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The information finding and evaluating strategies of 11 grade high school students engaged in the NLT-module Van HIV tot AIDS?



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Introduction

Today it has become essential to master information finding and evaluating skills, since we live in a society where access to information and the evaluation of this information are important for economic, educational and personal success. With the rising importance placed upon these so-called information literacy skills (Julien & Barker, 2009) and the expected level of these skills that students should master, there has been created a gap between the expected level and the actual level of information literacy skills that students are able to demonstrate. Thus, even though there is clear evidence that refined information literacy skills are advantageous for academic success, in general students are not able to demonstrate refined information searching skills and critical information evaluation skills (Brown, 2001). This study investigates which strategies of information finding and critical evaluation of scientific information upper secondary school students are actually using during an inquiry-based series of lessons in a secondary-level science classroom.

Theoretical background

Inquiry-based learning

The aim of inquiry-based learning is to develop and foster inquiring minds and attitudes that are important for students being able to face and manage uncertain futures. The website of PRIMAS (<http://www.primas-project.eu>) gives comprehensive information about inquiry-based learning and is one of the projects that advocates inquiry approaches to science education across Europe. Essentially, learning is based on pupils adopting an active, questioning approach (PRIMAS, 2012). The main goal of the inquiry approach is to make students familiar with investigative procedures used by researchers and scientists and to develop problem-solving and decision-making skills. So inquiry-based learning encourages students to develop their own expectations and explanations of observations. These principles of inquiry have much in common with the principles of information literacy, such as the ability to effectively find, select and evaluate needed information (Julien & Barker, 2009). Both inquiry as information literacy skills elicit prior knowledge and for both the student is required to formulate and use a strategy, either to search for information or in case of inquiry to seek evidence to support a hypothesis. After executing this strategy, the student has to communicate his or her findings at the end of his or her information seeking task and the same is asked of the student in inquiry based learning. It is therefore appropriate to conduct this research on information seeking skills and critical evaluation of information, in an inquiry-based learning environment.

Many students find it hard to search and find scientific information (Julien & Barker, 2009) and lack sophisticated information searching and critical evaluation skills. Students find it difficult to formulate search terms or keywords to start their search for information. And when students have

come up with certain keywords and find information, they are often unable to evaluate the trustworthiness of the source. Since students experience great benefits when they already master these skills at the start of higher education, it raises the idea of preparing students for these information literacy skills when still in high school. Some high schools are already trying to teach students this academic skill of finding and evaluating scientific information in order to prepare students for higher education.

This is also the aim of the inquiry-based learning module *Van HIV tot AIDS?* (in English: *From HIV to AIDS?*) taught in grade 11 and 12. This module strongly focuses on the development of academic skills (Bètasteunpunt Utrecht, 2010). These academic skills will not only be useful in biological research, but will provide a basis which these students can use in several scientific fields and they can even use them in their everyday life. They learn to find knowledge and how to evaluate information on trustworthiness.

The science subject NLT and the NLT-module *Van HIV tot AIDS?*

In 2007 a new science subject was introduced in the Netherlands, “Natuur, Leven en Technologie” (in English: “Nature, Life and Technology”, also indicated as Advances Science and Mathematics Education) or NLT. NLT is an optional subject within the science stream of upper secondary education, to be completed with a school examination (Bètavak-NLT, 2012). The objectives of NLT relate to broadening and deepening of the subject matter of natural sciences for students and allows for a better coherence in the different natural sciences. These objectives aim to motivate and better prepare students for future science studies. Other objectives of NLT relate to the innovation of education in general and science education in particular (Bètavak-NLT, 2012).

One of the modules within NLT is *Van HIV tot AIDS?*. In the NLT-module *Van HIV tot AIDS?* the students study HIV and AIDS on the basis of (ultimately self-formulated) questions to which they seek answers in (popular-) scientific articles (Bètasteunpunt Utrecht, 2010). The results of their searches are presented during the course to the teacher and fellow students and critically discussed.

The context of the module is formed by scientific research on HIV and AIDS and the contributions to that research from immunology, (bio)chemistry and mathematics (epidemiology). Concepts that are covered in this module include: the immune system, infection, replication, retroviruses, particularly HIV, structural changes of proteins and protein interactions. Students are provided with a useful strategy to find reliable information. At the end of this module students can search information by themselves, evaluate that information and present it to their fellow students.

More evidence in literature of students lacking information literacy skills

There is a lot of evidence in the literature that students lack information literacy skills, such as searching for information and critical processing and evaluating this information (Bilal, 2000; Brown, 2001; Coiro, 2003; Leu, 2002; Lorenzen, 2001; Pritchard & Cartwright, 2004). High school students often find it difficult to evaluate the trustworthiness of information, for instance if the source of the information is objective or not. Baule (1997) noted that the major difficulty encountered by children was to distinguish between accurate and inaccurate information. Children appreciated an information site on the internet if it was easy to find and use. These same students did not take a lot of time to evaluate the site for accuracy and reliability. On top of that, high school student seem to have a significant preference for the Internet and tend to choose electronic resources over printed resources (Barranoik, 2001). Research also indicates that students often demonstrate poor search skills, such as formulating search terms and evaluating websites (Barranoik, 2001; Fidel, Davies & Douglass, 1999). The research of Lorenzen (2001) found that high school students were not able to demonstrate adequate evaluation skills. Brill, Falk and Yarden (2004) found that the reading of scientific documents was done superficially by high school biology students. Many students are just simply looking for the correct answer to the given questions and they assess the information and its relevance based on the open or convenient access (Heinström, 2006). Students prefer the Internet, because it provides fast information access and offers a big variety of information and information seek based upon these priorities (ease and convenience) demonstrates inadequate information

searching skills (Urquhart & Rowley, 2007). Overall the literature on research on information literacy skills of students shows that in general students lack these skills.

Research in effective teaching methods of information literacy

There has been done little research in effective teaching methods to teach students information literacy skills. Falk and Yarden (2009) used adapted primary literature (APL) to examine science focused practices used by students during their meaning-making of the Results and Discussion sections of these adapted primary articles. They suggest that the research-oriented coordination practices (focusing on the meaning-making of the research, the findings and their implications) and some of the text-oriented practices (focusing on the text of the article itself, its function, organization, genre and the manner in which it reflects the research process) enabled the emergence of authentic scientific practices and learning by inquiry. On top of that, another type of text-oriented coordination practice enabled reflection on scientists' experimental processes, enabling learning science as inquiry. The teaching model of APL used in this investigation allowed for the emergence of two dimensions of inquiry learning and also the promotion of scientific literacy.

In another research, by Koeneman, Goedhart and Ossevoort (2011), unadapted primary scientific literature (PSL) and the strategy Cognitive Apprenticeship are used to successfully teach grade 11 secondary school students scientific argumentation. Through this teaching method most students were able to recognize the main structure of scientific argument, but the supporting arguments and the counter-argument of the main conclusion were not yet recognized. The results also showed that publications from PSL, with the help of a glossary, can be used as teaching material for 11-grade secondary school students.

