full question list. The question list follows the same themes and manner of questioning as this research and the questions are extensively backed up by other sources. 13 questions in the survey regarding climate change are thus directly taken from or adapted from these questions. The question list as presented by Leiserowitz et al. (2011) has been used in later research as well (Stevenson et al., 2014), but did not fulfill the needs for this research. Some of the questions were outdated, too easy, too specific, framed to give a specific answer or deemed irrelevant for this time period. Therefore this research has developed a new survey. Compared to the survey by Leiserowitz et al. (2011) the amount of question is considerably lower. One might argue this will give a less complete view of knowledgeability compared to a lengthy survey, but this survey still takes about 15-20 minutes for a student to fill in. Which proved already quite lengthy for some of the respondents. A more lengthy survey might have resulted in laxity in answering the questions, possibly resulting in bias. The survey does cover the most important questions, but does not go into specifics like the survey by Leiserowitz et al. (2011). Some other questions were added to fit the Dutch scenario.

Several questions also ask the respondents about their perceived knowledge and confidence about climate change, these questions draw inspiration from previous research (Hannibal & Vedlitz, 2018; Fischer et al., 2019; Thaller & Bundermann, 2020). Hannibal & Vedlitz research on perceived knowledge and assessed knowledge showed interesting correlations between the two. By asking the respondents their perceived knowledge both personally and compared to others , the research can see how this holds up to the assessed knowledge, which is measured by how many questions they answered correctly. The same questions will be asked before and after the knowledge questions, also giving the respondent an opportunity to adjust their perceived knowledge after the survey.

Lastly the survey asks about policy support. For this particular segment finding relevant questions in existing literature about climate knowledge proved a lot harder Questions or surveys were often no included in the consulted literature. Some inspiration

was taken from Hannibal & Vedlitz (2018) regarding the knowledge about existing policy and support for existing policy. A worldwide survey research by the UNDP (United Nations Development Programme) showed respondents a policy and asked respondents if they agreed. The same method seems to be used by European and Dutch Statistics Bureaus (Eurostat, 2021; CBS; 2021c). This method of questioning is easy to use, but has some drawbacks as well. Respondents who might be on the fence or don't totally agree or disagree or not represented as they have to choose between two extremes; agree or disagree. Therefore most of the questions relating to policy support in this survey will have a 5-point Likert scale, to capture the possible uncertainty or conflicted opinions of the students.

Ethical Considerations

The research will be in line with the Code of Conduct for Scientific Practice under Dutch law (KNAW, 2018) and will abide by the standards and behavioral rules set by the Campus Fryslân (University of Groningen, 2022b) and University of Groningen (University of Groningen, 2022a). The research revolves around climate change, which to some people and in some spheres may be a sensitive topic (Berbeco & McCaffrey, 2016). Besides that, some conclusions have to be drawn on participants' knowledgeability, by the research, but also by the respondents themselves during the survey, which might be confronting. Therefore it is essential to be discreet when conducting the survey, and confidentiality is of great importance. To ensure confidentiality the survey will be anonymous from the start and will not ask for personal data besides education year and gender. To secure the data, the survey will be taken with a secured online tool, Google Forms. The data is only accessible via the researcher's account, which is secured with two factor authentication. The database will only be accessible by the researcher and supervisors and will, in consideration of participant ratio, be deleted after the research has concluded. The topics and the survey as described above can also deter people from participation. Therefore it may be beneficial for the participation ratio and respondents' experience to appease any participant who does not feel comfortable for any reason. Withdrawal from the survey will be optional at any point of the survey. Further points for consideration during the survey will be openness to any question or discussion before, during or afterwards. Clear language and no jargon in both written and spoken sections will be paramount. Before taking the survey the participants will be told all of the considerations above and have to read through a small consent form *(included in Appendix 1)* Which they have to manually agree on, if they do not they can not continue or submit the survey.

Survey

The survey was conducted between May 17 and May 19 among 185 Dutch high school students from Friesland, the Netherlands. All students are from the same school and are equally distributed between class, with the exception of class 6, who had exam week in the survey week. This class is thus in some cases left out to allow for statistical analysis. In the Dutch school system 'Class' is similar to grade or year in other countries. Class 1 often consists of 12-13 year-olds and so on. The students follow the highest possible education level in the Netherlands. Most of the respondents are thus minors. The survey has been approved by the Ethics Committee of Campus Fryslân, University of Groningen and was allowed to proceed without further measures. Respondents who did want consent from their parents were given the option to do so. They received a link via magister (Online tool of the High School) to stay anonymous and have the option to fill the survey at home. The survey was only possible the fill in via google forms and not on paper to secure privacy. The students were not made aware of the survey prior to the survey. The survey was conducted over a 3-day period, so it is possible that students informed other students after their survey. However, students did not get to see the correct answers, so there was no real risk of bias. In Analysis there was no statistically significant change between responses or overall grades over the 3-day period. All surveys were taken in class, but around 20% of students decided to take the survey at home, this high number might be the result of the survey not being obligatory in class. These students had an email and phone number to ask questions if anything was unclear, this option was not used by any of the respondents.

Analysis

The survey mostly collected nominal and ordinal data, which was analyzed by use of the Google Forms results tool and for some result outputs this research makes use of SPSS. At that point none of the data can be linked to individuals or classes and can be used without compromising any privacy standards. The data file will not be distributed in its original form, but will be used to make graphs and calculate percentages. This reworked data will be shared in this Thesis only. The knowledge was measured by looking at the amount of good answers. This was compared to perceived knowledgeability before and after the survey and the respondents' stance towards policy and policy change. To abide by the rules of statistical tests some changes had to be made in the sample: For any comparison between gender, 9 respondents who did not identify as a boy or a girl were removed from the sample. For any comparison between grades(classes), 6 respondents from class 6 were removed from the sample.

RESULTS

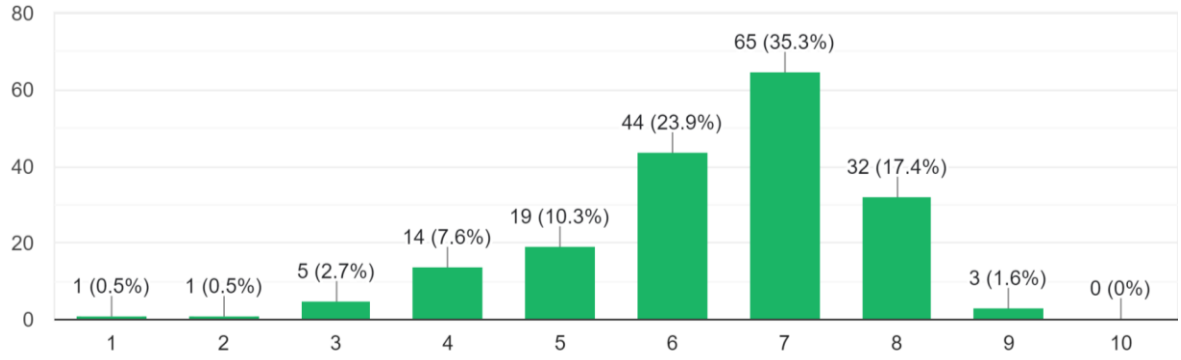
This chapter shows the results of all the questions separately. All questions yielded relevant results. The results have been summarized at the end of the chapter on page 36.

Q2-Q4: Demographics

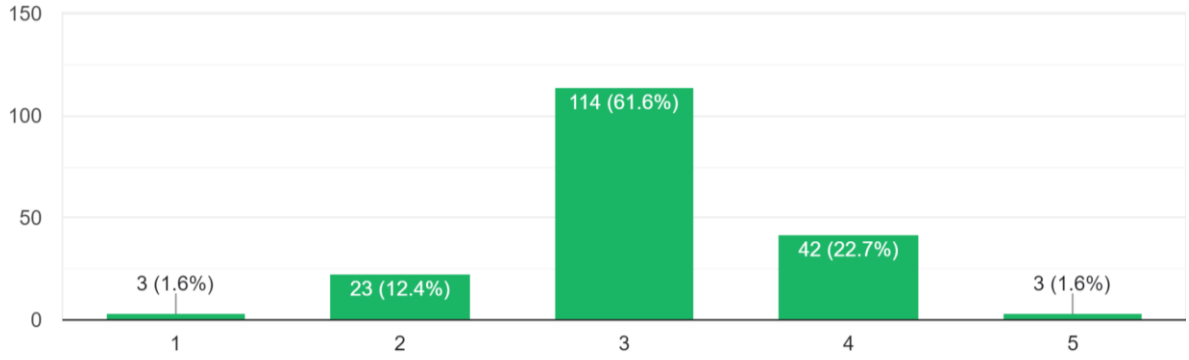
Students were asked *What is your education level?, In which year are you?* and *What is your gender?*.
In this case all respondents were part of the same school with one education level VWO/Gymnasium, which is the highest level of high school education in the Netherlands.
The school years were asked to determine differences in age and if the amount of time in higher education changed knowledge and policy support in any way. The years are not fairly distributed with representation between 25.4%(47) and 12.4%(23). A bigger outlier is 3.2% sixth-years, which can be contributed to the exam week coinciding with the survey week.
Gender is fairly distributed with 48.6% girls and 46.5% boys. 9 respondents identified as neither.

