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Media – Chemistry – Interest? Identifying the Types of Students' Chemistry - Related Media Reception

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Abstract

In the present qualitative study we identified different types of students' mass media reception on topics related to chemistry. 19 secondary school students participated in guided interviews concerning their overall encounter with chemistry in the mass media. The collected data was analyzed referring to *Grounded Theory* by an open and axial coding procedure. The evaluation is based on four categories including context, social condition, cause and consequence of media reception. For analysis, a special focus was placed on the development of interest with respect to media reception. In total, four types of media reception like „The News Focused" or "The Effect Focused" were identified. The guided interviews showed that students are interested in a large variety of chemical topics present in media. Due to this, a strong individualization of chemistry related media reception can be concluded. Finally, it will be shown that the results of this study are relevant for revising teaching materials in order to create individualized and motivating learning tasks.

Keywords: Students' Interests, Students' Media Reception, Chemistry in Media

Introduction

Entertaining and informing media (Lull 2000) are of pivotal relevance in students' everyday life (Biagi 2009). Students use media tools like personal computers, mobile phones, television or print media as part of their daily routine. Referring to the JIM-Study of the MPFS for example, 89% of the German students aged between 12 and 19 use the internet and television several times a week and 40% of the subjects read books, newspapers or magazines more than once a week (MPFS 2011). Hence, it is quite likely that students face chemistry related topics in media, *e.g.* explosions in action movies, science reports on nutrition and toxins or political talk shows concerning medicine, pollution and renewable energies.

> *Consequently, there has been intensive research and development on the usage of science-related media in class. A study of Klosterman, Sadler and Brown reveals that science teachers rather focus on using science-media to promote an understanding of science concepts instead of facilitating a general understanding of sustainability and socio-scientific issues (Klosterman, Sadler & Brown, 2012). Zimmerman, Norris and Phillips focus on a student-centered activation utilizing tasks on science in the media in order to promote students scientific literacy in class (Zimmerman et al., 2001; Norris et al., 2003; Phillips & Norris, 1999). Jarman and McClune developed teaching materials for science class to promote students an*

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aptitude and ability to engage critically with science in the news (Jarman & McClune, 2007).

However, in current research no detailed focus has been placed on students' interests in chemistry-related topics in media. Instead of a determination of topics in media that students are interested in, focus was rather placed on the design of learning materials based on media that frequently have been preselected without a consideration of the students' perspective. Therefore, it seems reasonable to determine students' interests in chemistry-related topics in media which will be explained in some detail in the following.

First, "interest" is a factor that seems to be highly relevant for the students' learning success in science class. This is proven by a meta-analysis of empirical studies about the correlation of students' interest and their learning achievements in chemistry lessons. The analysis reveals that the correlation of these two factors is r = 0.31, which is twice as high as the r-factor of German studies or social studies (Schiefele, Krapp & Schreyer 1993). For methodical and linguistic clarification with respect to the research in students' "interest", the term "interestingness" has been defined contrarily. While "interest" is defined as a stable disposition of a subject which leads him or her to profound learning activities, the term "interestingness" is defined as a volatile disposition of an object that draws a subject's attention but might not encourage him or her to further activities (Krapp 2001; Prenzel 1988). Thus, "interest" in a subject might have an effect on the learning achievements of a student, whereas "interestingness" of an object might not necessarily have this effect.

Second, a qualitative description of students' interests in respect of their chemistry-related media reception might contribute to the creation of innovative and more addressing learning material. To give an example, an explosion scene in an action movie could be used to introduce a concept like the combustion of alkanes or to assign the task of calculating the amount of gas released during the explosion. Since students spend a large part of their spare time exposed to mass media, such teaching material would connect chemistry concepts from the classroom to the experiences of students.

To sum up, a consideration of students' interests with respect to chemistry related topics has not been focused on yet, even though interest is a very important factor in teaching science and student-centred learning material could be created. Therefore, in this contribution we focus on the following three research questions: (1) Do students draw attention to chemical contents in media, like movies, reports etc.? (2) Does the media portrayal of these topics catch the students' interest? (3) Can these two questions be answered by identifying distinguishable types of students' media reception of chemistry related topics?

