„HOW DID SCIENCE LESSONS GO AT SCHOOL?"- INTRODUCING THE ANALYSIS OF UNIVERSITY STUDENT INTERVIEWS ON SCIENCE SUBJECTS

Erzsébet Jász[1], Magdolna Chrappán[1], Edina Malmos[1]

[1]University of Debrecen (Hungary)

Abstract

Educating science subjects has raised several problems in the past few years both in Hungary and internationally. Several questionnaire surveys have been realized on attitudes towards science subjects in Hungary and internationally, too. The teacher's personality is a key factor as it is in the centre of the whole teaching process. In our present research we have been applying the method of half structured interviews with the aim of learning more about general attitudes concerning science subjects with the help of exploring school experiences in a retrospective way. Analysing the interviews, it turned out that there is a deficiency regarding the methodological diversity of teaching these subjects. Some practical pieces of advice were also mentioned, such as teacher's empathy, helpfulness or patience. Interestingly enough, only few indicated the abundance of subject contents and their being too abstract. The analysis of these interviews helped us reveal those factors that predominantly affect attitudes to science subjects, the suggestions must be taken into consideration and used as guidelines for our further researches.

Keywords: scientific attitudes, sciences, interviews

1 INTRODUCTION

Science subjects being under represented has been a problem for decades not only in Hungary but at an international level, too ([1]). The appreciation of these subjects is rather unfavourable, their popularity is getting worse, students do not like them, they are difficult to learn and teachers are aware of the fact that the next generations of children will not like them any better.

There are some basic, related problems concerning science subjects. One of these is the dichotomy of quantity and quality ([2], [3]). As a result of this, it is going to be some kind of inert knowledge and this way the main goal of education, getting information of the world, will fail to be fulfilled ([4], [5], [6], [7], [8]). The large amount of subject material is not only hard to learn because it is too abstract but it also too much, and these two factors together result in students losing their interest and their negative attitude will lead to the fact that students will thrive less and less to acquire the basic skills ([9], [10], [11]). The whole learning process is influenced not only by the factors mentioned, teachers bear a great responsibility as well. Besides methodology the teacher's personality is an essential factor, his relation with students, the atmosphere and work morale are of great importance, too ([12]).

When analyzing the problems of science subjects it is not sufficient to rely on the data of a knowledge assessment test, we must also pay attention to the affective factors that influence achievement, learning attitude and success ([13]).

There have been several surveys on attitudes towards science subjects at a national ([14], [15], [16], [17]) and international level ([18], [19], [20], [21], [22]). The University of Debrecen is carrying out a research on the attitudes to science education, in which we wish to explore the complex impact mechanisms of parental attitudes and that of the whole school learning environment. As a result of these researches we made interviews with students in higher education, or recent graduates. Inour study we would like to the present the results and conclusions of these interviews, in order to have more overall correlations, personal information and experiences of the topic.

1.1 The purpose and questions of the survey

We have been carrying out our survey as a part of the OTKA project number K-105262, entitled "Innovative, interdisciplinary approach of science subject pedagogical researches". We had two goals: firstly, we wanted to deepen the results of the self-completed questionnaires which we put together in

the same project and secondly, we wished to explore general attitudes to science subjects in a retrospective way. We asked secondary and higher education students about their experiences.

The interviews provide a good chance to explore details, emotions, feelings that cannot be revealed based on the data of the questionnaires, however, they underpin and modulate statistics.

The main questions go all along with the OTKA project: what factors and impacts play a part in students' turning away from science subjects, what correlations are between the attitude to science subjects, teacher's personality, the methods and tools they use as well as learning habits and motivating factors. In present paper we will focus on these questions by analyzing the interviews.

1.2 The sample and method of the survey

In our survey stepping out of the frames of the impersonal questionnaires, we used the method of the half-structured interview in order to reveal deeper correlations regarding science attitudes.

The interviews were made with 114 higher education students or students who graduated recently (Chart1).