Q5 and Q6: Perceived Knowledge - Part 1

Q5: *If you would give yourself a grade about your climate change knowledge, what would you give yourself?* [184 responses; Mean = 6.33; Median = 7]

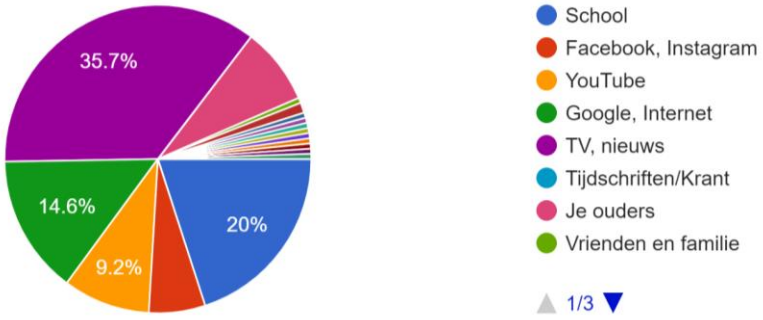


Q6: *Compared to your fellow students, how do you think you will score (1 is much lower, 5 is much higher).* [185 responses; Mean = 3.10; Median = 3]



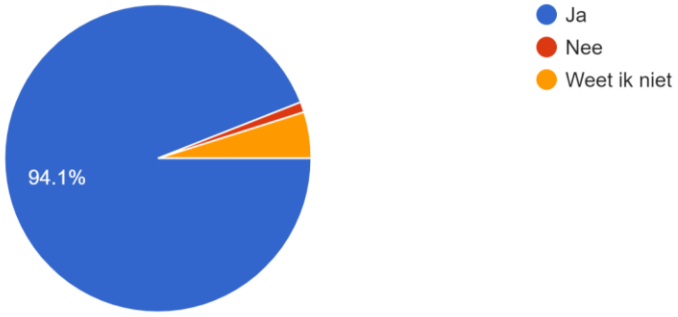
Most students consider themselves to be somewhat knowledgeable about climate change 78.4% of students grade themselves with a positive grade, while 21.1% think they don't know enough to give themselves a sufficient grade. Although not a very significant amount, relatively more students consider themselves to be more knowledgeable than their classmates, which statistically is not possible.

Q7: *What is your most commonly used source of information about climate change?*



35.7% of students has identified TV and the news to be their primary source of information; 20% answered school; 14.6% Google/Internet; 9.2% Youtube, 8.1% their parents; 5.9% Facebook/Instagram; Other answers were TikTok, Social Media, nowhere, multiple of the above and common sense.

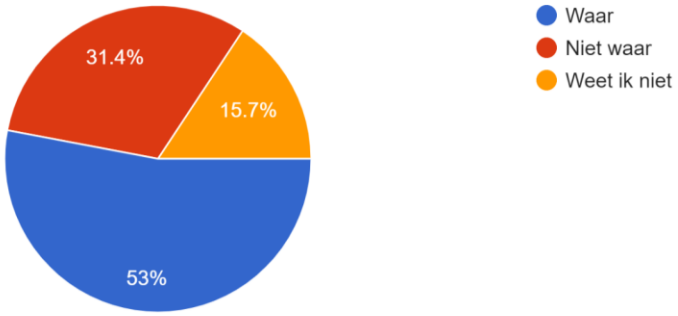
Q8: *Do you believe Climate Change is real?*



94.1%(174) of students acknowledge they think climate change is real, 4.9%(9) do not know for sure and 1.1%(2) think climate change is not real. Although there might be a slight possibility these students answered untruthfully, there is an equal chance it is not thus their submission will be regarded as valid nonetheless.

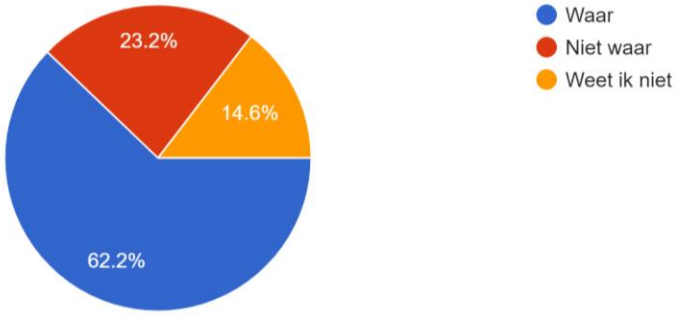
Q9-Q29 Knowledge questions

Q9: *"Climate change would also exist without humans."* [A = True]



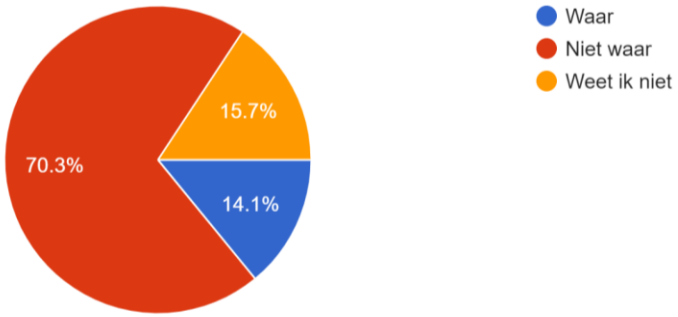
53% correctly answered that climate change is a natural phenomenon as well, 15.7% do not know and 31.4% were incorrect.

Q10: *"The earth always had changes in temperature, but nowadays it is hotter than ever before."* [A = False]



Only 23.2% correctly answered that the earth has been hotter than it is today. 77.8% were wrong.

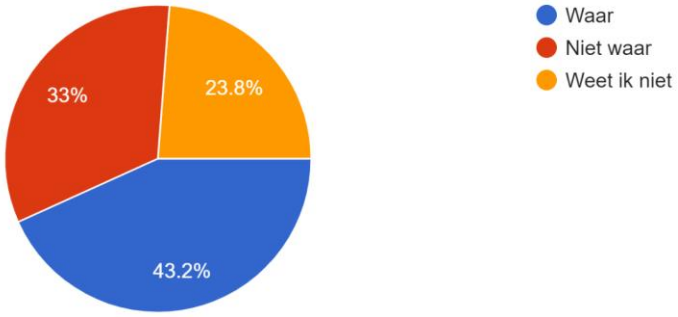
Q11: *"The climate on earth has been mostly the same for the past million years."* [A = False]



70.3% correctly answered that the climate has not been similar in the past millions of years 29.7% were incorrect.

Q12: *"The greenhouse effect would also exist without humans."* [A = True]

"Het broeikaseffect zou zonder mensen ook bestaan."
185 responses

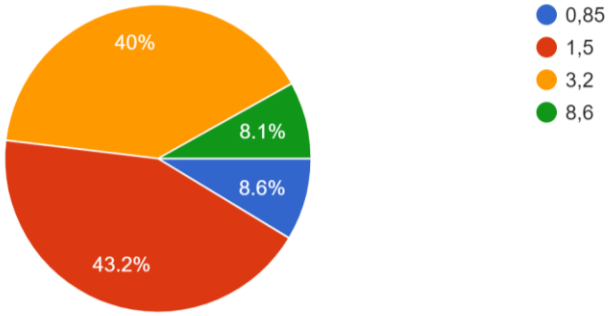


Only 43.2% know the greenhouse effect is not a human induced process; 56.8% are incorrect.

Q13: *How can you best describe climate change?* [A: 🟢]

69.2% of students could correctly identify the definition of climate change from six choices. 15.7% thought climate change is the result of meat consumption, car travel and airplanes. 10.8% thought climate change is a natural process because the earth is warming up. 2.2% think climate change is the result of tectonic movements and volcanoes and another 2.2% thought industry in China, the USA and Russia are to blame.

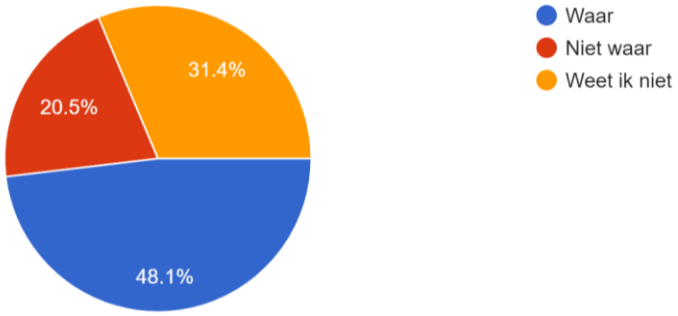
Q14*: *"The average temperature on Earth has since 1880 risen with ... degrees celsius."* [A = 0,85]



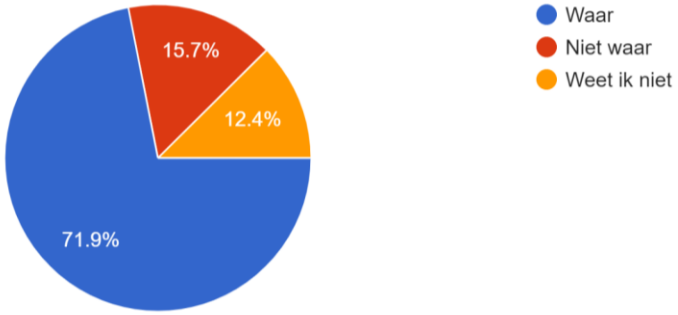
*Due to use of outdated sources the answers in this question did not list the correct amount of 1.1°C (NASA, 2022). Therefore results may have differed if this option had been included. Still this option is closest to 0.85°C, thus 91.4% still overestimates the amount of temperature rise.