Methodology

To explore the reception of chemistry related topics in media we used guided interviews and surveyed a nearly balanced sample of nine female and ten male lower secondary high school students. According to German high school curricula, these students have developed elaborated concepts of the particle nature of matter, the chemical bonding, different types of chemical reactions (e.g. redox reactions) and chemical formulas. Apart from that, the students have been selected randomly from high schools in Göttingen (Germany) and the students participated voluntarily. Considering the respective teachers' assessment, all of those randomly selected students are middle to high achievers. The interviews had no time limit and most of them took about 30 minutes. Open questions with a simple syntax and popular semantics were used in order to enable an uninfluenced analysis of the individual encounters with chemistry in media. Table 1 shows the questions and their corresponding functions.

Table 1: Interview structure for the determination of students' chemistry-related media reception

Central Questions	Corresponding Functions
In the following interview, I want to ask you about media in your everyday life. Could you please list some media and describe in which way you use them?	Ice-Breaking
	Introduction to the reflection process
	Eliciting individual associations with media reception in general
Do you remember chemical aspects or topics in these media? Media includes internet, television, cinema, newspaper, magazines, literature, audio books and video games	Reflecting on individual experience with chemistry related topics in media
	Eliciting chemistry related associations with media reception
Are you interested in the chemistry related topics you remembered and if so, to what extent?	Reflecting on individual interests referring to chemistry related topics in media
	Eliciting possible interest/interestingness
Please sum up – How do you detect chemistry related topics in media and to what extent are you interested in them?	Meta-reflection of individual experience with chemistry related topics in media
	Increasing the date set that has been collected so far
Would you support the idea to implement the media portrayal of the topics in school?	Reflecting on and eliciting ideas and demands of students according to the topics

Before the interviews were carried out, we conducted a pretest of the interview questions with randomly selected high school students in 8th and 10th grade in order to ensure the comprehensibility of the questions. After the conduction and audio recording of the interviews, they were transcribed and finally analyzed by an open and axial coding procedure. The latter is based on *Grounded Theory* model, which is the method of choice for explorative qualitative research (Strauss & Corbin, 1998). The categories determined by the open coding were related to each other. For this purpose, we used a C-Coding-Family consisting of a central phenomenon and the elements *condition*, *context*, *cause* and *consequence* (Strauss 1989; Glaser 1992). Figure 1 shows the structure of the family used for analyses in this study.