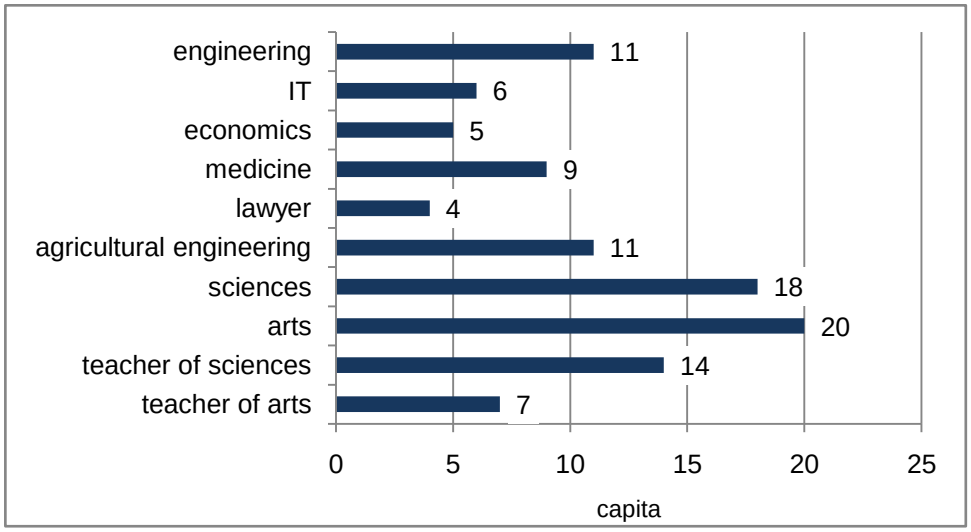

Chart 1 Distribution of respondents by majors (N=114)

Concerning majors, the sample is fairly heterogeneous. The interviewers could reach students of almost all fields, however, the importance of each major is not equal, and this is because the interviewers targeted their own acquaintances. Among the interviewees those belonging to the two main fields of science are represented to the largest scale, students of arts (27) and sciences (37), the classification of 9 respondents is not obvious. The heterogenity of the sample is useful because we could analyze the opinions of not only those who chose a science career but teacher students (21) also expressed their opinions and made suggestions.

The interview contained 16 questions, which among others, included panels on social variables and science subject attitudes. In the latter one are the questions on subject attitude, the usefulness of the knowledge, the methods and atmosphere of the lessons. It was important that primary and secondary school memories could come to surface and other pieces of information, personal experiences, memories that could not turn out by the questionnaire survey and we also asked the participants to make suggestions how teachers could improve the position of science subjects.

During the analysis we came upon some difficulties of presenting statistics. Not all respondents made a difference between primary and secondary school, or not everyone spoke about the methods and atmosphere of each subject. That is a typical feature of a half-structured interview, despite this we gained valuable data during the analysis. At certain questions, it is useful to handle the opinions of students of science or graduates holding a science degree as a split. This time we would like to highlight the most important results with the help of which we may have a better understanding of the position of science subjects in public education and the possible solutions.

2 THE PERCEPTION OF SCIENCE SUBJECTS

To show the perception of science subjects we applied a question through which we could not get factual information, still it was useful to have a general picture of attitudes to these subjects. We asked the respondents to describe science subjects with one word. There were 76 out of 114 who could say a word, the others made longer descriptions or differentiated the subjects. Besides the positive opinions like interesting (10), good (5), I liked (3),important (2) there were several, more neutral expressions such as varied (4), average (4), inconstant (3). The rather negative words as hard (3) and distant (4) do not really express resistance and only two, terrible (2) and I hated (2), refer to some kind of refusing attitude. So the respondents did not have only bad memories of science subjects in public education.

We tried to figure out which science subjects the respondents liked the most and the least. Setting up a statistical rank was hard because of the different types of the answers given, still the picture we got fits in well what is known in public awareness and what we learnt from the surveys. The most preferred subjects were biology and geography, the least ones were physics and chemistry, and we could also conclude that the position of chemistry and physics were less undervalued in primary schools than in secondary schools. Science students' preference depended on their major, so we could not say whether they liked physics or chemistry less.

After the general attitude and the differences of preferences we would like to deal with the factors influencing attitudes, based on the analyses. It is also the responsibility of schools to teach students how to get by in everyday life and based on this we wanted to know whether students could use their knowledge and if yes, in what areas (Chart 2).

