

Exploring Korean Adults' Long-Term Memory of School Science Education

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I. Introduction

People reading this article, including the author, regardless what they do for living, have much stronger relationships with science education than millions of ordinary people who once studied science during their school days but now doing nothing to do with science. But, in today's complex society, nation-wide policies of science education are generally controlled by the latter not by the former. For instance, the budgets for science education are set by the bureaucracy inside the government and deliberated by the members of the National Assembly, ultimately by ordinary people who practice their power by voting for them. School science education in Korea, especially, are severely influenced by the university entrance examination system which has been always one of the major political agenda in Korea.

We, as experts of science education, do carry out many different kinds of researches in order to improve school science education, and strongly believe that we are the very persons who have to take care of science education and who can solve its problems ultimately. Thus we do our best to investigate various aspects of school science, that is students' misconceptions and thinking processes, school curricular and teaching materials, teacher education and in-service training and so on. In other words, our research works are generally concentrated on the factors inside schools, i.e. those mostly related to students, curricular and teachers.

However, we do seldom think over what ordinary people do feel and experience when they learn science in schools. Since we, so called specialists in science education, are so different from them in personal experiences towards school science, it is usually not easy to imagine what ordinary people think about school science. As mentioned above, these people have a strong power over school science by paying taxes, sending their children to schools, formulating general opinions toward education and so on. Thus it is necessary to pay more attention to what they do, what they think and what they want to say in relation to school science education, in order to make our own professional activities more successful.

There have been a number of studies on attitudes toward school science and these studies usually investigated the attitudes of students (e.g. Song et al., 1992; Hur, 1993), of teachers (e.g. Kim & Lee, 1994) and of teacher trainees (e.g. Rajput, 1985; Grindrod et al., 1991; Segal & Cosgrave, 1992; Skamp, 1992). But ordinary adults' attitudes towards school science were rarely studied not only in Korea but also elsewhere in the world.

Therefore, this study is aiming to investigate what sorts of experiences ordinary adults still have in their memory from their school science even long after their school days. Adults' long-term memory of school science would be helpful to clarify main features of school science education and to make school science to be a source of more interesting and useful experiences.

II. Research Questions and Research Procedure

Different from our images of school science education which are continuously reminded and reflected, those of ordinary adults are greatly influenced by one or two strong experiences during their school days and these memories will remain robust and continuously affect their overall attitudes towards school science throughout their lives.

This study explored ordinary Korean adults' long-term memories of school science education by a small-scale survey. The purposes of this study can be summarized by the following questions:

- ① What kinds of delightful experiences did ordinary adults have from their school-days science education?
- ② What kinds of painful experiences did ordinary adults have from their school-days science education?
- ③ What are the characteristics of adults' long-term memories of their school science?
- ④ In adults' experiences on school science, are there any difference according to school level and subjects?

In this study a small-scale survey with ordinary adults in Taegu, a total number of eighty eight, was carried out. In the survey questionnaire, they were asked to give the examples of the most delightful as well as painful experiences from their school-days science education and to indicate whether these experiences were from their elementary, middle or high school days.

The age range of people involved in the survey was from 30 to 50 years old. The reason why these age groups, over 30 years old, were chosen is that people involved in this survey need to be old enough to forget less strong memories thus they can remember only very strong experiences from their school science. However, in the case of over 50 years old, adults are likely to be lack of the experiences of school science because many of this age group in Korea could have no formal school science education, particularly of middle and high school level. By this reason, this age group of people was also excluded from the survey.

In the process of sampling, the adults who have

specialities in science or science education, such as scientist, science teacher, medical doctor etc., were excluded because these people were subject to have had some kinds of intervention from their specialities after their school days.

Among 88 adults, the ratio of male : female was 59% : 41% and the ratio of age groups (i.e. 30s : 40s : 50s) was 44% : 28% : 27%. The reason of unequal distributions, less female and 40s & 50s, was that these groups of people were less willing to answer the questionnaire.(see Table 1)

Table 1. Distributions of participants according to sex and age

Age \ Sex	Sex		(sub-total)
	Male	Female	
Thirties	20 (25%)	19 (22%)	39 (44%)
Forties	15 (17%)	10 (11%)	25 (28%)
Fifties	17 (19%)	7 (8%)	24 (27%)
(sub-total)	52 (59%)	36 (41%)	total : 88 (100%)

Since the number of people involved in the survey was small, the results of this study need to be interpreted with caution. In addition, the method of survey, compared with other methods like interview or participant observation, is known to be not very effective especially in revealing their deep opinions. This study was carried out just to explore the Korean adults' long-term memories of school science, thus a more comprehensive survey including a larger and more systematic sampling process is needed in order to understand this matter more clearly.