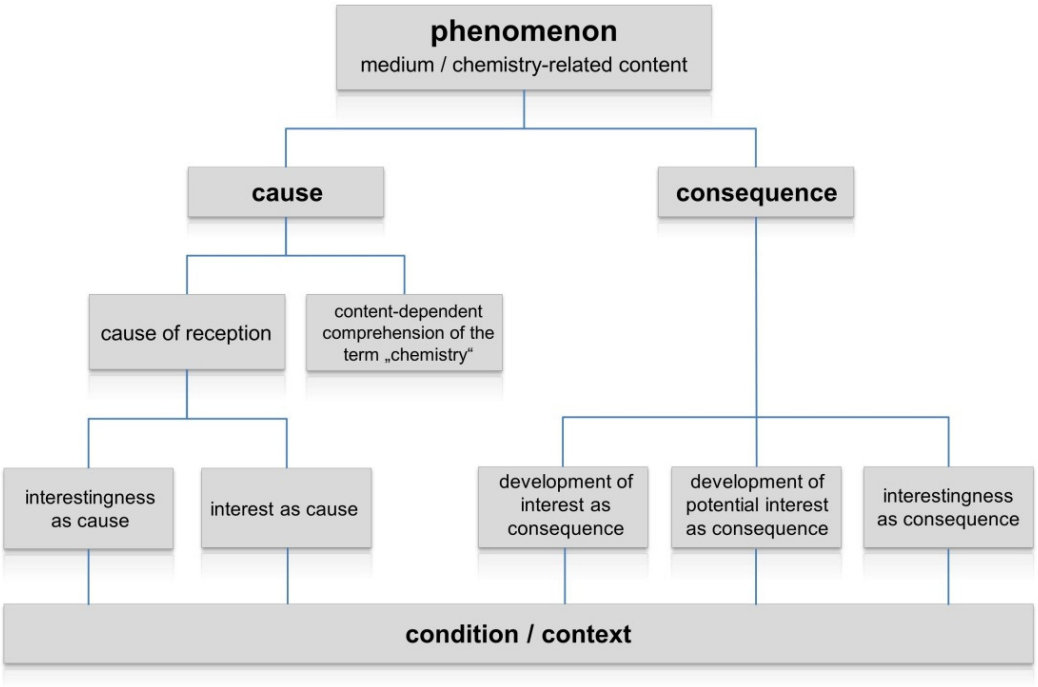

Figure 1: Analysis structure for the interviews based on the C-Coding-Family

Within this study we define the *phenomenon* as the student's reception of a medium dealing with a chemistry related topic.

To analyze the *causes* of the phenomenon we investigate (1) why the medium was perceived and (2) why the subjects are convinced that the topics they named were chemistry related.

With respect to the first question we try to identify whether interestingness or interest has led to the reception. For clarification, the term *interestingness as cause* describes the situation when a person perceived a medium because it caught his or her attention by coincidence, like "zapping" from one TV channel to another. In contrast, the term *interest as cause* is applied when a person mentions that he or she repeatedly and intentionally perceived further media with the same topic, *e.g.* when a student learned about a topic like pollution and deepens his or her knowledge by using different media. It becomes obvious that interestingness and interest, inter alia, differ from each other by a temporal factor, namely *context*. If *interestingness* is the reason for reception, then there is only one reception of a topic in a medium. Instead, when *interest* is the reason for reception, a reception of the same

topic in different media occurs. Since the social environment might have an influence on the cause of reception, we try to consider whether social *condition* factors were involved, *e.g.* influence of the parents, peer-group, school etc.

With respect to the second question, the context-dependent comprehension of the term "chemistry" is determined and can be applied to differentiate the types of media reception at the level of content. For example, we find a type who is focusing on explosions and another one focusing on toxins.

To determine the *consequences* of the phenomenon, we analyze if the reception had an influence on students' beliefs, insights and/or future actions. Our assumption that either interestingness or interest might be the cause of reception is also applied to the consequence of reception, whereas the following three distinctions can be made.

(1) The term *development of interest as a consequence* is applied when the students' media reception led to an independent, long-term and profound involvement with the particular chemical topic by using different media like non-fictional texts, documentaries etc.

(2) We use the term *development of potential interest as a consequence* when students show a clear motivation to approach the respective topic related to chemistry perceived in media but have omitted own investigations so far. For example this is the case when a student argues that a specific topic should be dealt with in school lessons.

(3) In contrast to the former distinctions the term *interestingness as a consequence* is utilized when the medial portrayal of a topic drew a student's attention without any initiative by the student to approach the topic in-depth.

Taking these definitions into account it becomes obvious that the *context*-factor is the relevant criterion to differentiate between (1)-(3). A repeated reception of the same topic in different media only appears when the consequence of the first reception has been *the development of interest* (1). A possible future reception of the topic appears when the consequence of the first reception has been *the development of potential interest* (2) and a single reception (no further receptions after the first one) appears when the consequence of the first reception has been *interestingness*. Furthermore, possibly relevant *condition* factors might also occur in all three distinctions, *e.g.* when students describe that they have seen an interesting report about renewable energies and discussed it with friends.

The resulting paradigms consisting of *phenomena*, *causes*, *context*, *conditions* and *consequences* are categorized as types of media reception. To increase the validity of our coding, the transcripts have been coded by two researchers separately and differences in their results were brought into harmony by discussion. Besides, we also tried to ensure the validity as well as the reliability of the coding by giving the interview transcripts to the respective students four weeks after the interview was conducted and asking the students to comment their statements and add additional information if necessary. Respective comments were also considered during the evaluation.

It is important to mention that students mostly cannot be assigned to only one type identified. In most cases the behavior of students corresponds with multiple types; however, we cannot identify more than three types in one interview. Finally, we also need to point out that the application of the C-Coding-Family is still based on our subjective interpretations of the data, though we try to follow the definitions of our research criteria that are given in this chapter as well as possible.