Q15 and Q16: Extreme weather and climate change

Q15: *"The 2021 floods in Limburg were the result of Climate Change."* [A = False]

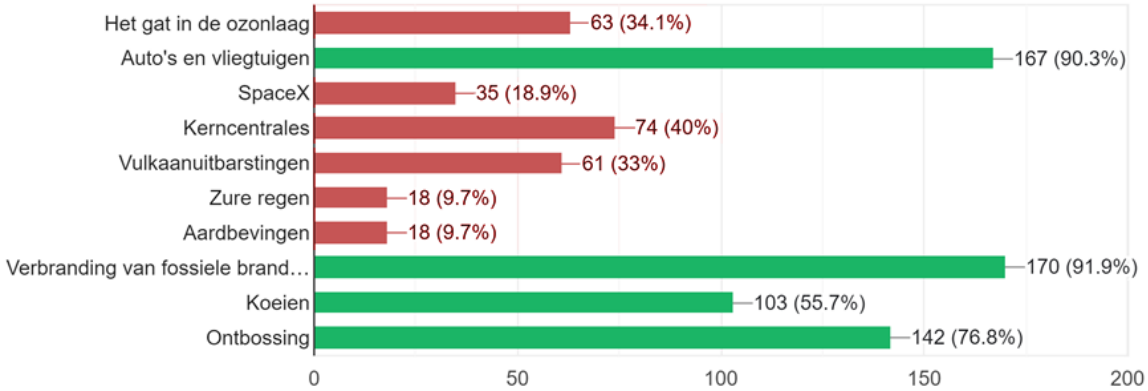


Q16: *"Extreme weather events are the result of climate change"* [A = True]



Extreme weather has only recently been officially linked to climate change. However there is still discussion if this is completely correct. We know for sure that in some parts of the world droughts or extreme rain are now more common, but linking singular weather events to climate change is very difficult and only suggestive. This question would thus in hindsight be difficult to grade, let alone compare to previous research with similar questions as during their research the statements were false.

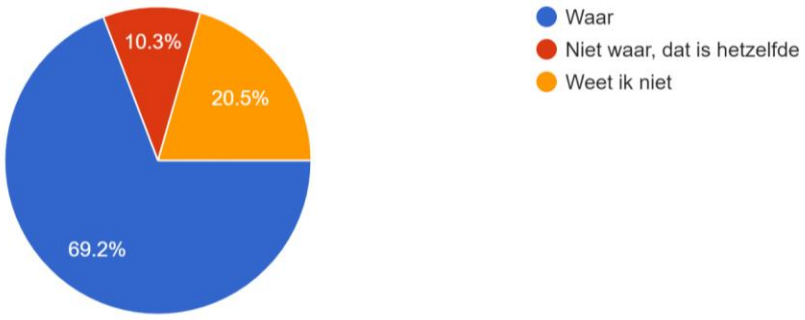
Q17: *Which of the following has a significant contribution to global warming?*



Cars and planes; burning fossil fuels; cows and deforestation have correctly identified as contributors to global warming by the students. 30-40% also think Nuclear power plants, volcanic eruptions and the hole in the ozone layer are contributors as well. A

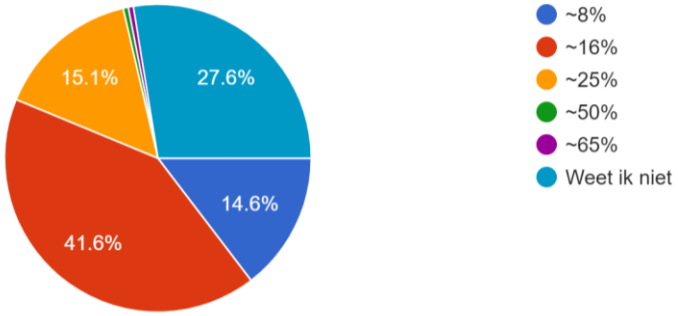
smaller portion think SpaceX(18.9%), acid rain(9.7%) and earthquakes(9.7%) are significant contributors to global warming.

Q18: *"There is a difference between green energy and renewable energy."* [A = True]



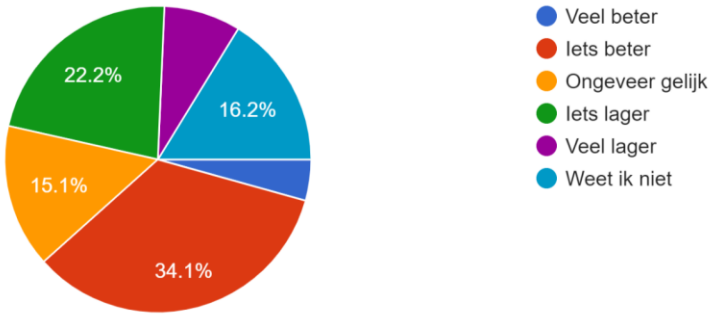
69.2% of students correctly answered that green energy is different from renewable energy. 30.8% of students were incorrect.

Q19: *How much of Dutch energy consumption comes from renewable energy?* [A = 8% (2021)]



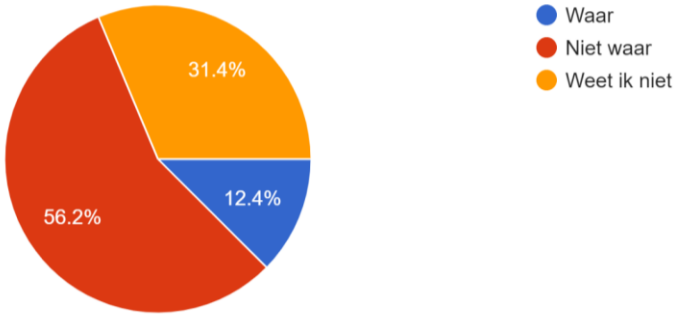
Although renewable energy production in the Netherlands is closer to 28% (CBS, 2022), the import of energy brings the Dutch total renewable energy consumption to around 8% (CBS, 2021). Therefore only 14.6% of students correctly identified the amount of green energy in the Netherlands.

Q20: *"Compared to other European states the percentage of clean energy in the Netherlands is ..."* [A: ●/●]



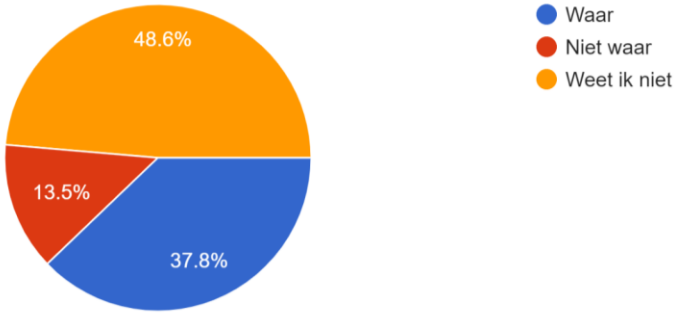
Depending on if you look at energy production or consumption the Netherlands performs slightly worse and much worse respectively. Therefore 30.3% of students correctly answered green or purple. 16.2% do not know and 38.4% think NL is doing better and 15.1% think NL is equal to the other EU countries.

Q21: *"Nuclear energy emits by far the most greenhouse gasses"* [A = False]



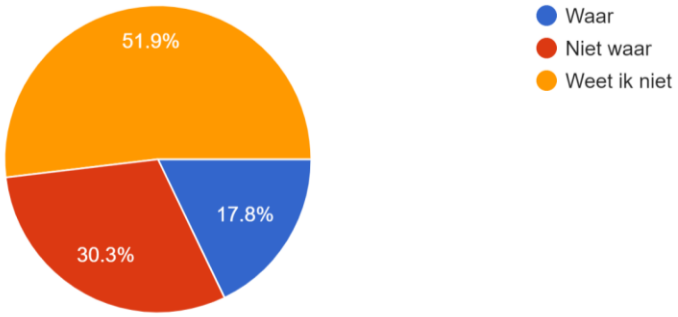
56.2% of students correctly answered false, where 43.8% were incorrect.