III. Survey Results and Discussion

1. Delightful Experiences of School Science

The most frequent responses mentioned by the adults as the most delightful experience were something related to "Practical and Experimental Activities" (65.9%). And the next most frequent responses were about "Outside

Classroom Activities" (19.3%). There were also some responses about "Normal Classroom Teaching" (3.4%) and about "Characteristics of Teachers" (2.3%). (see Table 2)

Table 2. Adults' delightful experiences of school science education

Delightful Experiences	frequency	percentage
Practical and Experimental Activities	58	65.9
Outside Classroom Activities	17	19.3
Normal Classroom Teaching	3	3.4
Characteristics of Teachers	2	2.3
Others	6	6.8
No responses	2	2.3
Total	88	100

"Practical and Experimental Activities" in science lessons were not common in Korea especially in the past and, as can be expected easily, these activities were revealed as the most important sources for delightful experiences of school science. Most of the replies in this category usually mentioned certain particular experiments from which they enjoyed or had good feelings and these were likely to be on their experiences of unexpected or fancy phenomena.

"When we had a chemical experiment by making a fire on a match using an alcohol lamp, the components were separated and ... the beautiful colors of the fire were very interesting." (30s, male, primary school)

"The experiment of blood coagulation was interesting. We tested blood types by taking out our own blood." (30s, female, high school)

"The memory of watching peculiar colours of rainbow coming from a prism and repeating the observation" (50s, male, elementary school)

However, a few adults also mentioned their general feelings on experimental works, rather than on particular experiences.

"Science lessons during middle schools days were

most interesting and delightful. I had a good memory of solving a problem step by step with some understanding by following the procedure of experiment." (30s, male, middle school)

The second most frequent responses were on "Outside Classroom Activities", i.e. various kinds of unusual science lessons (such as, collecting plants/insects, field study, cave exploration). Most of these activities were come from their elementary school days.

"when I went to collect insects with my teacher and friends" (30s, female, elementary school)

"Once we went to the sea and touched living things in the sea. That was so interesting and this experience remain vividly in my memory." (50s, female, elementary school)

Although these were classified as "Outside Classroom Activities", they can be considered as different kinds of "Practical and Experimental Activities" because these activities are basically practical works, clearly different from normal classroom learning.

There were also some adults mentioning the experiences of normal classroom learning as the most delightful experiences. These responses, however, were to do with meaningful understanding of scientific knowledge, not to do with traditional typical types of science learning which are mostly the sources of painful experiences, like discussed in the following section.

"Science lessons during elementary and middle schools were full of cramming methods. But in high school science lesson explained various parts of real-life thus understanding was fast and could be remembered long." (40s, male, high school)

"After listening the scientific explanations on natural phenomena, I could understand the things which were taken for granted for long time." (40s, female, middle school)

In addition, some responses were related to the characteristics of teachers. People had good feelings from personal aspects of their teachers (such as appearance or

personality, not specially related to the expertises of science teacher) and these experiences helped them to be interested in science lessons.

"The teacher was young thus I have a good feeling towards him and then science lesson was delightful." (40s, female, high school)

"In high school, my teacher taught the rather boring physics lesson with a humorous way of talking and action." (30s, female, high school)

In addition, one man mentioned his personal experience related to the exhibition of invention as a delightful memory.

"when my product which was made with my friends won the prize for school competition for an exhibition of inventions" (40s, male, on high school)

2. Painful Experiences of School Science

The most frequent responses mentioned by the adults as the most painful experience were about "Boring Styles of Classroom Teaching"(51.1%), and the next most frequent responses were related to "Practical and Experimental Activities" (28.4%). There were also some responses about "Too Much Homeworks"(4.5%), about "Characteristics of Teachers"(4.5%), and about "Outside Classroom Activities" (4.5%). (see Table 3)

Table 3. Adults' painful experiences on school science education

Painful Experiences	frequency	percentage
Boring Styles of Classroom Teaching	45	51.1
Practical and Experimental Activities	25	28.4
Too Much Homeworks	4	4.5
Characteristics of Teachers	4	4.5
Outside Classroom Activities	4	4.5
Others	4	4.5
No responses	2	2.3
Total	88	100

For "Boring Styles of Classroom Teaching" as the most painful experiences, people pointed the traditional shortcomings of Korean education, such as university entrance exam - oriented, rote memory - oriented and problem solving - oriented science learning.

"For the preparation for entrance exam, we had to memorize formula and solve problems in physics lessons. That was one of the most dreadful experience in my life." (30s, male, high school)

"We had no experience of experiments at all. The only thing we learned was scientific theories and they were difficult to understand" (30s, male, high school)

For many adults, physics and chemistry lessons were the sources of painful experiences, particularly complex formula and symbols appeared in those texts.