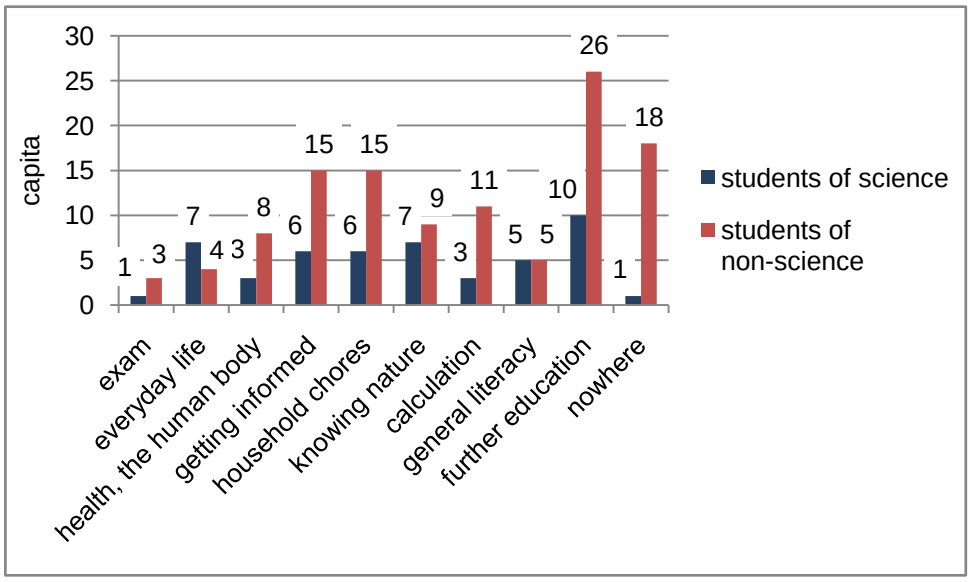

Chart 2: The areas in which science knowledge can be used (N=114)

We showed in a diagram in what areas students of science and non-science can use their knowledge. Out of the 22% of non-science major students there were 18 persons who said that they cannot use the acquired knowledge in any field. We believe that it is a large rate and it is sad as well that for one fifth of the respondents this field of science is of no use based on their primary and secondary school experiences. Those who took a maturation exam, a university entrance exam in any of these subjects got to the group of those wishing to go on with further studies. These data appeared with 32 respondents, which is not surprising, as on the one hand one third of the sample is of science major (32 capita), on the other hand mathematics, which is considered as a science subject, is a compulsory maturation exam subject.

Almost one third of science students stated that they used their previously acquired knowledge in further education, which is a significant rate, because we could expect science students to be aware of how important science subjects are to understand the world's processes better. We hoped and assumed that there would be some of them who will make use of their science knowledge. 69 respondents, two thirds of the sample, said that they can use their knowledge in everyday life, 11 of them did not mention any examples, the others, however, narrowed down the scale on the basis of which we could work out categories to express the figures. Within each category the science students

are presented separately, however, there is no significant difference, the tendency rates of answers match with those of other major of students. Most of them mentioned factual examples in connection with household, including cleaning, cooking, the use of detergents, the most important of which were chlorine and hypo. By the examples we may see which subjects had the most dominant role, which we can illustrate with the following quotation: “Well, for example domestic science… Cleaning, cooking and washing. It was also useful in growing plants. In energy saving and understanding invoices. (Hungarian literature major of 26). In case of getting informed it was geography, in case of the human body and health it was biology, in case of calculation mathematics, in case of knowing nature it was all subjects that played an important role in a complex way . We got some humorous answers as well: concerning physics, we got the following reply: “is there anyone who does not use gravity?” (a nurse student of 19). To the question, to what extent this knowledge got imprinted, we could answer with the help of a survey on factual knowledge, however, these data are valuable by themselves as well, since we can come to the conclusion that knowledge transfer is not completely without success in public education, something remains in the hands of those who finish their studies that can be used later from a practical point of view.

Regarding the question how science lessons went, what methods and tools were used, we would like to show some extracts from the interviews:

- „.. there was a chemistry teacher who couldn’t ven keep discipline and we took advantage of this and we fought paper pellet battles” (IT major of 20)
- „ the sentence of copy the ppt slides could be heard most” (economic informatics major of 20)
- From books and their own notes, which were written about 40 years ago, are dictated. I don’t really understand why teachers have to prepare so much for a lesson. They got their degree after graduating, began to teach and have been giving the same material ever since. As boring as it was at that time (20-year old student of biology)
- “In the chemistry classroom it was banned to touch anything, everything was in such a bad condition (21 year old student of public administration manager)
- “Thinking back, experimenting is not easy at all… how can the teacher handle the situation when out of 25 students(or it can be even 30) everyone could be active…?”(25 year old student of German studies and pedagogy)
- “ Most of the time there were lectures. We could give little presentations sometimes, there were extra-curricular tasks we could do. I liked those.. Group works weren’t too often… but I think teachers were always in the centre. (25 year old student of German studies and pedagogy)

These thoughts by some of the respondents indicate how these subjects were taught, with what methods, also show the teacher-student relationship and the infrastructural background of the institutions. Science subjects, it seems so, do not constitute an exception to methodological simplicity and being unfacial (Chart 3).