Q22: *"The Gap in the ozone layer was one of the first observations which confirmed climate change."* [A = False]



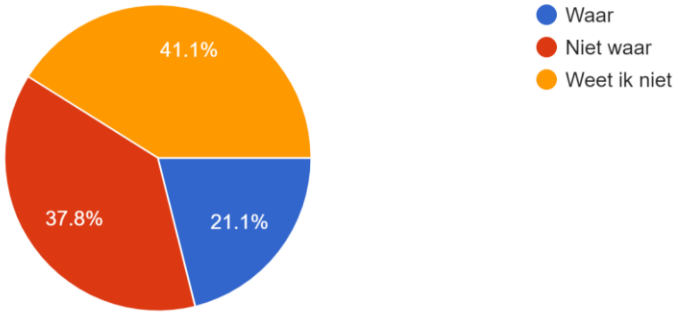
Only 13.5% of respondents could correctly identify this statement to be false, almost half (48.6%) do not know and 37.8% were incorrect.

Q23: *"Rockets from SpaceX cause gaps in the ozone layer, accelerating climate change."* [A = False]



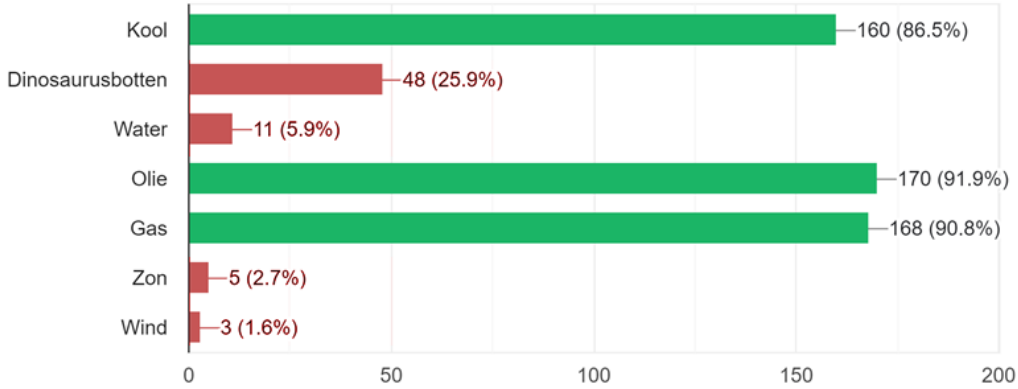
Only 30.3% of respondents could correctly identify this statement to be false, more than half (51.9%) do not know and 17.8% were incorrect.

Q24: *"The collapse of the Chernobyl Nuclear Reactor caused an acceleration of global warming"* [A = False]



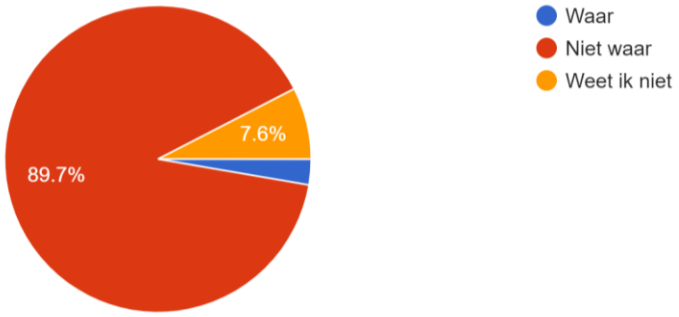
37.8% correctly identified the statement as false. 41.1% do not know and 21.1% were incorrect.

Q25: *Which of the following can be considered fossil fuels?*



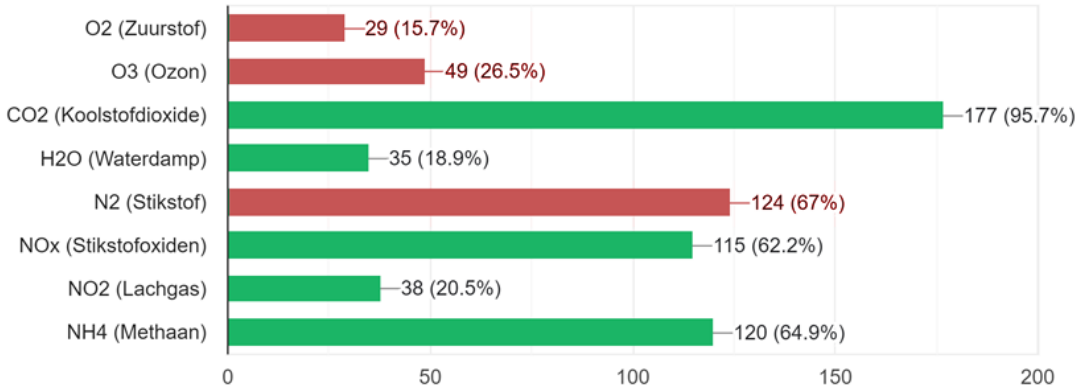
The three main fossil fuels(Coal, Oil and Gas) were correctly identified by almost all respondents 86.5% - 91.9%. 25.9% though dinosaur fossils can be considered fossil fuel as well. A select few also considered water, sun and wind to be fossil fuels.

Q26: *"If we would not stop emissions right now, climate change would stop directly as well."* [A = False]



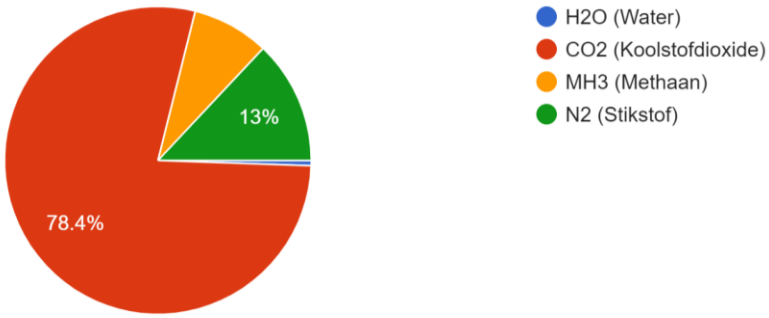
89.7% of students know that climate change will not stop when emissions are stopped. 10.3% are incorrect.

Q27: *Which of the following gasses can be considered a greenhouse gas?*



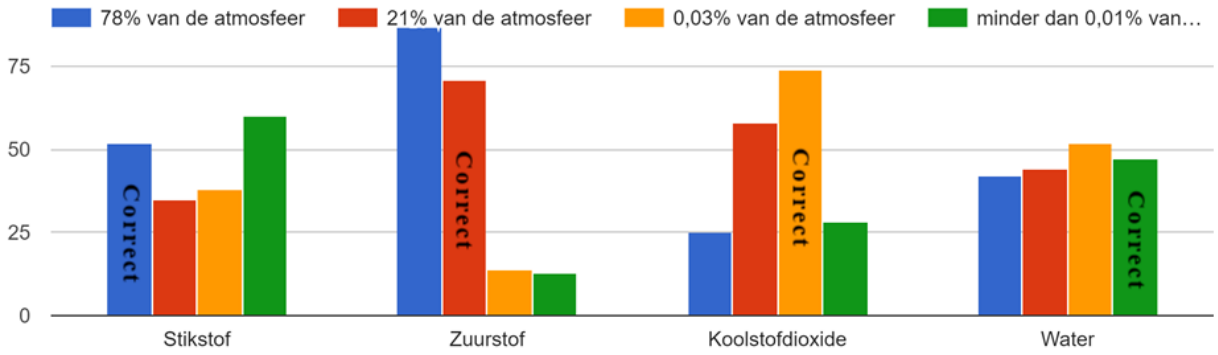
CO2 was correctly identified as a greenhouse gas by 95.7% of students. NOx and NH4 were identified by 62.2% and 64.9% respectively. H20 and NO2 were identified by ⅕th of the students. Most notably 67% of respondents think N2 (Nitrogen) is a greenhouse gas as well. Furthermore 26.5% incorrectly identified O3 to be a greenhouse gas and 15.7% incorrectly identified O2 to be a greenhouse gas.

Q28: *Which substance is mainly emitted during the burning of fossil fuels?* [A: ●]



78.4% correctly identified CO2 as the most common emitted substance as a result of burning fossil fuels. 13% incorrectly think N2, 8.1% incorrectly think MH3 and 1 respondent answered H2O.