"Memorizing the formula and technical terms of physics and chemistry, it was the most terrible time." (40s, male, high school)

"I remember... because the method of memorizing the symbols of chemical elements was so harsh" (40s, male, high school)

Although "Practical and Experimental Activities" were considered as the most delightful experiences, these activities were also the most painful experiences for many adults. The responses in this category were mainly related to various negative aspects of experimental works. But this does not necessarily mean that they did not like experimental works itself.

"When we had to write down experiment reports written on the blackboard... It was the most boring and uninteresting thing that we had to solve problems through blackboard demonstration without having experiments." (30s, female, middle school)

"After experiment, I had to clean up beakers as penalty" (40s, male, middle school)

"I did not like chemical experiments. There were various odours and the experiment was dangerous." (50s, male, high school)

"I could not even touch the equipments which had become treasures of the school. And we had to clean up labs whenever there were school exhibitions or open-days." (50s, male, middle school)

Especially, some adults were disappointed by the absence of science lessons, which were sometimes replaced by other major subjects for the university entrance exam or just omitted by some reasons in the school.

"When I was 3rd year of high school, we had no science lessons in order to prepare for the university entrance exam. I wanted to have science lessons." (30s, male, high school)

"Instead of science lessons, we had a time for physical exercise." (40s, male, no mention)

In addition, the inappropriate ways of teaching by science teachers were also the sources of painful experiences.

"Since we could not produce experimental results soon, we were whipped with a switch by the teacher." (30s, male, middle school)

Surprisingly, for someone, science lessons were so worthless that they could not give any memory at all.

"I can not remember what kinds of science lessons I had. I did not have any activity." (50s, male, elementary school)

3. Comparisons According to School Levels and Subjects

Table 4 shows the comparisons of adults' delightful and painful memories according to school levels. More delightful experiences were from elementary school science (56.8%) while more painful experiences were from high school science(44.3%). This reflects the fact that elementary school science had relatively more activities of experiments and outside classroom learning while high school science

was mainly concentrated on transmitting scientific knowledge.

Table 5 shows the comparisons of adults' delightful and painful memories according to school subjects. The responses could be categorized according to school subjects (i.e. physics, chemistry, biology and earth science) and the data which did not fit one of these were classified as 'Others'. In case of delightful experiences, the distribution was revealed in the following order : biology (29) > physics (28) > chemistry (9) > earth science (4). And, in case of painful experiences, the order was chemistry (14) > biology (12) = physics (12) > earth science (4). But a half of the reponses for painful experiences could not be classified into any of four science subjects because these were mainly related to the general characteristics of either classroom teaching or practical works.

Table 4. Delightful and painful experiences according to school level

Experiences School	Delightful Experiences	Painful Experiences
Elementary School	50 (56.8%)	11 (12.5%)
Middle School	26 (29.5%)	26 (29.5%)
High School	10 (11.4%)	39 (44.3%)
No Indication		10 (11.4%)
No Response	2 (2.3%)	2 (2.3%)
Total	88 (100%)	88 (100%)

Table 5. Delightful and painful experiences according to school subject

Experiences School	Delightful Experiences	Painful Experiences
Physics	28 (31.8%)	12 (13.6%)
Chemistry	9 (10.2%)	14 (15.9%)
Biology	29 (33.0%)	12 (13.6%)
Earth Science	4 (4.5%)	4 (4.5%)
Others	16 (18.2%)	44 (50.0%)
No Responses	2 (2.3%)	2 (2.3%)
Total	88 (100%)	88 (100%)

4. Different Experiences from the Same Activity : the case of "Frog Dissection"

One of the most interesting results of this study was that some particular activities in school science, especially "frog dissection", were so differently appreciated by students that some mentioned these activities as the most delightful as well as others as the most painful ones.

In the case of "frog dissection", 7 adults considered this activity as the most delightful experience while 8 adults considered as the most painful experience. Following quotations are the typical examples of these contradictory opinions towards "frog dissection":

("frogs dissection" as delightful experiences)

"When we in group had an experiment of frog dissection during biology class, the frog was jumping around the classroom." (30s, female, middle school)

"when we had frog dissection, I had an illusion that I became a doctor. And it was practical and interesting." (50s, male, middle school)

("frog dissection" as painful experiences)

"... once we had a dissection of frogs, ... seemed that many living things were cruelly slaughtered." (30s, male, middle school)

"I thought the frog was already dead, but the memory of watching that parts of the body, like heart, were still moving was painful and I hated it." (30s, female, middle school)

"I really hated the dissection of frogs. ... I hated to experiment frogs with nails on their hands." (40s, female, high school)

IV. Conclusion

This study explored the long-term memory of ordinary Korean adults towards school science education. A total of 88 adults living in Taegu city were asked to give examples of the most delightful as well as the most painful experiences from their elementary, middle, and

high school days. The age range of the persons participated in the survey was from 30s to 50s.