Problem statement

As mentioned above, information literacy skills have become essential for success in work and personal contexts for people living in modern Western societies. People are required to master these basic skills of finding and evaluating information in order to fully participate in modern life. Research indicates that very often students are unable to demonstrate proper information seeking skills (Brown, 2001) and that students in grades 11 and 12 are often unable to distinguish credibility in websites (Brem, Russell & Weems, 2001). On top of that there is little literature on proven strategies or methods how to effectively develop information literacy skills. Classrooms in which students learn science by an inquiry-based learning model provide an appropriate environment in which students can develop information literacy skills adequate for grade 11 (Julien & Barker, 2009). Since not all students who attend post-secondary educational institutions are provided with proper instructions, it is gainful that students already master basic information literacy skills when leaving secondary school. One of the aims of the module *Van HIV tot AIDS?* is to teach students these skills and offers therefore a great opportunity to study the information seeking and evaluating strategies of grade 11 students.

After several observations and experiences from the classroom it became evident that extra attention for learning the ways of searching for reliable scientific information in the module *Van HIV tot AIDS?*, could benefit the development of useful information literacy skills of students.

In order to improve such information literacy skills, it is important to investigate what useful strategies are provided to students to search, find and evaluate sources of scientific information. In particular, how do upper secondary school students find and evaluate sources of scientific information related to questions about the specific objects of interest in this module; HIV and AIDS. On top of improving the information literacy skills of students, it is also important to study the incorrect or inefficient strategies students apply and to adjust these.

Not only will this investigation lead to more insight in useful strategies to find reliable scientific information in inquiry-based learning environments, it can also add to the knowledge about information literacy skills in general. The findings of this research can also contribute to the knowledge about effective ways to teach upper secondary school students information literacy skills.

In addition, this research will lead to recommendations for improvement of the module *Van HIV tot AIDS?* itself.

Research goal and question

The aim of this research project was to describe which strategy the NLT module *Van HIV tot AIDS?* provides to search, find and evaluate sources of scientific information and to describe the information finding and evaluating strategies upper secondary school students actually use engaged in the NLT-module *Van HIV tot AIDS?*. On top of that it has been investigated whether those strategies used by the students are similar to the strategy provided by the NLT-module. This investigation could therefore also lead to the improvement of the module itself. Hence, the main question in this research was:

To what extent does the information finding and evaluating strategy of upper secondary school students match the strategy provided by the NLT-module Van HIV tot AIDS?

To answer this question the following sub questions were defined:

1. *What is the strategy posed by the NLT module Van HIV tot AIDS? to search and evaluate scientific information?*
2. *What is the (main) strategy to search and evaluate scientific information used by the students engaged in the NLT module Van HIV tot AIDS?*

By analyzing the searching strategy taught in a learning module (*Van HIV tot AIDS?*) which focuses on this academic skill of searching for reliable scientific information, observing teachers and students following this NLT-module and interviewing these students, it was possible to formulate an answer to these questions.

Each strategy was compared on different levels by using the typology of curriculum representations of Van den Akker (1998 and 2003), who continued building on the work of Goodlad (1979). This typology is outlined in Box 1.

To analyze which search strategy a typical learning module that focuses on this academic skill, the NLT-module *Van HIV tot AIDS?*, tries to teach the students, the learning material (Appendix A) has been evaluated on the level of the 'intended curriculum' (Box 1).

The level of the 'attained curriculum', which includes the learning experiences and the learning outcomes of the students, was also taken into account in this study. In order to discover what difficulties they encounter and what solutions they come up with and use while searching for scientific information the students engaged in the NLT-module were interviewed and observed in the classroom. In this way it was also possible to discover what strategies and information literacy skills the students truly use.

The level the 'implemented curriculum' includes how the teacher has interpreted the curriculum on paper and how he has executed this curriculum, so the actual process of teaching and learning. In this research the teacher was also the designer of the module, his interpretation of the documented learning material should be more or less the same as the formal intentions specified in the written curriculum. In order to investigate the teacher's role in teaching the students the strategy posed by the module the strategy provided by the teacher was observed during the lessons (Box 1).

These results together provide a description of both the strategy intended by the NLT module and the strategies upper secondary school students use to find reliable scientific information in relation to questions about HIV and AIDS and help answer the main question to what extent these information finding and evaluating strategies match-up with each other. So in the end the intended curriculum, the implemented and the attained curriculum were all compared to each other, by describing which searching and evaluation strategies the upper secondary school students use and

compare if these are similar to the strategies provided by the teacher and the module *Van HIV tot AIDS?*.

Box 1. Typology of curriculum representations. Adapted from Van den Akker (2003)			<u>Data collection in this research:</u>
Intended	<i>Ideal</i>	Vision (rationale or basic philosophy underlying a curriculum)	
	<i>Formal/Written</i>	Intentions as specified in curriculum documents and/or materials	Analyse information finding and evaluating strategy the module intends by evaluating learning material
Implemented	<i>Perceived</i>	Curriculum as interpreted by its users (especially teachers)	
	<i>Operational</i>	Actual process of teaching and learning (also: curriculum-in-action)	Analyse information finding and evaluating strategy the teacher provides by observing teacher in class
Attained	<i>Experiential</i>	Learning experiences as perceived by learners	Analyse information finding and evaluating strategy the students use by observing them in class and interviewing them
	<i>Learned</i>	Resulting learning outcomes of learners	

Methods

Setting and participants

To determine which strategies the students are provided with and which strategies students use during the lessons, the teacher (also the designer of the module) and 23 students were observed during all the lessons of the module *Van HIV tot AIDS?*. These 23 students enrolled in the module from February to April 2012. All students were in grade 11 of the pre-university tract during this module, but came from several secondary schools. The course was given at Utrecht University by the designer of the NLT-module *Van HIV tot AIDS?* and a fellow teacher (who was not observed), with one lesson of approximately 3 hours per week. At the end of the module 8 of these students were interviewed. These interviews were conducted in the secondary schools of these students and all under the same environmental circumstances. Schools and students have to provide separate consent for the conduction of the interview and participation in the interview.

Instruments and data collection

The observations were non-participant and non-structured observations and conducted by a single observer (the author). Each individual lesson of 3 hours was observed, which adds up to 7 observed lessons in total. During these observations an observation-scheme was used (Appendix 1), focusing on what the teacher provided his students with in relation to searching for reliable scientific information and on how students perceive and use this. This observation scheme included the activities and actions of the teacher, but also those of the students in relation to information seeking and evaluating. There was also made a distinction between the observed action and my interpretation of that action in the observation scheme. The observations were conducted to provide more insight in the role of the teacher in the process of learning information literacy skills and to help formulate questions for the semi-structured interview.

In addition to the observations, there were also semi-structured interviews (Appendix 2) with 8 of the 23 students engaged in the NLT-module *Van HIV tot AIDS?* focusing on the scientific information seeking and the evaluation of that information that was required during these lessons. These interviews were conducted by a single interviewer (the author) and each of the 8 students was

interviewed individually. The questions of these interviews were based on the strategy posed by the written learning material of the NLT module *Van HIV tot AIDS?* and the observations during the lessons. The interviews were performed using a critical-incident technique (Urquhart et al., 2003). The interviews were conducted by a single interviewer (the author) and they were transcribed for analysis. The interviews lasted about 15 minutes.

Data analysis

The analysis of the observations and the interviews was done qualitatively without the use of software, by descriptive analysis. The themes (questions, search terms, search process and reliability of sources) were identified primarily by a single coder (the author), with discussion and input from the research supervisor dr. A.E. van der Valk. The coding scheme (Appendix 3) describes the possible information finding and evaluating strategy in steps by separately labelling each step with its own code. The final coding was done by two coders. The second coder was an extern fellow student. The inter-rater reliability was moderate, with a Cohen's kappa of 0.46. The use of multiple coders and quotes from the interviews, which can illustrate findings, help to confirm the results. To analyse whether the strategy of the module matches up with the strategies of the students, the codes were all counted to investigate how often a student used that step correctly (with respect to the strategy of the module) in his or her strategy. Furthermore a main strategy of the students was extracted by selecting the most frequently used strategy steps.