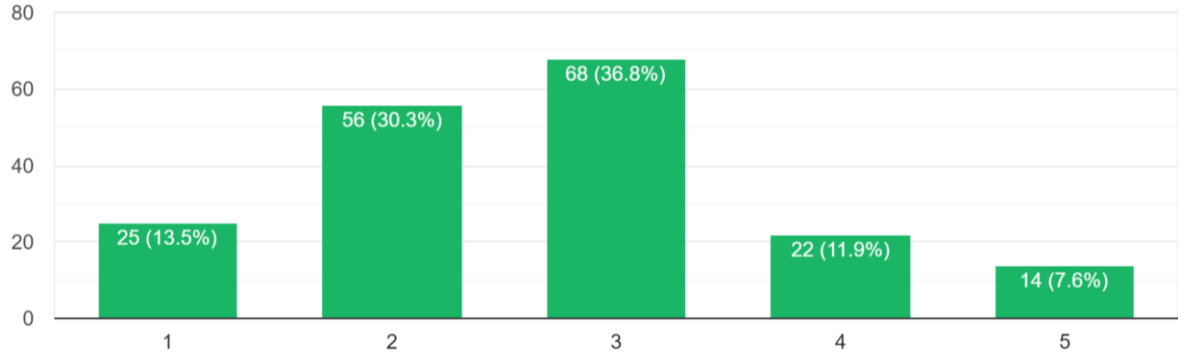
Q29: *Which substance belongs to which percentage of the atmosphere?* [A = 78% Nitrogen; 21% Oxygen, 0,03% Carbon Dioxide; less than 0,01% Water]



	78%	**21%**	**0,03%**	**>0,01%**
Nitrogen	**52(28.1%)**	87(47%)	25(13.5%)	42(22.7%)
Oxygen	35(18.9%)	**71(38.4%)**	58(31.4%)	44(23.8%)
Carbon Dioxide	38(20.5%)	14(7.6%)	**74(40%)**	52(28.1%)
Water(vapor)	60(32.5%)	13(7%)	28(15.1%)	**47(25.4%)**

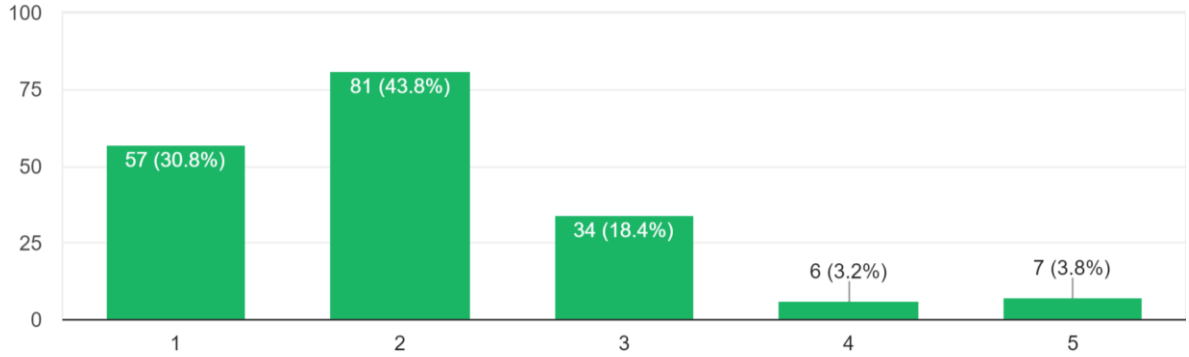
Q30 - Q35 Policy and Politics

Q30: *"I think we learn a sufficient amount about climate change in school." (1 is totally disagree, 5 is totally agree)* [185 responses; Mean = 2.70; Median = 3]



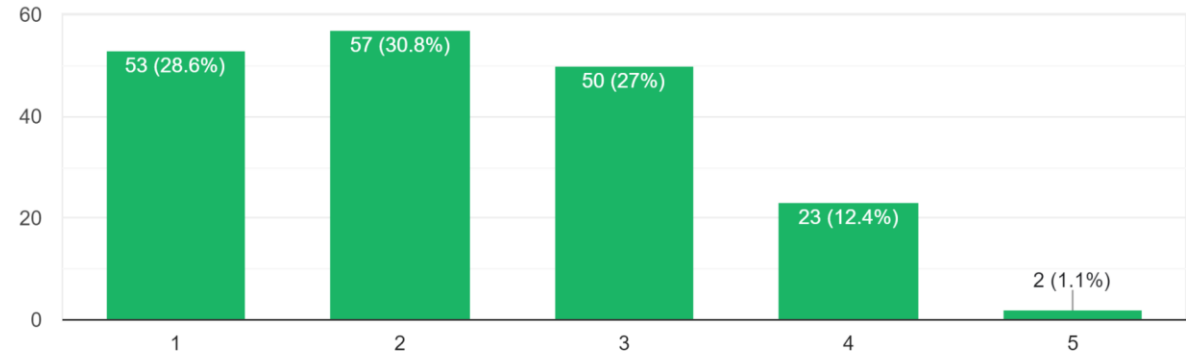
More students think they should learn more than students who think they learn enough. 36.8% think the amount they learn about climate change is enough.

Q31: *"Dutch politics act sufficiently in combating climate change" (1 is totally disagree, 5 is totally agree)* [185 responses; Mean = 2,05; Median = 2]



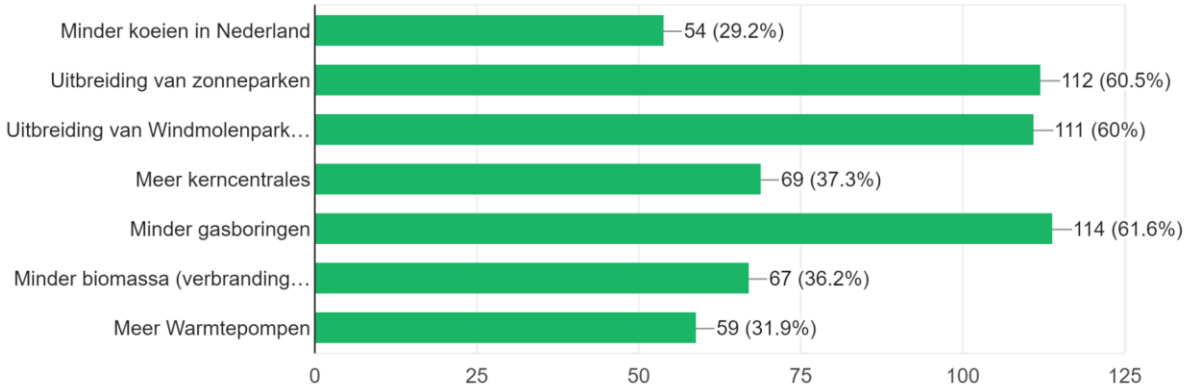
The large majority of students think the Dutch government does not do enough to combat climate change.

Q32: *"I am familiar with the climate policy of the Dutch government" (1 is totally disagree, 5 is totally agree)* [185 responses; Mean = 2.26; Median = 2]



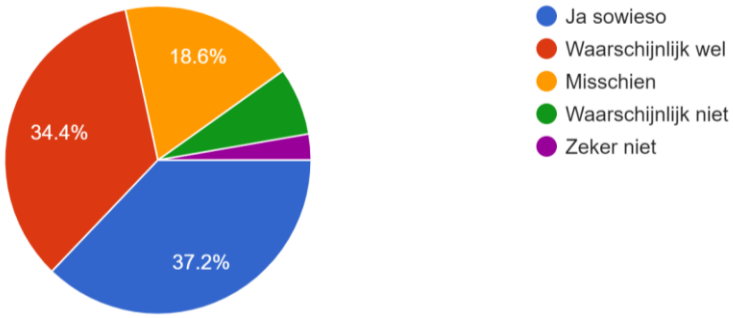
The majority of students are not familiar with current climate change policy. 27% think they have some knowledge. 13.5% think they are quite familiar with Dutch climate policy.

Q33: *Which of the following points do you think belong in the Dutch climate policy?*



All of these points are currently part of Dutch climate policy under Rutte IV (Straver & Bransma, 2021). Student support varies between the points with the majority supporting expansion of windmills and solar panels and the reducing of gas extraction. A minority of students support reducing the amount of cows, the expansion of nuclear power plants, the reduction of biomass and the expansion of heat pumps.

Q34: *"If I could vote, I would take the climate vision of a party into consideration when deciding on my vote."*



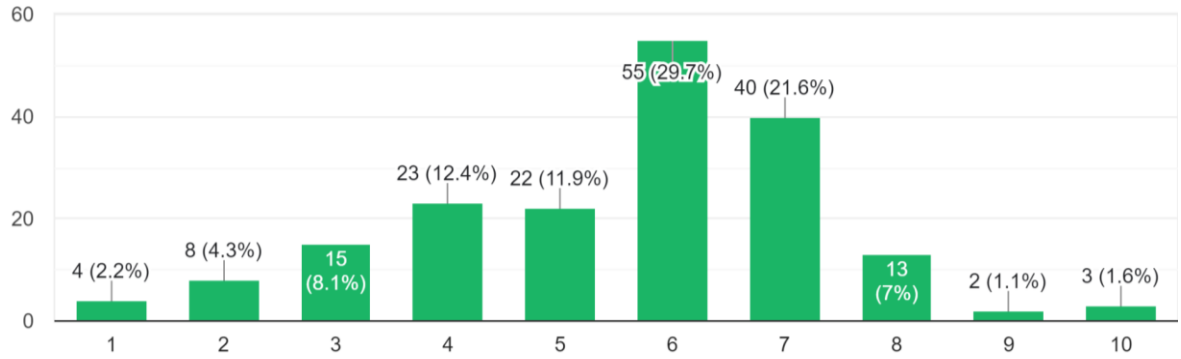
71.6% of students would consider the climate policy of a political party when they would vote. 18.6% maybe would consider it and 9.8% would not consider climate policy when voting.