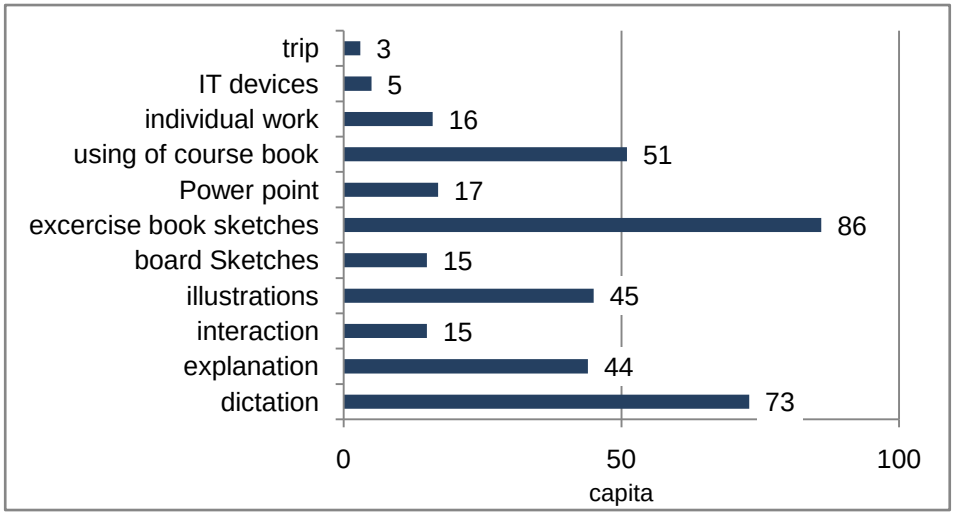

Chart 3 The distribution of methods and tools used in science lessons (N=114)

With respect to the applied methods and tools based on the experiences of the full sample, we may see that frontal methods are especially dominant. The fact that exercise book notes are the most frequently used tools, do not necessarily refer to being unfacial, because it can be an important tool of interactive, practical lessons as well, in order to help explain key definitions or charts. After exercise book sketches, the next most dominant tools are dictation, explanation and the use of course books. Illustrations are the fourth most significant tool, but its rate does not reach 50%, which is aggravating because it means that only 10% of the respondents thought that the lessons were interactive. Solving problems, IT devices, ppt also appear only in a small number in science lessons, and the last one only as a surface to be copied, which is not going to motivate students. Using experiments, individual student work, however, may raise and keep up interest and motivation.

In raising students' interest, the style and way of teacher's lecture are crucial, too because the lack of teachers' enthusiasm may bring about the fall of motivation as well: "in 10th grade the teacher gave his lectures with a bored expression on his face, he must have taught this many times" (a teacher of geography and mathematics,20) (Chart 4).

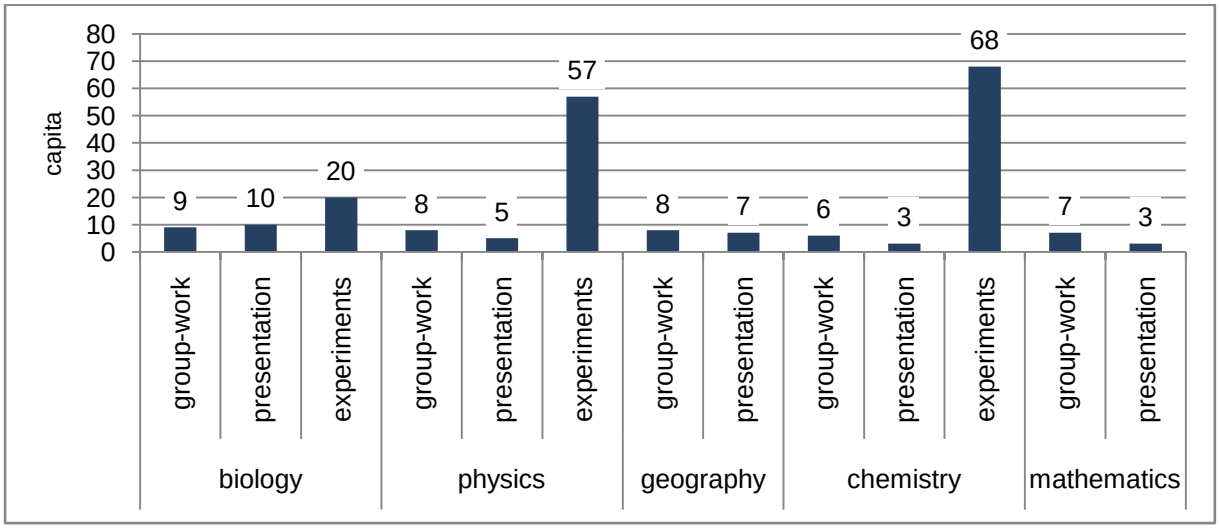

Chart 4 The distribution of group work, presentation and experiment in each subject (N=114)

The chart illustrates the rate of group work, presentations and experiments in each subject. There are some other tools that require individual or group work, possibly research work, make students think, are practical, but only the ones mentioned came up in the answers. Only few of the respondents said that they worked in groups or could make presentations. The rate of experiments was higher, but only in physics, chemistry, occasionally in biology but in case of geography, it was not mentioned at all. As far as experiments are concerned only half of the respondents said that they had it in class every now and then. One respondent said the following: "as we grew older the number of experiments dropped gradually." (woman of 36).