Results

The NLT-module Van HIV tot AIDS? search strategy for reliable and valid scientific information

In the first three chapters of the module students are each time increasingly made aware of a new aspect of a good search strategy. In the first chapter the importance of search terms is highlighted. In the second chapter the emphasis is on references and in chapter three students have to think of in-depth questions themselves.

Question

In the first chapter students have to answer processing questions and search questions. With the processing questions students can check whether or not they have understood the theory or subject matter of this chapter. With the search questions they have to search for information about the immune system themselves.

In the second chapter students first have to answer search questions and secondly in-depth questions. These search questions are there to help students with their search for information, through which they will gain a better understanding of the infection process. By answering the search questions students learn new concepts.

Later on in the students' searching process, they are constantly motivated to come up with their own questions. Because in order to answer the 'in-depth questions' they have to answer some other questions to ultimately come to the answer of the initial question. This is an important focus point throughout the whole module; constantly motivating the student to come up with their own questions.

In chapter three the search questions again help student to understand the general lines of this chapter. When they have successfully answered those questions, they surely have some questions of their own. The in-depth questions are no longer given in this chapter, the module only gives a few concepts or terms with which the students now have to formulate their own in-depth question. It is to this self-formulated in-depth questions that students have to find an answer to.

So as mentioned above in the first chapter students are given clear-cut search questions. In the second chapter there were in-depth questions added to these assignments. In the third chapter,

students had to formulate their own in-depth questions by using given concepts and terms. In chapter four, students have to work on a certain subject for a slightly longer time. After a quick orientation on their subject, they have to formulate a research question to which they will find a conclusive answer. Thus during this module students either are given a question or come up with a question on their own.

Search terms

After students have answered the processing questions in the first chapter more or less by heart, they have to answer search questions. The first thing they will have to do is to look in their textbook, for instance in the chapter about immunology, or in Binas, a handbook or guide for the natural sciences in the Netherlands, which is intensively used by both students and teachers. In here they can find a first answer and even more important, they can find relevant search terms in these books. On top of that, students are provided a list with search terms during this first chapter. They are advised to use these given search terms during their search for answers to the questions.

The new concepts the students learn in chapter two can be used as search terms while answering the in-depth questions about the details of the infection process. It is in chapter two that students really have to decide on their own search terms. They have to make their own search term list when they start their search for information.

In addition, the module advises using English search terms. By using English search terms, instead of Dutch search terms, students can find even more information, because more plenty and credible information on the internet is available in English rather than in Dutch.

So in order to answer the questions they have to search for information. The students' search starts with coming up with proper search terms. These search terms were given in the first chapter, but as the module proceeds students have to come up with their own. Students have to make a list of search terms for each question. If students have to answer an in-depth question they will need to use much more specific search terms than if they would had to answer processing or search questions.

Search process

After the students have read or done a quick search in their textbooks to find and select more search terms during chapter one, they can search in scientific books by using the index or search the internet, via a search engine, for articles which can provide them with a more in-depth answer.

The module also recommends students to search for pictures or images that might also visually help them to understand the new concepts.

Furthermore, the module points out that bioplek.org, www.kennislink.nl and Wikipedia are good starting points to begin their search on the internet. Wikipedia is a good starting point, but students should know by the end of chapter two that they will not find all the answers there with enough depth or complexity. The module also points out that the English version of Wikipedia offers a lot more detailed information than the Dutch version, so students have to visit the English version of Wikipedia as well.

Students are also made aware of the existence of Google Scholar. Through this search engine they can directly find scientific papers or scientific information.

In chapter three students are expected to at least use one scientific paper as a source of information to answer their questions. This can either be a research paper or a review article. The module describes that a good way of deciding whether the scientific paper contains the information which you need is to first read the abstract. And the quickest information is found in the introduction and conclusion. The shortcut key CTRL+F is also pointed out by the module as a search tool within a source.

Furthermore, students have to check the references in order to get more information about a certain subject. And if an article proves to be too difficult because the students lack certain prior knowledge, they have to either check if they can quickly learn more about this missing background information or they have to continue searching for a less difficult paper.

So in short, after formulating search terms, students start their search. The module advises students to use Binas, their school textbooks, bioplek.org, Kennislink or Wikipedia (both the Dutch as the more detailed English pages) as starting points of their search for information. These are sources which can provide students with a first answer and even more important, they can find relevant search terms in these texts. It's important that students realize that these sources do not offer information to answer the questions with enough depth or complexity. According to the module the answers with enough depth can be found in scientific books or scientific papers.

Binas, school textbooks and scientific books should be searched using the index. The internet can be searched with the use of a search engine. Google and Google Scholar are mentioned as proper search engines. In case of Wikipedia, the module advises students to look at the references at the bottom of the Wikipedia pages as well, because these references often lead to reliable and/or scientific websites or articles.

Reliability of sources

In chapter one students make the initial step towards evaluating the trustworthiness of information. If they use images or pictures they are advised to check what the source is of these images. Next to images, there are a lot of video's online about biological processes, however, not all of these movie clips are accurate, so if students decide to use a video in their presentation they have to be able to support those video's with other material. On top of that, it is important when using Wikipedia, that students also consider the references at the bottom of the pages. These references often lead to reliable and/or scientific websites or articles.

In the second chapter the first real steps are made to evaluate the trustworthiness of sources. Students have to answer questions about what makes a source reliable from a scientific point of view, how to evaluate the trustworthiness of a source and finally they have to give some examples of reliable websites about HIV and AIDS. Criteria students have to take into account are;

- *Who is the author of this text? What makes him an expert in this field of knowledge? Does he have any titles or credentials that prove that he is an expert and a reliable source?*
- *Where is this text published? Is it an objective source? Does it come from for instance a scientific magazine or does this source have other intentions, a pharmaceutical company for example has commercial benefits.*
- *When was this information written or published? Is it recently published information or might it be slightly out of date?*
- *Does this source have references? Is there a considerable list of literature that has been consulted for this work and can be used for further reading?*
- *Are the facts correct and accurate? Can you confirm this by finding the same facts in different sources?*
- *Are there an abundance of pictures that do not contribute to the richness of the text?*

In the third chapter the evaluation of the trustworthiness of sources and their information is taken to a higher level. Because it is often difficult to decide whether a source on the internet is reliable, students now have to try to come as close to the source of information from where a lot of knowledge found on websites is based on, scientific papers.

Students learn that scientific articles are very reliable. They are written by scientists who are experts in this field and these papers are about recent research. On top of that, students learn that scientific papers are always peer reviewed before they are published, which decreases the probability of containing false information.

In addition they have to apply the criteria of reliability, which they learned in chapter two, in order to evaluate if their sources of information are trustworthy.

Altogether, in order to evaluate the trustworthiness students need to study each piece information on who the author is, what is the source of the information, where and when was it published, what references does this source have and does this text contain accurate facts. As mentioned earlier students learn that scientific papers are very reliable and valid sources of information, so they are expected to find and use scientific papers to answer their questions.