Q35: *Do you think it is important for Dutch people to become more knowledgeable about climate change so that they can live smarter and can make more considerate political choices?*

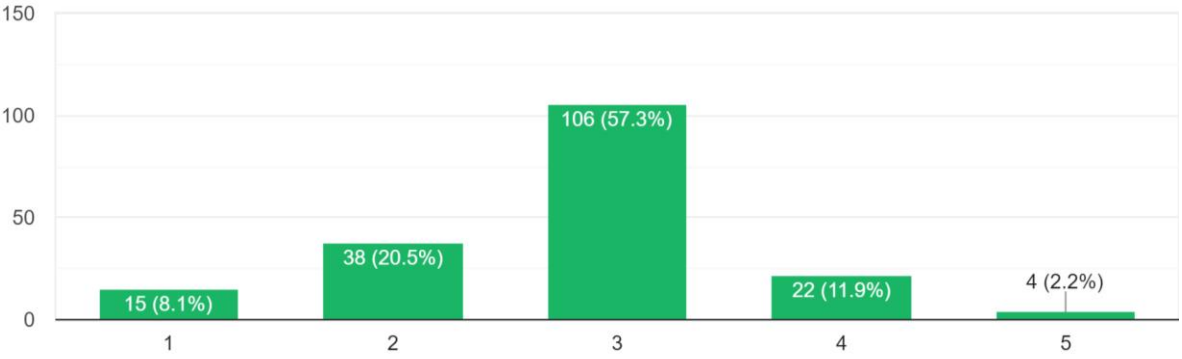
58.2% of students find it very important Dutch people become more knowledgeable. 37.5% think it is important, but there are more important things. 4.3% think it is not important.

Q36 and Q37: Perceived Knowledge - Part 2

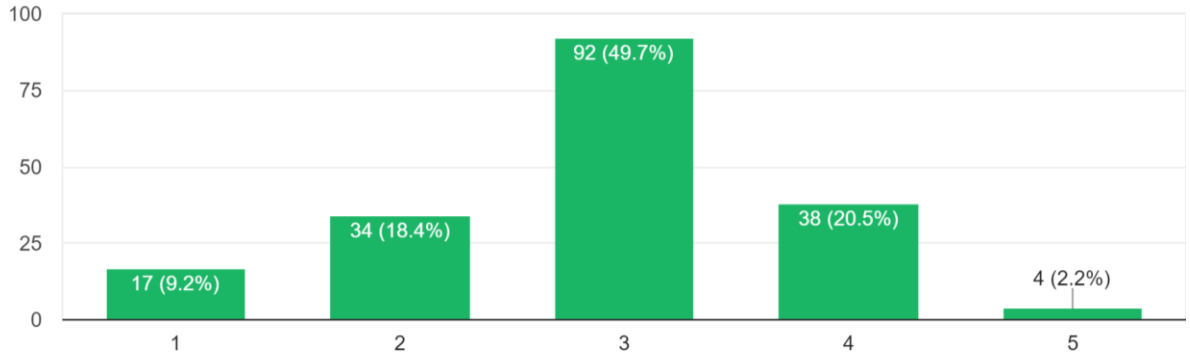
Q36: *How do you think you did?* [185 responses; Mean = 5.56; Median = 6]



Q37: *Did you know more or less than you thought?* [185 responses; Mean = 2.79; Median = 3]



Q38: How do you think you did compared to your fellow students? [185 responses; Mean = 2.88; Median = 3]



ANALYSIS

To answer sub-question 3: *Which positive trends, knowledge gaps and misconceptions regarding climate change are present among Dutch high school student?* the result of the survey are analyzed. The survey has produced a lot of data and just by looking at the results shown above we can make some interesting observations, like positive results, knowledge gaps and misconceptions.

Positive results

The data shows some positive results:

-Q8 shows 94.1% of the students believe that climate change is a real thing. According to the Dutch Bureau for Statistics, CBS 94% of Dutch adults think climate change is real.

-Q11 shows 70.3% of students know the climate has always been changing.

-Q13 shows 69.2% of students can correctly identify the definition of climate change.

-Q17 shows most students can identify the most significant contributing factors to global warming.

-Q18 shows 69.2% of students know that green energy is different from renewable energy.

-Q25, Q27 and Q28 show a general understanding of fossil fuels and CO2 and its role in climate change. 9 out of 10 students could identify the most prominent fossil fuels; 95.7% of the students identified CO2 as a greenhouse gas and 78.4% know CO2 is mainly emitted by burning fossil fuels.

-Q26 shows 89.7% of students know that stopping emissions now won't stop climate change.

Knowledge gaps

By looking specifically at the proportion of students who fill in don't know can give us an insight into where significant knowledge gaps might be found.

-Q21 and Q24 show that 31.4% do not know if nuclear power is polluting and 41.4% do not know whether the Chernobyl disaster contributed to climate change. Q17 also shows 40% of students believing nuclear power plants to have a significant contribution to global warming. It shows a very clear knowledge gap in the cleanness and negligible emissions of nuclear power.

-Q22 and Q23 show that 48.6% do not know whether the ozone layer is linked to climate change and 51.9% do not know whether SpaceX rockets make holes in the ozone layer and accelerate climate change. Both are false which a small percentage of respondents correctly answered. The ozone layer has been a subject of knowledge gaps and misconceptions in previous research, but has since its recent recovery not been much of a topic. Therefore the lack of knowledge might also be the result of students not knowing what the ozone layer is, instead of purely not knowing the relation or rather the unrelatedness of ozone and climate change.

-Q32 shows a majority of students are not or slightly familiar with the current Dutch climate policy. This might be because all students are minors and thus have no reason to know Dutch climate policy, but at the same time Q31 shows most students are discontent with the current climate actions by the government.

Misconceptions

By looking specifically at the proportion of students who fill in the incorrect answer can give us an insight into where significant misconceptions might be found.

-Q9 shows that 31.4% of students think climate change would not happen without humans, another 15.7% of students does not know for sure, thus 47.1% of students were incorrect.

-Q10 shows 62.2% of students believe that the earth has never been hotter than it is today, another 14.6% of students does not know for sure, thus 76.8% of students were incorrect.

-Q12 shows 33% of students believe that the greenhouse effect would not exist without humans, another 23.8% of students does not know for sure, thus 56.8% of students were incorrect.

-Q14 shows that 91.4% of students think that since 1880 the earth's temperature has risen more than it actually has.

-Q17 shows 40% of students think nuclear power plants contribute to global warming, 34.1% think the ozone layer is involved and 33% falsely identified volcanic eruptions to significantly contribute to global warming.

-Q19 shows that 85.4% of students overestimated the proportion of renewable energy as part of total Dutch energy consumption.

-Q20 showed 69.7% overestimated the Dutch position regarding the production and consumption of renewable energy against the rest of the EU.

-Q22 shows that 37.8% of students think that the hole in the ozone layer was the first thing confirming climate change, another 48.6% did not know, thus 86.4% of students were incorrect.

Perceived Knowledge versus Assessed Knowledge

To answer sub-question 4: *How does perceived knowledge of students compare to their actual knowledge about climate change*

Perceived knowledge: Comparing Q5 and Q36 show a significant drop in perceived knowledgeability after the survey: 6.6 > 5.6. Students may have found the questions hard, which might have resulted in a change of confidence and perceived knowledgeability towards the end. Comparing Q6 and Q38 show a drop in perceived knowledgeability compared to other students as well: 3.10 > 2.88. While before on average students thought they knew more about climate change than their classmates, that number has become negative after the survey. The majority of respondents still think they know about as much as their fellow students.

Assessed knowledge: The assessed knowledge was measured by calculating the amount of correct answers a student gave in the knowledge questions. This included question 9 through 29, with exemption of Q14 and Q15. Questions where multiple answers were correct were calculated by giving a point for a good answer and subtracting a point for a wrong answer. This could not get under 0 per question. So for 2 wrong answers on Q25 a student would receive 0 points. For three correct and one wrong answer the student would receive 2 points. This score was divided by the total amount of points a student could receive and multiplied by 10. The grades of the students averaged on 4.7, with the lowest grade being a 1.3 and the highest being a 8.8, the latter was a considerable outlier with the nearest score on 7.5. The 8.8 proved to be a legitimate entry, but was removed for some of the statistical tests.

So although some students clearly adjusted there perceived knowledge after taking the survey, 6.3(6.33)> 5.6(5.56) the average grade ended being a 4.7(4.67). Therefore in line with past research (Hannibal & Vedlitz, 2018; Fischer et al., 2019; Thaller & Bundermann, 2020), knowledge level was generally perceived higher by the respondents than their actual knowledge.

Differences and similarities in gender and class

T-test on gender and knowledge(grades) surprisingly resulted in a strong positive correlation between gender and knowledge. Boys(86) averaged on a 5.2, while girls(90) averaged on a 4.2. This is surprising because past research did not find a positive correlation between gender and climate knowledge. See *Appendix 2* for all SPSS output on gender.