The question also arose whether apart from the lack of interest and interactivity, it was hard to acquire subject material of science subjects because they contained too many factual, lexical and abstract concepts. Naturally, the learning process is largely affected by the social background as well, typical features of the age, but it is for sure that unfacial methods do not make the situation better (Chart 5).

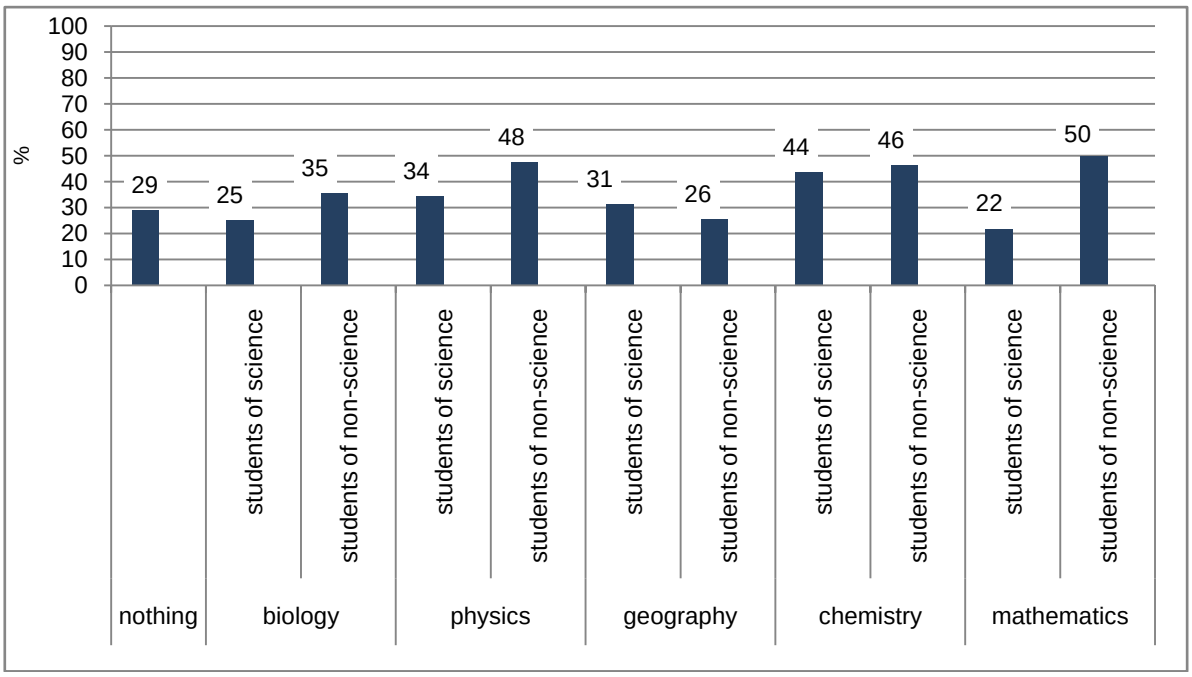

Chart 5 Learning difficulties by subjects (%) (N=114)

Out of the 114 respondents only 33 said that these subjects were not hard for them. They needed some extra practice, but all in all had no difficulties in primary and elementary school. 84 persons said that some or all of the subjects were difficult for them. Among these respondents only 5 were science majors, so we cannot come to the conclusion that these subjects were definitely easy for science students. Non-science students had the most difficulty with mathematics, physics and finally chemistry. Biology is in a better position and as the sample shows, geography was the easiest to learn. The chart underpins the preference rank of subjects, the less preferred chemistry and physics were harder to learn. In case of science students, the differences may be explained by the differing majors. For science majors, mathematics was the most difficult subject, in case of the other subjects it was not calculations, logical relations that caused the problems but the amount of time devoted to them, which comes from the other fields of interests.