These steps together form an adequate search strategy to find reliable and valid scientific information. The student is able to search by self-formulated search terms, which are specific enough to lead him/her to useful information, and that he/she is able to make use of the right search tools, like a search engine as Google (Scholar) or the index in a book. Students have to continually come up with new questions based on newly found information in order to get a more detailed and accurate answer to their research question. By using the criteria to assess reliability of this search strategy of the module, the students learn to evaluate the reliability of the found information.

The students' search strategy for reliable and valid scientific information

The observations revealed that almost every student (20 out of 23) struggled with formulating their own proper search terms in the beginning of the module. The observed teacher (also designer of the module) provided scaffolding by continuously stimulating the students by asking questions with the objective of that they come up with new questions which should lead the students to generating and developing new search terms. The teacher never gave up the answer to the students' question, the students had to find the correct answer by themselves. The teacher always responds to the students' questions by asking them a different question in order for the students to start thinking into a different direction which would enable them to continue their search. The observations also showed that many students experienced problems with assessing the trustworthiness of the sources during their search for scientific information.

By the end of the module students were no longer asking the teacher as many questions about search terms as in the beginning and they were able to work independently on their own. However, they remained to have some difficulties with assessing the credibility of the found information. These problems with reliability will be specified later on in this section of the paper.

The following table (Table 1) shows the results from the interviews, which were taken by the end of the module. The eight students were asked about certain steps in their strategy to search for reliable scientific information. Table 1 shows how many students of the group of eight mentioned and correctly performed each step in their strategy with respect to the strategy posed by the NLT-module Van HIV tot AIDS?.

Search terms

As you can see in the section about search terms most students (7 out of 8) were able to generate their own search terms by the end of the module. In addition, the strategy of retyping the question as a search term was no longer used; six students made it clear never to use this strategy anymore.

Furthermore, the table shows that half of the students mentioned to use English search terms. Students have to go through the process of going from general search terms at the beginning of their search towards more detailed and specific search terms at the end of their search for information. In the interviews they were asked about this process and 7 out of 8 said to start their search with easy, basic or general terms and would later on in the search use more complex specified terms. They all describe it as a process that feels natural to them. They start searching with these easy terms and they will encounter increasingly more complex terms during their search and each time they use these new terms as a next more specified search term. One student described this process with some examples: "We started with HIV in monkeys and apes, and then we found out that this was actually called SIV [Simian immunodeficiency virus]. So we started using SIV as a search term and SAIDS instead of AIDS. You will automatically continue searching. I do not know which words we came across with after that, but you will find certain words in your source of information which you might not understand at first, but then you should use those terms to carry on your search."

Table 1. Number of students per step who either correctly or incorrectly applied step in their own search strategy with respect to the search strategy of the module Van HIV tot AIDS?

Major theme	Theme	Step within strategy	Total number of students who mentioned this step in their search strategy and performed it*	
			Correctly	Not or incorrectly
Question	Origin	Given processing question	2	0
		Given search question	3	0
		Own invented in-depth question	3	0
Search terms	Origin	Given search term	1	0
		Own generated search term	7	0
		Retyped question as search term	6 **	0
	Language	Dutch	1	0
		English	4	0
	Process	Start with general	7	0
		End with specific	5	0
Search process	Internet, search tools	Google	8	0
		Google Scholar	6	0
		Wikipedia NL	4	0
		Wikipedia ENG	5	0
		Wikipedia references	3	0
		Bioplek.org	5	0
		Scientific website	1	0
		Shortcut key CTRL+F	4	0
		Youtube	1	0
			Books, search tools	Table of contents
Index	3			1
Aimed browsing	3			0
	Binas, search tools	Binas in general	4	1
		Index	1	0
		Random browsing	1	0
		Aimed browsing	2	0
	Booklet module	Booklet in general	2	0
Reliability	Criteria trustworthiness	Author in general	1	2
		Expert titles of author	5	0
		Source in general	2	0
		Scientific paper	4	0
		Newspaper	1	0
		Commercial purpose	5	0
		Organization	2	1
		Forum	1	0
		Layout of source	5	0
		Date of publication of source	3	0
		References	8	0
		Correct facts	5	2
		Clarifying schemes or images	2	0
		Superficial criteria	0	5 ***
	Where criteria learned	At school	4	2
		Module Van HIV tot AIDS?	7	0
		Through personal experience	3	0
		Through family	1	0

* (Total number of students in interview group was 8)

** (Did not retype question as a search term)

*** (Used superficial criteria to evaluate reliability)

Search process; internet

All of the interviewed students state to have used internet and Google as the search engine to search the internet. However, just six of them were aware of Google Scholar.

There were 6 out of 8 students who used Wikipedia regardless of which language version and five students of who used Wikipedia explicitly stated to use Wikipedia only as a good site to begin their search with.

Just 3 out of 8 students used both the Dutch and the English version of Wikipedia. Just one student said to have used the Dutch version exclusively and another two students mentioned to have only used the English version of Wikipedia. Besides the choice of which language version, students could also use the references at the bottom of the Wikipedia pages. There were only 3 out the 8 interviewed students that said they had paid attention to the references of Wikipedia even though the teacher advised the students to use these references.

In the booklet of the module scientific oriented websites like Kennislink and Bioplek are also mentioned as a startingpoint and it is advised to watch some Youtube videos to visualize some concepts. The shortcut key CTRL+F is also pointed out by the module as a search tool within a source, and 4 out of 8 students mentioned to have used this shortcut key to quickly search e.g. an article.

All these extra search tools were not used as much by the students and were always used in addition to the much more frequently used search engines (Google and Google Scholar) and Wikipedia.

Search process; books

Besides the usage of internet as a search medium, students could also use books. These books could be their school textbooks or the more scientifically based textbooks brought to class by the teacher. Although 7 out of 8 students claimed to have used a book somewhere during their search for information, they also stated that they prefer the usage of internet and consider books limited in their quantity of information. On top of that they often state that they find it much more difficult to search within a book than on the internet. Observations also revealed that students open up the book and start searching but eventually get lost within the abundance of text, give up their search and go back to the internet. Student: "In class there were always those scientific books of the teacher, with more information about HIV or aids, but those were quite difficult to read. They were written in difficult English and you could not search within them easily."

A remarkable result is that only 4 of the 8 students were aware of the existence of an index as a search tool in books and one of them even stated not to use it since she did not consider it useful. This left just three of them who actually stated to use the index. Instead of using the index, students often browsed books randomly.

Another search medium is Binas. Only half of the students used Binas and only as a starting point of their search or to refresh their prior knowledge. By the end of the module none of the students used Binas anymore. Student: "In the beginning I used Binas, but at a certain point Binas just offered too little information with too little depth. So then it was not of much use to me."

The last written medium is the booklet of the module itself. It was both noticed by the researcher during the observations as by a student herself that almost no one of her fellow students read the booklet. It became evident from the interviews that only one student used the booklet as a source of information. One student: "It struck me that I was one the very few who actually read the booklet before class and answering the questions. I remember one time when I had to give the definition of AIDS, I literally took this out of the booklet and all the other students told me to slow down in order for them to write my answer down. And I really literally told them what was stated in the booklet and they did not even know!"

Evaluation of reliability of sources

The next step in the strategy is to evaluate the found information. The observations already revealed that students experienced many difficulties during this stage of their strategy and the results of the interview back up this finding.