As the most delightful experiences, adults mentioned practical and experimental activities (65.9%) and outside classroom activities (19.3%). That is, 86% of the adults said that activities from non-normal classroom science lessons were the most delightful experiences. On the other hands, for the most painful experiences, 51% mentioned non-attractive styles of classroom teaching and 28.4% mentioned negative aspects of practical and experimental activities.

More than a half of the delightful experiences mentioned by the adults were from their elementary school days while nearly a half of the painful experiences were from high school days. And one third of the adults mentioned examples from physics and biology as the delightful experiences.

Despite numerous warnings against the rote memory - oriented and university entrance examination - oriented science teaching in the past, today's school science is still remained the same in its style. Considering this problem serious, such tendency in school science should be changed very soon, otherwise our schools will produce millions of people who have very negative attitudes towards school science and ultimately they will be a great hinderance for the development of school science education in Korea.

Another thing to keep in mind is that having some activities which are considered to be as good and meaningful experiences by many people does not automatically improve people's attitudes toward school science. For instance, in this study, nearly 30% of the adults told that they had the most painful experiences from practical and experimental activities. This was also dramatically shown from the case of "frog dissection".

The case of "frog dissection" also illustrates an important dimension of science education which has been neglected for long time by science educators, that is ethical problems in science education. There is no doubt about that today's society is getting more and more related to science and technology and that science is heavily related to various ethical and moral problems of society. Thus school science should address this matter

more openly and help our students to be better prepared for their future which will be full of ethics-related scientific judgements (e.g. Musschenga and Gosling, 1985 ; Frazer and Kornhauser, 1986).

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(국문초록)

학교 과학교육에 대한 한국 성인의 장기기억에 대한 탐색

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본 연구는 우리 나라의 성인들이 자신의 초중등 학교 시절 경험하였던 학교 과학교육에 대해 어떤 종류의 즐거운 혹은 괴로운 기억들을 현재까지 갖고 있는가를 탐색하였다. 성인들은 오래 전 경험하였던 매우 인상적인 활동이나 장면들을 통해 학교 과학교육을 기억할 것이고, 이러한 기억은 그들의 학교 과학교육에 대한 전반적인 태도에 결정적인 역할을 할 것이다. 따라서 성인들의 학교 과학교육에 대한 이러한 기억들을 살펴보면, 학교 과학교육의 특징을 이해하고 장기적으로 학교 과학교육을 보다 즐거운 경험의 장으로 만드는 데 도움이 될 것이다.

본 연구는 소규모의 설문 조사를 통해 이루어졌으며, 설문 대상은 대구지역의 30-50대 성인 88명이었다. 설문은 현재 과학과 관련된 특정한 직업을 갖고 있지 않은 사람을 대상으로 하였으며, 설문에서 응답자들은 자신들의 초중등 학교 과학교육을 받으면서 가장 즐거웠던 기억과 가장 괴로웠던 기억이 구체적으로 무엇이며 이러한 경험은 초중고 어느 때이었는가를 응답하였다.

성인들이 가장 즐거웠던 기억으로 지적한 것은 실험·실습 활동(65.9%), 야외학습 활동(19.3%) 등으로 전통적인 교실수업 이외의 활동이 약 86%로 나타났다. 그리고 효과적인 교실수업, 교사의 인성적 특징, 과학전람회 참가 등의 경험을 언급한 경우도 부분적으로 있었다. 성인들이 가장 괴로웠던 기억으로 지적한 것은 따분한 교실수업(51.1%), 실험·실습 활동의 부정적인 측면(28.4%) 등으로 나타났으며, 부분적으로 과도한 숙제, 교사의 인성적 특징, 야외학습 활동, 과학수업의 부재 등을 지적한 경우도 있었다. 또한 전체적으로 즐거웠던 기억은 국민학교 시절의 경험에서(56.8%), 반면 괴로웠던 기억은 고등학교 시절의 경험에서(44.3%) 많이 나타났다.

특히, "개구리 해부 실험"의 경우, 7명이 가장 즐거웠던 기억으로 8명은 가장 괴로웠던 기억으로 언급하여 매우 상반된 견해를 나타냈다. 따라서 동일한 활동일지라도 학생들에게는 매우 상반된 경험으로 작용하게 되며, 이 경우 생명체에 대한 과학실험의 윤리적 문제와 이에 대한 갈등을 분명하게 드러냈다.