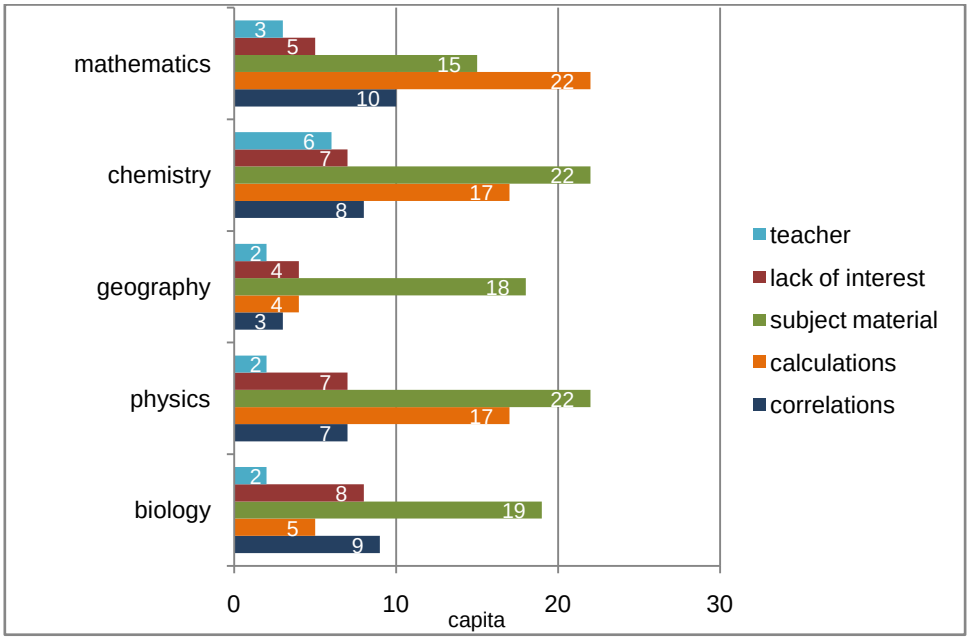

Chart 6 The reasons for difficulties by subjects (N=114)

We illustrated in a separate diagram what factors caused difficulties in the full population, based on their frequency. Primarily correlations, calculations and the subject material caused problems. Some of the respondents mentioned which parts of the material were extremely difficult, in biology these

were biochemistry, genetics, evolution, the nerve system, the hormone system; in physics they were optics and electricity; in chemistry for some it was organic for others inorganic chemistry; in mathematics they were coordinate geometry, geometry and equations; in geography they mentioned petrology and Earth's history.

The difficulty and preference of themes are related and may differ with other respondents so we cannot jump to conclusions but it is clear that the subject contents of public education need rethinking. Making calculations caused the biggest problems in mathematics and they did not cause too much difficulty in biology and geography, which can be explained with the nature of these subjects. We put to the "teacher" category those cases when the students spoke about teachers being boring, unable to explain well or keep discipline. One fourth of respondents mentioned being unmotivated as a problem. So not many of the respondents mentioned the fact that teachers could make learning science subjects easier, but according to them unfacial methods contributed to their difficulties. The amount of material does not depend on teachers but in order to raise interest they must be able to motivate students and transfer knowledge that can be used in everyday practical life.

We asked the interviewees to come up with suggestions for science teachers to make these subjects more successful. They articulated these based on their own experiences and memories. These suggestions may be broken down to two large groups, one includes methodological culture, the other includes the elements of teacher attitudes (Chart 7).

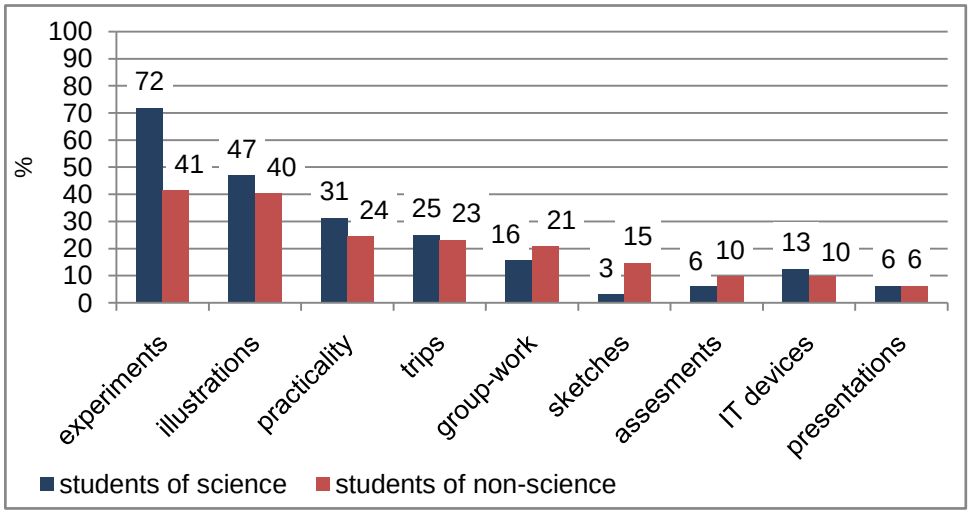

Chart 7 Suggestions for methodological culture in percentage (N=114)

In case of the suggestions we divided the samples into two parts, as we were curious to know what suggestions science students had made. In both groups experiments and illustrations were mentioned most, however, science students would devote more time to the first one. The other significant difference was related to sketches and assessment, in case of these tools, non-science students would prefer to have a larger focus on them. IT tools were put into another group, including applications, websites, interactive board and we listed films, pictures, IT based passive tools in the category of illustrations. It was surprising that new digital innovations were hardly mentioned, whereas ppt came up a lot more as an alternative of the traditional frontal dictation. Other important suggestions included field trips, field practice, short walks in order to enhance learning through direct illustrations and experiences. Another essential aspect was making subject contents more practical:

" more practical lessons would be great. So that students shouldn't only learn things by heart but they could understand them, too." (23-year old man with a BA management degree).