As shown in Table 1, six students made clear in the interviews to pay attention to the author of a text when evaluating the reliability of information. Five of them stated to look at the title of expertise of the writer. One of the students: "Sometimes it was specified that the author was a professor and that makes a source much more reliable than when it is not specified and it only says just someone's name." When two other students were asked why they did not pay any attention to whomever had written the text, they both replied that they did not know any important names of experts, so they never considered it useful to look at the author in order to evaluate the credibility of a source. One of them: "I never look who the author is, their names do not mean so much to me."

The following step in the evaluation process is to check where the information is published. All 8 students in the interviews mentioned that they take the place of publication into account while assessing the trustworthiness of a source. Only half of them mention scientific papers as highly reliable source of information. Only one student commented on the reasoning behind the high reliability and the peer reviews that precede a publication of a scientific paper; "At school you learn that Wikipedia cannot be considered a very reliable source, since everyone can write there. Scientific papers that are published in for instance Nature can be considered reliable, because those papers have a whole reasoning behind them, there has been done research and the papers are reviewed by other researchers before they are published."

Most of the students do know to look at the purpose of a source. They know that for example some websites are commercial and can give biased information. Only one student stated that she believed that most sites have an informative purpose.

Just 3 out of the 8 interviewed students say to also consider the date of publication, but all students say to pay attention to the references of a source, since that is the primal source of information. Five students also noted in the interview that they look at the layout of a source. Student: "I also look at the layout of a website; if it looks professional it probably is more reliable."

Five students from the interviews knew how to check whether a fact is probably correct by using multiple independent sources which state the same fact. Two students, however, did not explain the correct procedure to check the accuracy of facts. One of them states that she would ask the teacher when she is unsure and the other explained to continue searching as specific as possible, but that she actually did not have a solution to this problem.

Some students (5 out of 8) mentioned to use superficial point of criteria. These criteria ranged from stating that they did not have to evaluate the trustworthiness of the scientific books to just search for scientific papers because the teacher said so. Four students did not feel the necessity to evaluate the trustworthiness of the books, because these were provided by the teacher and if he considered these books to be reliable they must be. Another student said that if the source is a PDF-document this will mean that it probably is reliable.

There is a certain assignment (assignment 2-1) in chapter 2 in the module. This assignment lets the student think about the criteria that make a source reliable. They need to write those criteria down and give at least 4 examples of website that they think provide reliable information. During the observations it became apparent that almost no one made this assignment even though it was homework. On top of that, there was no time left during class for the teacher to go over this exercise and this meant that the assignment was never discussed in the classroom.

When the students were asked where they learned all the criteria they used during the evaluation a source, 7 out of 8 responded that they mainly learned these criteria during the NLT-module *Van HIV tot AIDS?*

When the students were asked directly what skills they thought they had learned during this module some responded with that they really learned how to find reliable scientific sources of information and that there was a certain progression in their ability to find these since the start of this module. Another student mentioned even more newly acquired skills she learned during this module; "At school you have to make assignments and there you learn the basics about the credibility of sources. But it was during this module that the teacher insisted on constantly asking yourself if what you have found is correct and where you can find more information. On top of that, I had not learned about

Google Scholar at school, it was during *Van HIV tot AIDS?* that I learned about this useful tool, the usage of English search terms and the usage of scientific papers.”

Discussion and recommendations

This discussion describes how the found strategy of the students corresponds with the proposed strategy of the NLT-module *Van HIV tot AIDS?* On top of this, it will also provide some recommendations for improvement of the module.

First some limitations of my study, as is typical for most qualitative research, the sample of this study was small, but some themes emerged that could help provide direction to further research or improvements of the module itself. Another restriction in this investigation was that were not conducted any interviews of the students at the beginning of the course. So the progression in learning is mostly based on the combination of both observations and the interview at the end of the course. Furthermore it is plausible that students have also learned from each other in class, but this was not investigated directly in this study. The teacher was not interviewed in this study, but such an interview could have provided more insight from a different perspective.

From the findings of this study, it can be concluded that in general the students' strategy to find reliable scientific information matches up with the intended strategy of the module. Both the observations as the interviews revealed that most students follow the same steps as those posed by the strategy of the module. However, there are some parts of the students' strategy that do not match up quite as good with the intended strategy, particular in the section on reliability, and those parts require some more attention. This discussion will therefore mostly focus on the differences between the two strategies.

Question

The start of the students' search for information in order to answer their question, which is either given or formulated by themselves, begins with understanding the question. If the question seems unclear to the student they use the keywords in the question which are unknown to them as a search term and firstly try to find out what the definition of this keyword is. One student says: "After a first glance at the question, I really had to look up the definition of every word, what these words truly meant." This is actually also the way the module intends the students to act. First read the question thoroughly, then select the words that you do not know the meaning of and find out what they mean, so that the student will be able to understand the question completely.

Search terms

Once the students have understood the question, it is time for them to generate the proper search terms. From the observations during lessons about chapter 2 and the beginning of chapter 3 it became clear that almost every student (20 out of 23) struggled with coming up with proper search terms by themselves. It was several times observed that if students cannot generate their own search terms they then use the entire question as a search term and type this into e.g. the Google search bar. However, when the students were interviewed by the end of the module they do not use this strategy anymore, 6 out of 8 students in the interview state never to type over the entire question to use as a search term. A quote from one student: "No, I actually never type over the entire question into Google, because there are also a lot of other words in such a question and otherwise Google also searches for those words." Another student says: "I really use keywords. First I think about what I truly want to find out and what kind of information I am looking for and then I proceed on that." A third student claims: "I do not type over the question, maybe parts of it, but I only use the most important keywords of the question. I do not use the whole question since you will get a lot of nonsense as well." So instead of typing over the question, most students (7 out of 8

interviewees) are able to generate their own adequate search terms themselves by the end of the module, which shows that they have gone through a learning process. This is one of the skills the module intends to learn these students, generating specific and complex search terms to lead you to a reliable answer with enough depth and complexity.

So as mentioned earlier, the observations made apparent that the students had the most difficulties with formulating their own proper search terms in the beginning of the module. The teacher's role in the process to overcome these difficulties was to provide scaffolding by continuously stimulating the students by asking questions. This was done so that the students would come up with new questions which would ultimately lead the students to generating and developing new search terms. It was remarkable that even within one lesson, as it proceeded, more and more students were able to come up with their own search terms instead of just copying the question out of the booklet to type in for instance the Google search bar or asking the teacher for help. In addition the teacher never gave up the correct answer to their search question, so the students had to find the correct answer by themselves. One student made a comment on this to her fellow student during an observation: "During this module you really have to find the answers to the questions on your own, because the teacher will not straight up give you the answer. That is different from any other course or module I have ever had!" During the observations it was noticed that the teacher always responded to the students' questions by asking them a different question, without giving them a conclusive answer. This was done in order to let the students start thinking into a different direction which would enable them to continue searching.

Next the module advises students to use English search terms since these will lead to both a greater quantity and quality of information. From the interviews it became clear that not every student uses English search terms, they all start with Dutch (their mother language) search terms and only half of the interviewed students (4/8) say to eventually use English terms at the end. Student: "At the beginning I used Dutch basic search terms. But as I gained more information about the subject, I translated the terms into English, because then I would get much more results." Another student states: "Well, most of the time the scientific papers are not written in Dutch, but in English. So you'll find plenty more information if you use English search terms." There should be placed much more stress upon the usage of English search terms, since those will help students to find plenty more detailed information.