Results

In the following section, we will characterize the identified types by applying the outlined criteria and providing examples from the interviews. The four types of media reception that will be introduced are the following: "The News Focused", "The Effect Focused", "The Equipment Focused" and "The Crime Focused". These types were named according to the phenomena that were mentioned most in the interviews.

The News Focused

Students of this type perceive daily news several times a week to inform themselves generally about regional and worldwide incidences. Starting from the phenomena, this type mostly associates the term "chemistry" with *dangerous substances and their effects*. Those students do not recognize chemistry related topics because they intend to, but because these topics are connected to present events and affairs in the news. Taking this into account, we assume that a general *interest* in regional and worldwide events is the *cause of reception*. Examples of the topics given by the students are the Dioxin Scandal in Germany 2011 and the Oil Tanker Accident in the Gulf of Mexico 2011.

A female student reported that she had heard of the Dioxin Scandal in the news. She and her mother discussed if the information given in the media are reliable. Due to this scandal, the student reflected on her own daily diet. The résumé of the reflection process was: "Man musste halt selbst entscheiden ob die Dioxineier jetzt gefährlich sind oder nicht (*Everyone has to decide on his or her own whether eating eggs with dioxin is dangerous or not*)." It can be supposed that dealing with the topic took place repeatedly over a longer period of time; therefore, the *development of interest* regarding the influence of dioxin on nutrition and its medial portrayal can be described as the *consequence of reception*.

Another student remembered the Oil Tanker Accident. He had the permission by his parents to watch the German daily news called "Tagesschau" with them. The boy was absolutely shaken by the accident and he was worried about the influence of the encroaching oil slick. In addition, the student came up with the idea of establishing "so etwas wie eine Informationsstunde (*something like an information lesson*)" for newsworthy physical and chemical topics in school. Because no further investigations about the topic were done by the student, the *development of potential interest* concerning the influence of petrol on nature can be described as the *consequence of reception*. Table 2 sums up the type description of The News Focused.

Table 2: The News Focused

The News Focused				
phenomena	***media***	Daily news (television and newspapers)		
	topics (e.g.)	Dioxin Scandal in Germany 2011		
		Oil Tanker Accident in the Gulf of Mexico 2011		
causes	***content-depending comprehension of the term „chemistry“***	*dangerous substances and their effects*		
	cause of reception	general *interest* in regional and worldwide happenings	***condition***	permission by the parents to watch the news with them
			context	repeated reception
consequences	referring to the dioxin scandal: *interest* in the topic and its media portrayal		***condition***	reflection together with the mother
			context	supposed repeated reception
	referring to the oil tanker accident: *potential interest* in the topic		***condition***	-
			context	single reception

The Effect Focused

Students of this type are characterized by perceiving effects like explosions or burnings in movies, movie-trailers or TV-shows as chemical incidences. Within this type there are differences in the *cause* of reception.

One subset of the students conveys that they do not only perceive chemical aspects in those media but they also think they are “cool”. For that reason, their *cause* of reception is *interest* in the chemical background of the mentioned effects or at least *interestingness* of the effects. Based on their receptions they think about the technical realization of those effects in movies or TV-shows – Which chemicals are required, under which conditions do they react etc. However, they do not pursue investigations, so that the *consequence* of reception is *development of potential interest* in the creation of fascinating effects. For example, a male pupil watched a movie called “Fast and Furious 5” in cinema with his friends, because the trailer of the movie caught his attention. The chemical content of the movie was described as an “illegal Lachgaseinspritzung in Motoren, die zu einer starken Beschleunigung der Autos führt (*illegal laughing gas injection in motors which leads to an explosive acceleration of cars*).” Therefore, the term “chemistry” is understood as a *mixture of substances that causes fire and explosions*. The *generation of potential interest* as *consequence* of reception can be derived from the student’s thoughts about the possibility to create such a mixture of substances in practice.

The second subset of the students perceives chemical contents in those media incidentally, i.e. *interest* or *interestingness* does not play any role for the media reception.