By removing class 6, the homogeneity of variances between groups is insignificant, thus we can assume the variance between groups is equal. The ANOVA on class (year) and knowledge(grades) also surprisingly resulted in a strong positive correlation between class(age) and knowledge, see *Table 1*. Although the differences in average grade between class 2 & 3 and class 4 & 5 does not seem to differ much in the sample, it seems clear there is indeed a trend of the average knowledge improving with class (year). See *Appendix 3* for all SPSS output on class.

					95% Confidence Interval for Mean			
	N	Mean	Std. Deviation	Std. Error	Lower Bound	Upper Bound	Minimum	Maximum
1	47	4,0426	1,35967	,19833	3,6433	4,4418	1,25	7,08
2	29	4,5977	1,15986	,21538	4,1565	5,0389	2,50	6,67
3	45	4,6759	1,41825	,21142	4,2498	5,1020	1,67	7,08
4	23	5,1993	1,65178	,34442	4,4850	5,9136	2,08	7,50
5	35	5,2262	1,50008	,25356	4,7109	5,7415	2,08	8,75
Total	179	4,6718	1,46814	,10973	4,4552	4,8883	1,25	8,75

Table 1: Descriptives of grades per class

Correlation between climate knowledge and policy support

To answer sub-question 5: *To what extent does climate knowledge of Dutch students correlate with changes in policy support?* this survey uses Q30-Q34.

The results were recoded in SPSS to make testing possible. Using the already existing grade variable and Q30 and Q31 the resulting scatterplots *(Appendix 4)* show there is no correlation between higher knowledgeability among students and more support for current policy.

CONCLUSION

This thesis has discussed the concept of climate knowledgeability in literature and the many aspects that influence it. It discussed past research on climate knowledge an policy support. Using a survey conducted among 185 Dutch high school students this research has found knowledge gaps and misconceptions in the sample. It found both positive relations in climate knowledge and gender and climate knowledge and class(year). It found no relation between climate knowledgeability and policy support in the sample.

By reviewing literature from the past decades the research identified key aspect of climate knowledgeability. These include the importance of climate change knowledge in peoples decision making, lifestyle and support for politics and policy. The literature showed a strong relation between politics, which is thus often part of the climate conversation. Improved climate knowledge among the general public and among politicians might yield significant steps towards a better climate response. But this improvement of knowledge has been a slow process, if you can call it a process. Scientist have a hard time to convert knowledge to usable knowledge for people and politicians to understand. They fail to improve policy with their knowledge. Generally the media suffers the same problem. Partially dependent on experts themselves, media has failed to improve climate knowledge significantly over the past few years. But has improved awareness, which does help the climate cause. But for there to be an even better climate response, first climate knowledge needs to be improved. Education might be one of the best places to start knowledge improvement, because of the large range of the sector.

Clearly most of the academic world agrees that climate knowledgeability should have a positive impact on policy support. A relation which has also been proven by some of said literature. The results of this research do not yield the same conclusion. In the sample of high school students there was no correlation between the assessed knowledge of students and there support for policy. The difference of outcome between this research and past research can be the result of multiple factors. First it could be that in this sample policy support is generally low and thus there is no good way to measure differences. The difference could be the result of differences in questions. The question of this survey do not dive deeply into policy per se, especially compared to other research. More datapoints might yield a different result. Lastly the factor of age can also play a role. Past research has focused on other age groups. Because older people are generally more involved in politics, they might have more varying views on policy than adolescent high school children.

Misconceptions and knowledge gaps identified as early as 1994 (Bostrom et al., 1994) and again in 2011 (Leiserowitz et al., 2011) still persist today in the sample.

Although there seemed to be some positive trends on knowledge about the impact of climate change and greenhouses gasses, there are still knowledge gaps in the effect of nuclear energy and the ozone layer, and misconceptions about the impact of humans and the progress of the Dutch energy transition. Also in line with other research was the perceived knowledge of student being higher than their actual knowledge about climate change.

So to answer the question *"To what extent can knowledgeability about climate change among Dutch students improve or contribute to the national climate change response by the state and the public itself?",* probably to a great extent. This research has not been able to answer what the exact impact of climate change knowledge on the climate response. This might be more easily measurable when an actual programme to improve climate change knowledge is in place. However, the literature review and positive responses by the students suggest there is a high chance that improvement of climate knowledgeability would improve climate change response, especially among students. Climate knowledge has proved to be multi-faceted and can impact political choice as well, which in turn might improve the support for the right policy, which in turn leads to a better climate response.

This research does have its drawbacks. The research sample is big enough to represent the population of the school, but does not necessarily say anything about students outside of said school or students in the Netherlands in general. Therefore the results are not representative to the full Dutch population. Further research could build upon the results of this research to confirm it's authenticity and representiveness for the whole Dutch population. Further research could build on this research and its survey. Especially the questions about climate policy can be improved to better capture the impact of knowledge on this subject.

This research has shown the still existing problems in climate knowledge and addresses the lack of progress to effectively improve knowledge. Their might be more research needed to better understand how to actually do that. But the knowledge gaps and misconceptions found in this research seem pretty clear and are in fact easily fixed. With more data in different parts of the country and on different education levels, there might be an option to construct a national programme to improve climate knowledge in the younger generation. This might in turn positively impact the general response of the public and from the government towards climate change.

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APPENDICES
Appendix 1

See attached files or use [Link]

Appendix 2
Gender (SPSS Output)

In the category gender three answers were given: boy(86), girl(90), other(9). Those we filled in other are left out of statistical analysis of gender.

Descriptives per group

Correlation between gender and knowledge(grade)

T-Test

Group Statistics

	Benjeeen	N	Mean	Std. Deviation	Std. Error Mean
Score	1	86	5,2083	1,42019	,15314
	2	90	4,2083	1,31324	,13843

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Score	Equal variances assumed	1,055	,306	4,853	174	,000	1,00000	,20607	,59329	1,40671
	Equal variances not assumed			4,844	171,377	,000	1,00000	,20643	,59252	1,40748

T-Test is significant so we reject the H0, so there is a difference in the means and thus we can assume there is a difference between gender.

Correlation between Gender and expected grade (before the survey)

T-Test

Group Statistics

	Benjeeen	N	Mean	Std. Deviation	Std. Error Mean
Alsjejezelfeencijfermoestgevengebasseerdopjekennisove	1	85	6,59	1,348	,146
	2	90	6,13	1,384	,146

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Alsjejezelfeencijfermoestgevengebasseerdopjekennisove	Equal variances assumed	,071	,790	2,201	173	,029	,455	,207	,047	,863
	Equal variances not assumed			2,203	172,832	,029	,455	,207	,047	,862

T-Test is insignificant so we accept the H0, so there is a difference in the and we can not assume a statistical difference between boys and girls regarding expected grade before the survey.

Correlation between Gender and expected grade (after the survey)

T-Test

Group Statistics

	Benjeeen	N	Mean	Std. Deviation	Std. Error Mean
Hoedenkjedatjegescoord hebt	1	86	6,00	1,795	,194
	2	90	5,18	1,784	,188

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Hoedenkjedatjegescoord hebt	Equal variances assumed	,593	,442	3,047	174	,003	,822	,270	,290	1,355
	Equal variances not assumed			3,047	173,526	,003	,822	,270	,290	1,355

T-Test is significant so we reject the Ho, so there is a difference in the means and thus we can assume there is a difference between boys and girls regarding expected grade after the survey.

Correlation between gender and the question if students should learn more in school

T-Test

```
[DataSet1] X:\My Downloads\Klimaatkennis.csv\MainrgradedGender.sav
```

Group Statistics

	Benjeeen	N	Mean	Std. Deviation	Std. Error Mean
Ikvinddatwegenoegoverkli maatveranderinglerenop school	1	86	2,90	1,018	,110
	2	90	2,53	1,134	,120

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Ikvinddatwegenoegoverkli maatveranderinglerenop school	Equal variances assumed	4,258	,041	2,226	174	,027	,362	,163	,041	,683
	Equal variances not assumed			2,231	173,335	,027	,362	,162	,042	,682

T-Test is insignificant so we accept the null hypothesis and we can not assume a statistical difference between boys and girls regarding the will to learn more about climate in school.

Correlation between gender and the question if students think they would consider climate change when voting for a political party.

T-Test

Group Statistics

	Benjeeen	N	Mean	Std. Deviation	Std. Error Mean
Alsikmochtstemmenzouik deklimaatvisiehoezemetk limaat	1	86	2,06	1,044	,113
	2	89	2,06	1,015	,108

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Alsikmochtstemmenzouik deklimaatvisiehoezemetk limaat	Equal variances assumed	,026	,873	,013	173	,990	,002	,156	-,305	,309
	Equal variances not assumed			,013	172,323	,990	,002	,156	-,306	,309

T-Test is insignificant so we accept the null hypothesis and we can not assume a statistical difference between boys and girls regarding consideration of climate change when voting for a political party.

Correlation between gender and the question if students think people should know more about climate change.