Search process

So with formulating the proper search terms the real searching process has begun. The students were able to use several search media, such as internet, schoolbooks, scientific textbooks, Binas and the booklet of the module. All 23 students engaged in the module *Van HIV tot AIDS?* used internet as a medium to search for information. Internet was actually by far the most common used medium, all eight interviewed students state that they have used internet the most often. This finding is in line with the literature on the popularity of the usage of internet by students as a source of information (Barranoik, L., 2001).

Internet

When using the internet as a search medium, all students use Google as their search engine, which is consistent with the overall popularity of Google worldwide (comScore, 2012). Google Scholar is less known to students, just 6 out of 8 used it. Since Google Scholar is clean and slick search tool to find for instance scientific papers, it would be naturally to use it as standard part of your search strategy during this module. Three out of the six students who used Google Scholar state that they have found this specific search engine by accident, the other three students already learned about it at their own school. Once found by the students, they all acknowledged its usefulness. Student: "We used Google and also Google Scholar, but if you search with Google you will get more superficial and unreliable results than when you use Google Scholar. The results of Google Scholar are sources of information with much more depth, it are mostly scientific articles." So taken this into account, it might be advantageous for the search strategy of the students if the teacher would explain it in class

or if it was specifically mentioned in the booklet of the module as a proper search engine to directly find scientific or scholarly literature.

Furthermore the module describes Wikipedia as a good starting point for the students search for information. There were 6 out of 8 students who used Wikipedia regardless of which language version and five students of who used Wikipedia explicitly stated to use Wikipedia only as a good site to begin their search with. One student said: "I have not used Wikipedia extensively, but more to start reading about this new subject and to select a few search terms. So I really used it as an easy website to begin with." Another student gave a similar explanation: "You can use Wikipedia as kind of a startup to begin your search and then check the references for new sources." This use of Wikipedia is done correctly with respect to the strategy posed by the module and should remain to be an important advice to students.

Students also explained that they preferred to use the English version of Wikipedia, since it gave more detailed and elaborate information than the Dutch version. This is in line with the reason why the module advises the students to use the English version. Student: "I used both versions. The Dutch version of Wikipedia did give most of the time a part of the information, but when you looked at the English version there was a lot more information." Another student: "I have used the Dutch version as well as the English version, but mostly the English one. The English version is much more comprehensive and clear than the Dutch one."

The NLT-module *Van HIV tot AIDS?* also advises students to pay attention to the references at the bottom of the Wikipediapages to use as new sources. This was also explicitly mentioned as a tip by the teacher during the lessons. However, only 3 out the 8 interviewed students say they have paid attention to these Wiki-references. Since being able to use those references of Wikipedia is one of the reasons that make Wikipedia a good starting point, the usage of these references can be more focussed on in class.

Books

Another striking result was that the usage of an index as a search tool in a book was rather unknown, only 3 students could describe that by using the index you can search the book more easily and were able to actually use the index. Some students browsed the books for information randomly, which was never recommended to them by the module, since this is a time-consuming activity and often will not be rewarding. In the future there should be more focus on the proper usage of the index by either the teacher or the module. There is still much to be gained in the area of book search tools.

If students are provided with the proper search tools for books, perhaps they will be encouraged to make more use of the books provided by the teacher in the classroom, since these books are now more or less left aside.

The little usage of Binas and only in the beginning of the students' search is actually also what the module intends for students. Binas simply does not give information with enough depth and complexity, so in order to get correct and reliable answers to your question you have to divert to other sources of information. This step was mostly correctly performed.

There can be gained some improvement in the usage of the last search medium, the booklet of the module itself. The results showed that the booklet was very scarcely used as a source. During future classes students should be better motivated or stimulated to read the booklet as well since the booklet itself gives a lot of reliable, clear and elaborate information about many concepts within the immune system, HIV and AIDS.

Evaluation of reliability of sources

Another major point of focus in the module is the evaluation of the trustworthiness of sources of information. It is in this stage of the strategy of the students that the most difficulties and problems arise.

Some students said not to pay attention at who has written a text, because they do not know any important names of experts. The teacher could explain to them that titles in front of a name or positions at certain research facilities could also be criteria of credibility with respect to the author.

Assignment 2-1 in chapter 2 in the module should be discussed during class, so that every student has discussed this part. This assignment focuses on the criteria that make a source reliable and is an important part of the learning trajectory. Now the teacher went over the criteria in passing, so not every student was reached in this way.

There could also be more explained why students should use scientific papers. These papers are considered very trustworthy according to the module and there is actually an assignment to at least use one scientific paper during the module, but only 4 out of 8 students stated to actually have used such a paper to answer questions. On top of that many students, who did say they had used a scientific paper, said their reason to do so was because the teacher had asked them to do this and because it was an assignment of the module. Perhaps if the teacher would focus more on the reasoning behind the usage of a scientific paper as a source and if the assignment would include the action of actually handing in the paper, on which they based their final answer, more students would be stimulated to truly use a scientific article as a source.

Many students also look at the layout of a source. This is not part of the criteria the module provides, since many commercial websites can have a professional looking layout, but can still provide unreliable and biased information. Students explained that they consider a website to be trustworthy if it looks clean and professional and if it has a high level of difficulty of the used language. These are superficial criteria, which cannot be used to evaluate the trustworthiness of a source. The module can respond to this by giving a more detailed explanation why you cannot solely rely on how e.g. a website looks.

Another superficial point of criteria used by the students was the evaluation of the reliability of the provided scientific books. Half of the students explained during the interviews that they had not paid any attention on evaluating the trustworthiness of these books, since they considered them to be reliable because the teacher brought them with him. A way of avoiding such shallow thinking could be by intentionally adding a less reliable book or even a fake one. Or perhaps the teacher could sometimes directly ask a student while he or she is searching the book whether or not he or she had paid any attention on for instance the date of publication.

A question that arises from these findings is that it possibly is not feasible to achieve proper skills to evaluate the credibility and reliability of information in the short amount of time available for the module. Perhaps by increasing the course with one or two more lessons, focussing on these skills there can be achieved much more improvements in the reliability section of the strategy of the students, unfortunately the available time for the course is often very limited.

Conclusion

This research has investigated the information finding and evaluating strategy taught by the module *Van HIV tot AIDS?* as well as the strategies the students actually perform, who were enrolled in this course.

At the beginning of the course observation revealed that the information literacy skills of the students were of a low-level. Students were unable to formulate proper search terms and had difficulties to find information that could provide them with answers with enough depth and complexity. Also the evaluation of reliability of the found information was often not paid much attention to.

This matches up with the found evidence in the literature on information literacy skills of high school students; students often lack adequate information finding and evaluating skills. Research shows that students have particularly the most difficulties with generating search terms and assessing reliability of the source of information (Julien & Barker, 2009; Baule, 1997).

Conversely, by the end of the module, both the observations and the interviews showed a different story. The students were in fact now able to generate proper search terms and were able to find and formulate answers to the questions with enough depth and complexity. They clearly had gone through a learning process with respect to finding and searching information during the course *Van HIV tot AIDS?*. Nevertheless, students still proved to have difficulties with evaluating the trustworthiness of the found information at the end of the module. The stage of assessing the reliability of the information sources turned out to be the bottleneck of this investigation of the information finding and evaluating strategy.