However, the *consequence* of their receptions is equal to the one of the subset mentioned before. For example, a female student in 10th-grade made general statements about action movie-trailers and action TV-shows that she is confronted with several times a week. Within these trailers cars explode, are ignited etc. Taking this into consideration, her understanding of the term "chemistry" can be described as *a mixture of substances that causes fire and explosions*. As an effect of her reception, she asks herself how those effects can be realized in the media production and especially in which way safety regulations are satisfied. Additionally, she would like to deal with this topic in school because she values the connection to her media reception in everyday life. In conclusion, these *consequences* of her reception can be regarded as a *development of potential interest* in the chemical backgrounds of fire and explosions in the media. Table 3 sums up the type description of The Effect Focused.

Table 3: The Effect Focused

The Effect Focused				
phenomena	***media (e.g.)***	a) "Fast and Furious 5"		
		b) trailer of action movies / action TV-shows (in general)		
	topics (e.g.)	a) laughing gas injection		
		b) explosions and fire		
causes	***content-depending comprehension of the term „chemistry"***	*mixture of substances that leads to fire and explosions*		
	cause of reception	Referring to "Fast and Furious 5": *attraction of the medium*	***condition***	influence of friends
			context	single reception
		Referring to the other media: reception by chance	***condition***	-
			context	single reception
consequences	referring to the documentation: *interestingness* of the process		***condition***	-
			context	single reception
	referring to the "Punkt 12"-newscast: *potential interest* in the chemical backgrounds		***condition***	-
			context	single reception

The Equipment Focused

Students of this type perceive chemical aspects in science movies for children. The reception already took place in their childhood and was caused by *interestingness* of the media. This type was constructed due to the evaluation of an interview with a female student. Unfortunately, she neither could remember the titles of the movies she watched nor how often

she watched them. However, she could describe typical scenes of the movies: "Ein verrückter Professor stand neben seinem Tisch, auf dem so eine Apparatur mit ganz vielen Gläschen aufgebaut war (*A crazy professor stood next to his table on which an experiment with many glasses was built on*)." Therefore, the term "chemistry" is understood as *laboratory equipment of a chemist*. Nowadays she reflects on her childhood fascination in a rational way: "Heutzutage mach ich mir Gedanken darüber warum das Experiment so aufgebaut ist und was die einzelnen Bestandteile für eine Rolle spielen (*Nowadays I think of how the experimental setup works and what function every part of it has*)." The results of her reflection process were not mentioned and she also did not comment on the question of an integration of those media in chemistry lessons. Thus, an *evaluation of potential interest* in the laboratory equipment of a chemist can be assumed. Table 4 sums up the description of The Equipment Focused.

Table 4: The Equipment Focused

The Equipment Focused				
phenomena	***media***	science movies for children		
	topic	experiments with glasses and their function		
causes	***content-depending comprehension of the term „chemistry"***	*laboratory equipment of a chemist*		
	cause of reception	-	***condition***	-
			context	
consequences	*potential interest* in complex experimental setups with glasses		***condition***	-
			context	single reception

The Criminal Focused

The students that can be assigned to this type have one thing in common: They perceive chemical contents like poisonous substances and acids and their effects in criminal movies or belletristic. Similar to "The Effect Focused" there are differences in the *cause* of reception.

On the one hand, there are students who like to consume criminal movies or belletristic, because they find them entertaining or thrilling. In these cases, the *cause* of reception is *interestingness* of the medium. As an example, a male student regularly watched the American criminal series "Monk" with his cousins. One of these episodes is about an organ donor who gets poisoned by mercury in prison so that he dies and his organs cannot be used anymore. In this case, "chemistry" has the meaning of *poisonous substances and their effects*. As an effect of the reception, the student stated that "wenn [er] mehr über den Vergiftungsprozess im Körper wissen würde, dann hätte [mir] die Serie vielleicht noch mehr Spaß gemacht (*if [he] had known more details about the effects of poison on the body [he] would like this series even more*)." Therefore, the *consequence* of this reception is a *development of potential interest* with reference to the toxicity of mercury for human beings.