T-Test

Group Statistics

	Benjeeen	N	Mean	Std. Deviation	Std. Error Mean
VindjehetbelangrijkdatNe derlandersmeerkenniskri jgenover	1	86	1,52	,681	,073
	2	90	1,46	,603	,064

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
VindjehetbelangrijkdatNe derlandersmeerkenniskri jgenover	Equal variances assumed	1,047	,308	,699	174	,485	,068	,097	-,123	,259
	Equal variances not assumed			,697	169,256	,487	,068	,097	-,124	,259

T-Test is insignificant so we accept the null hypothesis and we can not assume a statistical difference between boys and girls regarding the question whether people should no more about climate change.

Appendix 3
Class (SPSS Output)

In the survey age was converted to class(similar to grade or year). In the category six answers were given; Class 1(47), Class 1(29), Class 1(45), Class 1(23), Class 1(35) and Class 6(6). For statistical analysis class 6 is left out.

Correlation between class and knowledge(grade)

Descriptives

Score

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
1	47	4,0426	1,35967	,19833	3,6433	4,4418	1,25	7,08
2	29	4,5977	1,15986	,21538	4,1565	5,0389	2,50	6,67
3	45	4,6759	1,41825	,21142	4,2498	5,1020	1,67	7,08
4	23	5,1993	1,65178	,34442	4,4850	5,9136	2,08	7,50
5	35	5,2262	1,50008	,25356	4,7109	5,7415	2,08	8,75
Total	179	4,6718	1,46814	,10973	4,4552	4,8883	1,25	8,75

Test of Homogeneity of Variances

		Levene Statistic	df1	df2	Sig.
Score	Based on Mean	1,160	4	174	,330
	Based on Median	,845	4	174	,498
	Based on Median and with adjusted df	,845	4	161,277	,498
	Based on trimmed mean	1,127	4	174	,346

ANOVA

Score

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	35,926	4	8,982	4,494	,002
Within Groups	347,743	174	1,999		
Total	383,669	178			

Homogeneity of Variances between groups is insignificant , thus we can assume the variance between groups is equal. ANOVA is significant so we reject the Ho, so the means of the groups are equal and thus we can assume there is a difference between classes.

Correlation between class and expected grade (before the survey)

Descriptives

Hoeveeldenkjedatjeweetoverklimaatveranderingvergelekenm

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
1	47	2,96	,721	,105	2,75	3,17	1	5
2	29	3,10	,557	,103	2,89	3,32	2	4
3	45	3,13	,694	,103	2,92	3,34	2	5
4	23	3,30	,470	,098	3,10	3,51	3	4
5	35	3,09	,818	,138	2,80	3,37	1	5
Total	179	3,09	,684	,051	2,99	3,20	1	5

ANOVA

Hoeveeldenkjedatjeweetoverklimaatveranderingvergelekenm

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	1,969	4	,492	1,052	,382
Within Groups	81,417	174	,468		
Total	83,385	178			

ANOVA is insignificant so we accept the Ho, so the means of the groups are equal and thus we cannot assume there is a difference between groups regarding expected grade before the survey.

Correlation between class and expected grade (after the survey)

Descriptives

Hoedenkjedatjegescoordhebtvergelekenmetje Klasgenoten

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
1	47	2,81	,992	,145	2,52	3,10	1	5
2	29	2,97	,906	,168	2,62	3,31	1	4
3	45	2,76	,981	,146	2,46	3,05	1	5
4	23	3,13	,694	,145	2,83	3,43	2	4
5	35	2,91	,853	,144	2,62	3,21	1	4
Total	179	2,88	,913	,068	2,75	3,02	1	5

ANOVA

Hoedenkjedatjegescoordhebtvergelekenmetje Klasgenoten

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	2,632	4	,658	,785	,537
Within Groups	145,905	174	,839		
Total	148,536	178			

ANOVA is insignificant so we accept the Ho, so the means of the groups are equal and thus we cannot assume there is a difference between groups regarding expected grade after the survey.

Correlation between class and the question if students should learn more in school

Descriptives

Ikvinddatwegenoegoverklimaatveranderinglerenopschool

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
1	47	2,81	1,227	,179	2,45	3,17	1	5
2	29	2,52	,986	,183	2,14	2,89	1	5
3	45	2,78	1,166	,174	2,43	3,13	1	5
4	23	2,74	,864	,180	2,37	3,11	1	4
5	35	2,63	1,031	,174	2,27	2,98	1	5
Total	179	2,71	1,088	,081	2,55	2,87	1	5

ANOVA

Ikvinddatwegenoegoverklimaatveranderinglerenopschool

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	1,992	4	,498	,415	,798
Within Groups	208,902	174	1,201		
Total	210,894	178			

ANOVA is insignificant so we accept the Ho, so the means of the groups are equal and thus we cannot assume there is a difference between groups regarding the will to learn more about climate in school.

Correlation between class and the question if students think they would consider climate change when voting for a political party.

Descriptives

Alsikmochtstemmenzouikdeklimaatvisiehoezemetklimaat

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
1	46	2,24	1,177	,174	1,89	2,59	1	5
2	29	2,10	1,012	,188	1,72	2,49	1	5
3	45	1,96	,952	,142	1,67	2,24	1	4
4	22	1,91	1,019	,217	1,46	2,36	1	4
5	35	1,97	1,071	,181	1,60	2,34	1	5
Total	177	2,05	1,051	,079	1,89	2,21	1	5

ANOVA

Alsikmochtstemmenzouikdeklimaatvisiehoezemetklimaat

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	2,782	4	,696	,624	,646
Within Groups	191,760	172	1,115		
Total	194,542	176			

ANOVA is insignificant so we accept the Ho, so the means of the groups are equal and thus we cannot assume there is a difference between groups regarding consideration of climate change when voting for a political party.

Correlation between class and the question if students think people should know more about climate change.

Descriptives

VindjehetbelangrijkdatNederlandersmeerkenniskrijgenover

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
1	47	1,57	,715	,104	1,36	1,78	1	4
2	29	1,41	,733	,136	1,14	1,69	1	4
3	45	1,53	,625	,093	1,35	1,72	1	4
4	22	1,36	,492	,105	1,15	1,58	1	2
5	35	1,43	,558	,094	1,24	1,62	1	3
Total	178	1,48	,640	,048	1,39	1,58	1	4

ANOVA

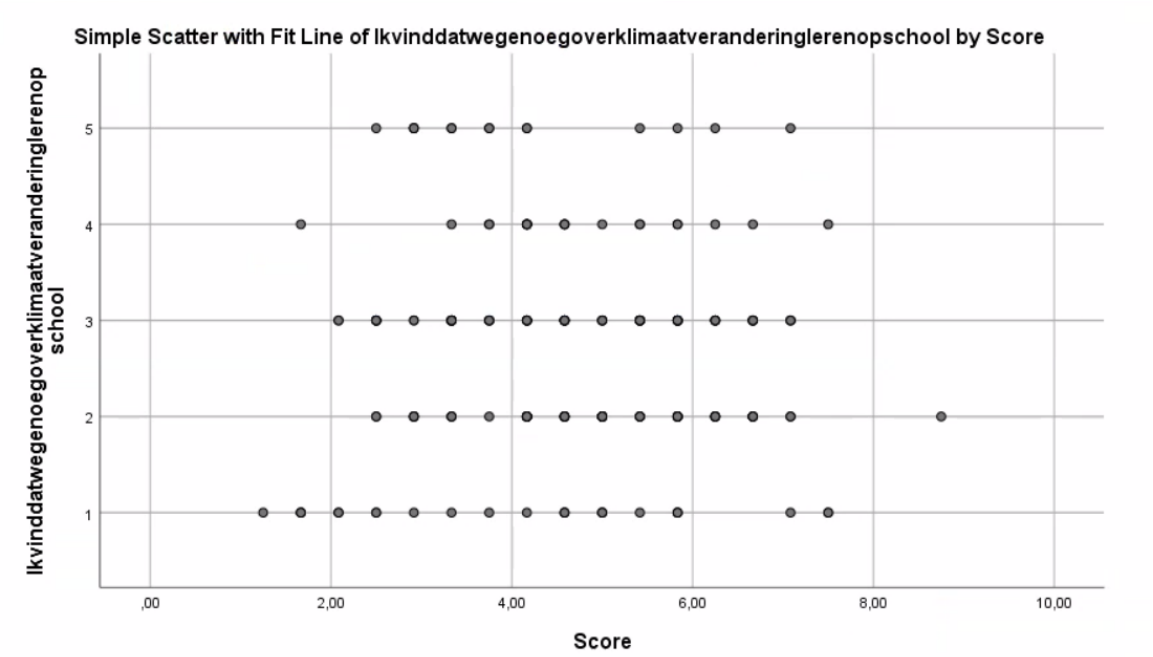
VindjehetbelangrijkdatNederlandersmeerkenniskrijgenover

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	1,063	4	,266	,644	,632
Within Groups	71,386	173	,413		
Total	72,449	177			

ANOVA is insignificant so we accept the H0, so the means of the groups are equal and thus we cannot assume there is a difference between groups regarding the question whether people should no more about climate change.

Appendix 4
Policy Support (SPSS Output)

Correlation between grade and the question whether there is enough teaching about climate change in school



Correlation between grade and the question whether the government does enough about climate change.