Here at the end, we return to the main question, *“To what extent does the information finding and evaluating strategy of upper secondary school students match the strategy provided by the NLT-module Van HIV tot AIDS?”*. This research shows that in general the students’ information finding and evaluating strategy does match the strategy intended by the module in the end. The main bottleneck lies within the evaluating strategy of the students. There is still much to be gained in this section of the strategy, but this can be achieved by small improvements such as those mentioned before.

Overall, the module proved to be quite successful in teaching its students how to formulate adequate search terms and the strategy of searching, finding and evaluating scientific information of the students generally corresponded with the strategy intended by the module. However, there still is some room for improvement for this module in the stage of evaluating information. If more time and attention is paid to this section, it is likely that students enrolled in this module will in the end master appropriate information literacy skills to be able to fully participate in our society where quick access to reliable information is becoming more and more important.

Directions for further research

More questions arose from this study, and these may provide new starting point for further research. Such questions are what is the true starting point of 11 grade students at the beginning of the module and do students also learn from each other? It is therefore advisable to also conduct interviews of the students at the beginning of the course, this in addition to those conducted at the end of the module. This could offer more data on the true learning trajectory of the students. It is also possible to explore the strategies of students in grade 11 that did not enrol in this module *Van HIV tot AIDS?*

Furthermore students tend to learn from each other as well. It is interesting to take this into account in future research on students’ learning of information literacy skills, since it is possible that students also learn incorrect or ineffective strategies from each other.

Another way of shedding more light on the matter is by also interviewing the teacher. He or she can provide information from a different point of view. It is also interesting to investigate the search strategy of the teacher himself/herself. It is possible that the search and evaluating strategy of the teacher requires more development and that it does not match up with the strategy of the module. It would be incorrect to expect the teacher to deliver adequate search and evaluation strategies or curriculum, if their own skills are in need for improvement. The outcomes from such investigations into the information literacy skills of teachers could help to identify more ways of developing more effective information searching and evaluating skills for both students and teachers.

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Appendix 1.

Observation-scheme (blank template)

Time	Situation	Action teacher	Actions student	My interpretation

Example filled in observation-scheme: *Observation-scheme lesson 2*

Time	Situation	Action teacher	Actions student	My interpretation
13:30	Start of lesson	Introducing lesson, explaining planning of today	Logging in on computers	
13:35	Students working on exercises		In groups working on assignments on the computer	
13:45		Teacher walks around to answer questions	Students try to answer the assignments in the booklet and ask the teacher questions	There seem to be a lot of uncertainties about the evaluation of the course.
13:55		Teacher gets books about HIV and AIDS, and BINAS	Students also use the books and Binas	
14:05			<p>Students use google to search the internet. Search terms:</p> <ul style="list-style-type: none"> -GP120 binding -CD4 -Entire questions typed in -HIV+weerstand (HIV and immunity) -membraaneiwwitten (membrane proteins) <p>Students also use Wikipedia on internet. They use search terms in Dutch as well as in English.</p> <p>Students also use the book Binas. They use the index to look up some search terms.</p>	

			Two groups have found a scientific article on Pubmed. (Separate from each other)	They have found these articles by accident. Teachers have not explained were students could find scientific papers. One groups explains that they found this paper by typing in some search terms in google.
			Two students (twins) use the website of the UMCU about HIV.	When asked: Found via google.
			Student uses Google Books	When asked: Found by accident via entering in some search terms in google.
			Another student uses Google Translate to translate some difficult English texts.	Google translate was a tip from the teacher.
			One group has started to make a powerpoint presentation.	
			Two students (twins) use the books the teacher has provided. They use the index to search the book.	They use a keyword to search the book with use of the index. They find some pagenumbers. They do not find the answer they were looking for on those pages quick enough so they go back to their computer and continue searching on the internet. Now by typing in the entire question in google.
			Website AMC hospital	
			The website Bioplek is used by 4 groups. Search term: AIDS	Some found this website through google with the search term AIDS

			Twins use website "medisch wetboek".	Students states that he uses keywords to search the internet with google. He also says he prefers searching in books, but that he had a hard time filtering the correct answer from the books which were provided by the teacher. It is also remarkable that the student uses Google the most often, but does not look at the credibility of the found information.
			Students use Google Images to find overview images or scheme's to use in their presentations.	
			Another group claims to be finished.	
14:35		Teacher reacts on groups who states to be finished by saying: Bad news ladies, you are never finished.	Reaction group: But we have answered all the questions in our assignment.	
		Teacher responds: And have you answered all the new question you might have come up with?	"No, not really and there is one question that we didn't understand..."	Teacher and students continue discussion and together try to find an answer to their remaining questions. Teacher doesn't give the answers, but asks more questions in order to provide the students with some scaffolding.
			Another group uses the website Stop AIDS Now.	When asked how did you find this? Students reply: We saw it on the

				television, so we decided to use it and typed in the direct URL.
14:35	Break	*****	*****	*****
15:00	Introduction, restart lesson	Teacher gives planning	Students continue on their assignments	
15:20	Presentations assignments		One groups has used a scientific paper of a research project done in the AMC about Langerhanscells in their presentation.	
16:05	End of presentations, start on assignment 2-6.	Teacher searches the internet for a movie-clip about HIV entry in cells.	Students work on assignment 2-6.	
16:10	Movie-clip	Teacher shows short movie and gives extra explanation	Students watch movie.	
16:15	End of lesson	Teacher rounds up lesson 2 and introduces chapter 3. Divides students in groups for assignments next week.		

Appendix 2.

Semi-structured interview protocol

Docentenhandleiding en leerlingen module meenemen. Check je opname apparatuur. Neem altijd extra batterijen mee. Altijd op dezelfde manier het interview inleiden.

Ik ga nu het interview bij je afnemen. Ik zal het vrij strak houden, dit om mijn onderzoek zo betrouwbaar mogelijk te houden. Er zijn geen foute of goede antwoorden die je kunt geven. Je moet zo eerlijk mogelijk antwoord geven. Het gaat er om dat je precies vertelt wat je hebt gedaan tijdens het zoeken naar informatie. Je kunt de module op elk gewenst moment erbij pakken en openslaan als je dat wilt.

Interview vragen

1. Je hebt de module Van HIV tot AIDS gevolgd. Hierbij moest je onder andere opdrachten maken tijdens de lessen en thuis. Heb je hierbij zelf actief naar informatie gezocht?
2. Als je dan terug denkt aan die opdrachten die je had, welke informatie had je dan nodig? Kun je een voorbeeld noemen?
3. Waar heb je deze informatie, die je nodig had voor die opdracht, geprobeerd te verkrijgen?
 - Zijn er naast deze bronnen, nog meer bronnen gebruikt?
 - Heb je misschien de volgende bronnen gebruikt: BINAS, schoolboek, internet, tijdschrift, televisie, krant, iets anders?
4. Hoe heb je binnen deze bronnen naar informatie gezocht?
 - Welke middelen heb je gebruikt bij het zoeken op internet?
 - Heb je gebruikt: zoekmachine, wikipedia, kennislink, bioplek of direct adres website ingetypt?
 - Bij zoekmachine: google? Ben je bekend met Google-Scholar?
 - Hoe gebruik je deze zoekmachine? Wat type je in?
 - Heb je zelf zoektermen verzonnen of heb je de vraag uit de opdracht overgetypt?
 - Kun je voorbeelden noemen van zoektermen die je hebt gebruikt?
 - Hoe heb je een keuze gemaakt tussen de resultaten die de zoekmachine gaf?
 - Welke middelen heb je bij een boek/tijdschrift/krant gebruikt om te zoeken?
 - Heb je de inhoudspagina, het register/index gebruikt?
 - Bij andere bronnen? Hoe gezocht?
5. INDIEN VAN TOEPASSING - Even terug naar Wikipedia. Heb je uitsluitend de Nederlandse Wikipedia pagina's gebruikt?
 - Ben je op de hoogte van de Engelse versie van Wikipedia?
 - Heb je de Engelse versie ook gebruikt?
 - INDIEN NEE: Waarom? Taal? Ben je op de hoogte van vertaalmachines?
6. Waarom heb je deze bronnen uitgekozen om te gebruiken?
7. Waren deze bronnen nuttig in het geven van de informatie die je nodig had?
8. Als je terugdenkt aan elk van die bronnen, wat maakt ze nuttig of maakt ze minder nuttig voor jou?
 - Denk daarbij aan hoeveelheid informatie, de snelheid van het zoeken, moeilijkheidsgraad gevonden informatie en de taal?