On the other hand, there are students for whom we could not identify any *cause* of reception. These students also have in common that their *consequence* of reception can be described as a *retrospective interestingness* of criminal movies, series and belletristic. Therefore, they are not showing any intention to treat these media and topics more profoundly. For example, the movie "Sherlock Holmes" was watched by a male student. He retold the story of the movie where "der Böse ein Magier ist, der alle Probleme mit dem Einsatz von Chemikalien löst (*the bad guy is a magician, who is solving every problem by using chemicals*)." After locking Sherlock Holmes in a room the magician uses a poisonous gas to kill him, whereas the magician's allies who are in the same room where given an antidote before. It can be concluded that this student also comprehends "chemistry" in terms of *poisonous substances and their effects*. The *retrospective interestingness* of the movie is caused by the fact that "dieser Magier schon vor hundert Jahren Chemikalien benutzen konnte (*this magician was already able to use chemicals one hundred years ago*)." Apart from that, he does not think about reasons why these substances are poisonous and what chemical reactions take place in the human body – therefore, a development of potential interest in the chemical background cannot be assumed. Table 5 sums up the description of the Crime Focused.

Table 5: The Criminal Focused

The Crime Focused				
phenomena	***media (e.g.)***	a) "Monk"-episode "Mr. Monk Goes to Jail"		
		b) "Sherlock Holmes"		
	topics (e.g.)	a) mercury intoxication		
		b) poison/antidote and their effect on the human body		
causes	***content-depending comprehension of the term „chemistry"***	*poisonous substances and their effects*		
	cause of reception	referring to "Monk"-series: *attraction of the medium*	***condition***	watching the episode with the cousins
			context	regular reception
		referring to "Sherlock Holmes": -		
consequences	referring to the "Monk"-episode: *potential interest* in the chemical backgrounds		***condition***	-
			context	single reception
	referring to "Sherlock Holmes": *interestingness* of the chemical topics		***condition***	-
			context	single reception

Conclusion and Outlook

The present study aimed at identifying different types of students' media reception referring to chemistry related topics. Within this study students were able to describe and reflect their encounters with chemical topics portrayed in media. Special effort was placed on an open interview structure so that we could avoid giving any definition of the term "chemistry" and, thus, influencing the individual concepts of the students. The evaluation of the collected data by axial coding resulted in four types of media reception, which gives evidence that (1) students are interested in a great variety of chemical topics portrayed in media and (2) they might approach most of them more profoundly. Apart from that, at most types of reception we could identify more than one of the kinds of consequences mentioned above, i.e. interest, potential interest and interestingness.

These outcomes raise further research questions which are relevant for a valid description of students' reception of chemistry related topics portrayed in the media. Due to the fact that only a single topic was mentioned once, we assume a *strong individualization of the media reception referring to chemistry related topics* among students. Considering this assumption, additional qualitative and quantitative research should focus on

- a further description and differentiation of the types that have been identified,
- the completion of identified reception types,
- an identification of gender-specific differences in the media reception of students,
- an identification of differences in the media reception of students with respect to their grade level and conceptual chemistry knowledge,
- the impact of the depicted factors, i.e. causes of reception, consequences of reception, context factors and condition factors, on the type affiliation of a student
- the temporal stability of the types as parameters of a student's character.

A detailed and valid description of students' media reception by approaching these questions might contribute to the development of individualized learning materials:

Firstly, alternative *introductions* to basic chemistry concepts could be developed and applied in class. To address "The News Focused", one could start a teaching unit on the solubility of polar and nonpolar substances by discussing an oil tanker accident like the one mentioned above. Here, the resulting environmental problems of oil floating on water could be addressed.

Secondly, alternative *exercises* to practice the application of basic chemistry concepts could also be given to students. Addressing "The Effect Focused", laughing gas injections into car motors portrayed in movies like "Fast and Furious 5" could be used as a sample application of the reaction of laughing gas with petrol and oxygen. After an input on oxidation numbers, this reaction can then be defined as a redox reaction. Furthermore, students could calculate the reaction enthalpies to understand why laughing gas injections result in an explosive speed increase for cars.

Thirdly, alternative *problem-based tasks* could be implemented in class. After units on proteins and coordination complexes, "The Crime Focused" might benefit and be motivated by an open task to investigate how mercury affects the human body and why it is poisonous.

To conclude, the consideration of students' interests in chemistry-related topics in the media might result in a more effective and student-centred teaching of basic chemistry concepts.

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