We must raise the question though whether the success of science education depends only on experiments, illustrations and more practical explanations (Chart 8).

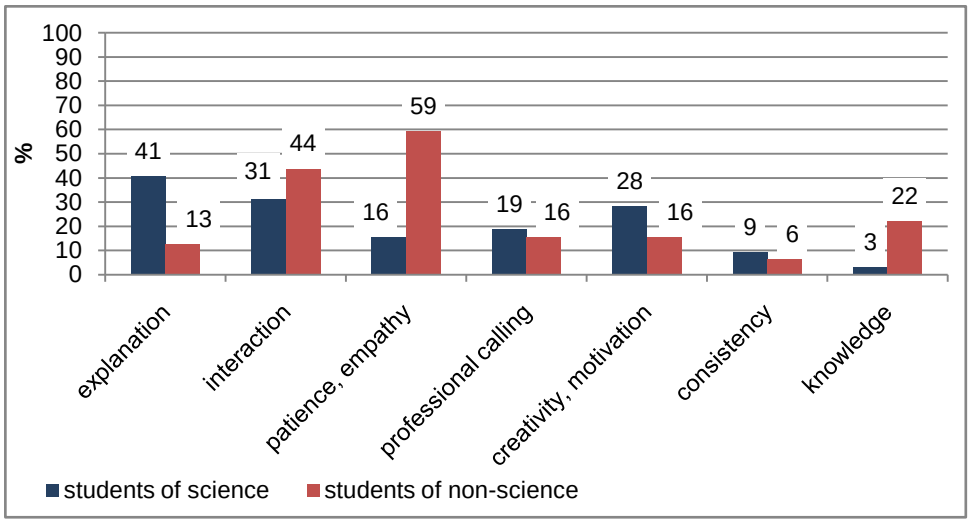

Chart 8 percentage rate of teacher qualities (N=114)

Besides methodological culture teachers' personality is of great importance as well and this appeared among the suggestions. Most students highlighted interactions that depend less on methods and more on teachers' attitude. It is vital that stepping out of frontal frames, teachers would involve students in the learning process by encouraging them to express their ideas and this way making classroom activities more interactive. Science students emphasized the importance of explanations, whereas non-science students considered the professional competence of teachers even more essential, although only 8 of them made suggestions concerning this.

Another significant difference is that only 16% of science students mentioned teacher's quality, among others attitude, while 59% of non-science students considered teacher qualities as important factors.

It did not turn out whether these students had negative experiences with teachers of these subjects and that is why they highlighted this factor as especially crucial. The correlation can be seen in the questionnaire: the less motivated students are and the more difficulties they have, the more dramatic their feeling of failure will be. This correlation, however, stands only for students who do not take interest in science subjects.

There were some more suggestions that could not be put into either main groups:

- „ We must fight for curriculum reforms. The subject materials are far too many. And there is something in it." (teacher of history and Hungarian literature, 21)
- " First of all, the subject contents must be radically reduced, because a great deal of them just waste of time, we won't remember it after some time." (teacher of English and French, 27)
- "this doesn't depend on teachers, but more money should be invested. And there were lots of mistakes in the course books, so some books should be rewritten. Everyone should use the same books and equal opportunities should be given that I didn't have, compared to a student in Budapest." (teacher of chemistry and mathematics,21)

3 SUMMARY

As a conclusion we can say that by analysing the interviews we got closer to the goals we set in our introduction. But now when summarizing the factors that may lead to the problems of science education, we try to approach from teachers' point of view. We place teachers in the centre of the teaching-learning process and not attitudes or difficulties. Based on respondents' opinions we can conclude that methodological tools are not varied enough, the transfer of knowledge is mainly frontal and the tools of interactive, practice-centred, experience based learning are missing or rather few. In the learning process the most serious problems come from the amount and the structure of the contents as well as from difficulties in understanding calculations, logical correlations. Despite all these, however, two thirds of students realize that even if in a small compass but they can use the acquired science knowledge in everyday life.

There are differences between the subjects as we can induce from the surveys, physics and chemistry are difficult to learn, while biology and geography are more preferred by students. It also turned out

from the interviews that there is not a general distancing from science subjects, still there are several challenges these subjects have to face.