9. Tijdens de module wordt ook veel aandacht besteed aan de betrouwbaarheid van informatie. Hoe bepaal je of een bron betrouwbaar is?
 - Welke criteria voor betrouwbaarheid ken je?
 - Internet:
 - Let je op: referenties, update site (actualiteit), auteur (beroep en onafhankelijkheid), doel van de site (is deze onafhankelijk), zijn de feiten correct en is dit te controleren (kom je het vaker tegen)
 - Boek:
 - Let je op: jaar uitgave, auteur (beroep en onafhankelijkheid), overvloed plaatjes, ruime literatuurlijst
10. Heb je de criteria kunnen toepassen die bepalen of een bron betrouwbaar is?
11. Hoe en waar heb je geleerd om criteria te gebruiken voor zulke beslissingen, heb je dit geleerd op school of uit eigen persoonlijke ervaringen, van een vriend, familie of ergens anders vandaan?
12. Zijn dit bronnen die je normaal ook zou gebruiken voor biologielessen? Of voor andere vakken zoals natuurkunde, scheikunde of wiskunde? Zou je deze bronnen gebruiken voor andere doeleinden, zoals persoonlijke interesse of om een persoonlijk probleem op te lossen? Waarom wel en waarom niet?

Appendix 3.

Coding-scheme interviews

Hoofdthema	Thema	Label	Code	
1. Vraag	1. Oorsprong vraag	1. Gegeven	VERW (verwerkingsvraag)/ ZOEK (zoekvraag)/ VERD (verdiepingsvraag)	
		2. Zelf bedacht	VERW (verwerkingsvraag)/ ZOEK (zoekvraag)/ VERD (verdiepingsvraag)	
2. Zoektermen	1. Oorsprong zoektermen	1. Gegeven	GEV (gegeven)	
		2. Zelf verzonnen	ZVER (zelfverzonnen)	
		3. Vraag overgetypt	VROV (vraag overgetypt)	
	2. Taal	1. Nederlands	NL (Nederlands)	
		2. Engels	ENG (Engels)	
	3. Proces van algemeen naar specifiek (Moeilijkheidsgraad/ Specificiteit)	1. Start zoektocht	1. Start zoektocht	ALGZO (algemene zoektermen)/ SPZO (specifieke zoektermen)
			2. Einde zoektocht	ALGZO (algemene zoektermen)/ SPZO (specifieke zoektermen)
3. Zoekproces	1. Medium	1. Internet	GO (google)/GS (google scholar)/... WIKNL (wikipedia Nederlands) /WIKENG (wikipedia Engels)/ WIKREF (wikipedia referentie links)/... KEL (Kennislink) BIPL (Bioplek) DIWE (direct website adres) YOTU (youtube filmpjes) CTRLF (sneltoets om trefwoord binnen 1 pagina te vinden)	
		2. Boek	INH (inhoudsopgave)/ REG (register of index)/ WILDB (willekeurige doorbladeren)/ GERDB (gericht doorbladeren)/...	
		3. Binas	INH (inhoudsopgave)/ REG (register of index)/ WILDB (willekeurige doorbladeren)/ GERDB (gericht doorbladeren)/...	
4. Betrouwbaarheid	1. Criteria	1. Auteur	EXTI (expert titles)/JO (job)/...	
		2. Bron (waar gepubliceerd)	SCI (scientific magazine)/COM (commerciele website)/ FOR (forum)/...	
		3. Actualiteit	RE (recent)/OD (out of date)	
		4. Referenties	REF (referenties)	
		5. Correcte feiten	CORF (correcte feiten)	
		6. Overvloed plaatjes zonder toegevoegde waarde	OPZW (overvloed plaatjes zonder toegevoegde waarde)	
		7. Duidelijke plaatjes/overzichtsschema's verduidelijking	PLOS (duidelijke plaatjes of overzichtsschema ter verduidelijking)	

	2. Waar criteria geleerd	1. School	SCH (school)	
		2. Module Van HIV tot AIDS?	HIV (module van hiv tot aids?)	
		3. Persoonlijke ervaring	PERS (persoonlijke ervaring)	
		4. Vriend	VR (vriend)	
		5. Familie	FAM (familielid)	
5. Aandachtspunten binnen zoekmiddel	1. Zoekmachine (google en google scholar)	1. Volgorde zoekresultaten	VOLG (volgorde zoekresultaten)	
		2. Titel zoekresultaat	TIT (titel zoekresultaat)	
		3. Dikgedrukte (zoek-)woorden	DIK (dikgedrukte zoekterm)	
		4. Tekstje	TEK (tekstje bij zoekresultaat)	
		5. Link/URL bron	URL (url of link van de bron)	
		6. Referenties	GOREF (referenties van de bron)	
	2. Wikipedia	1. Dikgedrukte (zoek-)woorden	WIKDIK (dikgedrukte zoekterm op wikipediapagina)	
		2. Highlighted zoekwoorden (links andere wiki-pagina's)	HIG (highlighted nieuwe zoekterm als link naar andere wikipagina)	
		3. Referenties (links bronnen)	WIKREF (wikipedia referentie)	
6. Motivatie medium	1. Internet	1. Toegankelijkheid	TOEG (toegankelijkheid)	
		2. Hoeveelheid informatie	HOEV (hoeveelheid informatie)	
		3. Snelheid zoeken	SNEL (snelheid zoeken)	
		4. Moeilijkheidsgraad	MOEI (moeilijkheidsgraad)	
		5. Taal	TA (taal)	
	2. Boek	1. Toegankelijkheid	TOEG (toegankelijkheid)	
		2. Hoeveelheid informatie	HOEV (hoeveelheid informatie)	
		3. Snelheid zoeken	SNEL (snelheid zoeken)	
		4. Moeilijkheidsgraad	MOEI (moeilijkheidsgraad)	
		5. Taal	TA (taal)	
	3. Binas	1. Toegankelijkheid	TOEG (toegankelijkheid)	
		2. Hoeveelheid informatie	HOEV (hoeveelheid informatie)	
		3. Snelheid zoeken	SNEL (snelheid zoeken)	
		4. Moeilijkheidsgraad	MOEI (moeilijkheidsgraad)	
		5. Taal	TA (taal)	
7. Strategie en bronnen	1. Gebruik	1. School	SCH (school)	
		2. Persoonlijke interesse	PERIN (persoonlijke interesse)	
		3. Oplossen persoonlijk probleem	OPP (oplossen persoonlijk probleem)	