Students made plenty of useful suggestions to improve the position of science subjects and facilitate knowledge transfer, such as improving methodological culture, making subject contents more practical. They also emphasized the importance of personality and attitude qualities which may influence the atmosphere of lessons and student-teacher relationship. It is teachers' responsibility what themes of the subject contents they will put in focus in order to raise students' interest and creativity and make their lessons more interesting and motivating.

Problems mainly are rooted in the lack of varied methodological culture and the insufficient teacher-student relation.

To sum up if we would like science education to become more successful we should restructure the curriculum, however, to underpin this statement, we will need further research in the field.

REFERENCES

[1] Ormerod, M. B., & Duckworth, D. (1975). Pupils' Attitudes to Science. Slough: NFER

[2] Ledbetter, C. E. (1993). Qulitative comparison of students. constructions of science. Science Education, 77: 611–624.

[3] Vosniadou, S. – Ioannides, Ch. (1999). A fogalmi fejlődéstől a természettudományos nevelésig − Egy pszichológiai megközelítés. Iskolakultúra, 9/ 10, 18-32. [From conceptual development to science education - A psicholoigical approach]

[4] Bereiter, C. (1984): How to keep thinking skills from going the way of all frills. Educational Leadership, 42: 75-77.

[5] Bransford, J. D. - Franks, J. J. - Vye, N. J. - Sherwood, R. D. (1989). New approaches to instruction: Because wisdom can't be told. In: Vosniadou, S. és Ortony, A. (szerk.) *Similarity and analogical reasoning*. Cambridge University Press. New York

[6] B.Németh, M. (2010). A természettudományi tudás/műveltség értelmezései a nemzeti standardokban. Iskolakultúra 20(12), pp. 92-99. [Interpretation of science knowledge/literacy on national fields]

[7] Gerber, R. (2000). The contribution of fieldwork to lifelong learning. In Fieldwork in geography: Reflections, perspectives and actions, ed. R. Gerben and K. C. Goh, 195-210. Dordrecht, The Netherland: Kluwer

[8] Yang, D. – Wang, Z. – Wu, X. – Fu, W. (2014): Teaching Business Shops and Stores' Locations Through Field Studies, The Geography Teacher, pp. 55-65.

[9] Chrappán, M. (2001). Körkérdés a természettudományi nevelésről II.: a természettudományos képzésről. Új Pedagógiai Szemle, 51./ 10, pp. 66-76. [Investigation about the science education II.: The science training]

[10] Csapó, B. (2002). Iskolai osztályzatok, attitűdök, műveltség. In: Csapó, B. (szerk.) Az iskolai műveltség. Osiris Kiadó, Budapest. [Marks, attitude, literacy at shool]

[11] Csíkos, Cs. (2010): A PRIMAS projekt. Iskolakultúra Online, 1, pp. 4-12. [The PRIMAS project]

[12] McKinsey–Company (2007). How the word's best-performing school systems come out on top.

[13] Lengyel, Zs. (2002.) Szociálpszichológia. Osiris Kiadó. Budapest. [Socialpsichology]

[14] Ballér, E. (1973). Tanulói attitűdök vizsgálata. Pedagógiai Szemle, 23/ 7-8, pp. 644-657. [Investigation of students' attitude]

[15] Báthory, Z. (1989). Tanulói kötődések vizsgálata négy tanulói korosztály körében. Pedagógiai Szemle, 39/12, pp. 1162-1172. [Investigation of stundent's attitude with four age goups]

[16] Orosz, S. (1992). Tantárgyi attitűd és tantárgyi habitus. Iskolakultúra, 3-4, p. 38-45. [Subject attitude and subject habit]

[17] Csíkos, Cs. (2012). Melyik a kedvenc tantárgyad? - Tantárgyi attitűdök vizsgálata a nyíltvégű írásbeli kikérdezés módszerével. Iskolakultúra, 22/ 1, pp. 3-13. [Which is your favourite subject? - Investigation of subject attitude with open ended questions]

[18] OECD (2006). Assessing Scientific, Reading and Mathematical Literacy A Framework for PISA 2006. OECD Publications. Paris

[19] Venville, G., Oliver, M., Longnecker, N., & Rennie, L. (2010). Selecting Science Subjects: Why Students Do, Why They Can't! Teaching Science,56 (3), 19. Retrieved from Questia.

[20] Khan, G. N., & Ali, A. (2012). Higher Secondary School Students' Attitude towards Chemistry. Asian Social Science,8 (6), 165.

[21] Agranovich, S., & Assaraf, O. B. (2013). What Makes Children like Learning Science? an Examination of the Attitudes of Primary School Students towards Science Lessons. Journal of Education and Learning,2 (1), 55.

[22] Narmadha, U., & Chamundeswari, S. (2013). Attitude towards Learning of Science and Academic Achievement in Science among Students at the Secondary Level. Journal of Sociological Research,4 (2), 114.