How an Enrichment Summer Program is Meeting the Expectations of Gifted Science Students: A Case Study from Finland

Sakari Tolppanen
Department of Chemistry, University of Helsinki, Finland

Kirsi Tirri
Department of Teacher Education, University of Helsinki, Finland

Abstract

This study investigated the expectations of gifted students for a science enrichment summer program held in Finland in 2011 and how these expectations were met. The students' expectations were studied by analyzing the answers of 1,935 camp applicants. Altogether, 4,348 expectations were identified through content analysis. The data showed that the majority of the students (90%) expressed academic expectations followed by social (68%) and ethical (38%) expectations. This research also analyzed how well five specialists who taught at the camp were able to meet student expectations by implementing a given curriculum. The results indicated that the academic expectations were met in various pedagogical ways, while the social expectations were also realized; however, some of the teachers encountered challenges in realizing the ethical expectations. The implications of this study are discussed in order to benefit curriculum design and teaching in enrichment summer courses for the gifted.

***Keywords*:** Gifted education; enrichment programs; science education; summer camp.

All over the world, gifted students need to deepen their knowledge, insights, and reasoning skills, develop their personalities, and establish networks of peer relationships. We know from previous empirical research that gifted individuals who have enjoyed special developmental programming often praise these earlier experiences as an important basis for their later careers (Tirri & Campbell, 2002; Hany & Grosch, 2007). In this paper, we present a case study of a special enrichment summer course, the Millennium Youth Camp, held in Finland, and how it has met the needs of gifted international science students. We compare the expectations of all students (N=1,935) who applied to the camp to the curriculum implemented by specialists (N=5) teaching at the camp. This investigation helps to assess how the different needs of gifted students were actually met during the camp and the kinds of enrichment this special course can provide for international students from diverse cultural backgrounds.

With regard to academic needs, researchers have suggested that education should reflect gifted students' abilities, interests, and passions (Subotnik et al., 2011) by providing a curriculum containing advanced content, which allows the students to advance at a faster pace than is usual (Colangelo, Assouline, & Gross, 2004). In addition to academic needs, gifted students also have a unique set of social needs. They need support from their families, teachers, and peers to realize their full potential (Tannenbaum, 1983). For instance, research shows that group membership has an effect on a student's educational outcomes. If the group devalues academic effort and achievement, it is possible that the gifted student will also devalue these things (Bliuc, Ellis, Goodyear, & Hendres, 2011). Furthermore, a supportive learning community helps the gifted student reach a higher level of independent learning, which can be associated with academic success and satisfaction (Bliuc et al., 2011; Pike, Schroeder, & Berry, 1997; Zhao & Kuh, 2004).

The importance of looking into the social context of the learner has long been recognized by educational psychologists (e.g., Anderman & Anderman, 2000); furthermore, it has been noted that a strong social identity results in a deep approach to learning (McInnis, 2001), which in turn can increase the level of academic performance. It is, therefore, important to look at the interpersonal and social aspects of learning rather than the "decontextualised individual" (Bliuc et al., 2011; Goodnow, 1992). In other words, an ideal learning environment supports holistic learning (Tirri, 2011b; Tirri, 2012) and acknowledges the social and emotional needs of the gifted student (Tirri & Kuusisto, 2013). These needs include the student's moral development. Excellence should therefore be combined with ethics, and future scientists should be guided to discussions of the ethical aspects of their discipline (Tirri, 2011a).

In a study conducted by Cross and Coleman (1993), gifted adolescents were asked to compare themselves socially, intellectually, and behaviorally with other students. The study showed that students identified themselves as being different academically, but not socially. Gifted students have also been found to prefer homogeneous groups over heterogeneous ones, mainly for academic reasons (Adams-Byers, Whitsell, & Moon, 2004).

National policies for gifted education vary widely from one country to another, and some policies reflect a "love/hate" relationship, especially in the United States (Colangelo & Davis, 2002). In the U.S., the most common method of supporting students of differing abilities has been ability grouping. The grouping is usually based on intelligence or aptitude testing, which is often seen as discriminatory, for example, to minority students (Benbow & Stanley, 1996). In some countries, such as Finland, educational differentiation by a teacher within an inclusive classroom has been the most common method of meeting the needs of gifted students. In recent years, enrichment possibilities in the forms of summer programs and university courses have also been available (Tirri & Kuusisto, 2013). For culturally- diverse gifted students, enrichment has been suggested as more appropriate and effective than other educational models for the gifted (Hébert, 2002; Renzulli & Reis, 1997). In this paper, we contribute fresh knowledge to this discussion by presenting ways in which a specific summer enrichment course, namely, the International Millennium Youth Camp, can contribute to the holistic development of gifted science students worldwide.

The Potential of Enrichment Programs to Meet the Needs of Gifted Students

Enrichment means providing learning experiences that are not usually found in the regular curriculum, including more in-depth material to advance the core content or more challenging teaching strategies (Clark, 2002). Gifted learners will be offered enrichment opportunities through various activities, such as independent studies, learning centers, field trips, and weekend and summer/winter study camps (Davis & Rimm, 1998). In general, enrichment programs can foster gifted youngsters academically (Rogers, 2007) and help them experience positive changes in higher-level thinking and creativity (Schenkel, 2002). The peer pressure brought to bear on gifted students, who consequently hide their giftedness, might be eased in enrichment camps, where the students, in the presence of similar peers, may feel less alienated (Rimm & Rimm-Kaufman, 2001).

Many studies have shown that educational camps foster interest in a given field, such as science (e.g., Birinci, Seyihoglu, Sezen, & Tekbiyik, 2011; Foster & Shiel-Rolle, 2011). Young people generally enjoy camp activities. Camps have been shown to have a positive effect on increasing the students' self-confidence in science education (Birinci et al., 2011). Moreover, camps help develop creative and productive thinking (Renzulli & Reis, 1997) as well as motivation (Frost, 2005). There is also some indication that the long-term effects of such camps persist over time. In a recent study (Tolppanen & Aksela, 2013), participants in a week-long enrichment program were studied a year later. The findings showed that the participants' level of self-confidence and motivation persisted over time, and the students were more inclined to notice opportunities around them. However, in a longitudinal study,

Hany & Grosch (2007) found that participants in a gifted enrichment program did not perform better in life than non-participants. Based on their results, the researchers suggested that gifted students are able to navigate successfully through life whether they attend enrichment programs or not; however, their study did not address whether non-participants had attended enrichment programs other than the one being studied. Thus, further research on longitudinal effects is still needed.

The Millennium Youth Camp

In 2004 the National LUMA (LU stands for 'luonnontieteet', natural science in Finnish, and MA for mathematics) Centre was launched in Finland to serve as a collaborative organization among universities, schools, and the business sector. The objective of the LUMA Centre is to promote the teaching and study of natural sciences, mathematics, computer science, and technology on all educational levels. One of its many activities is the Millennium Youth Camp (MYC), which is geared to 16- to 19-year-olds who are gifted in science (LUMA, 2014).

The camp has been held in the summers of 2010-2013, and each year the number of applicants has been approximately 1,000 or more. The top applicants are chosen based on their giftedness and motivation (Vartiainen & Aksela, 2012). The camp is organized by Finland's Science Education Centre LUMA in collaboration with Technology Academy Finland (TAF), Aalto University, and industry (LUMA, 2014).

The curriculum goals of the MYC

The campers are divided into theme groups based on their interests. All of these groups follow the camp's general curriculum, work on a group project, and participate in certain activities, which are both academic and social in nature. Academic activities include visiting universities and companies, attending the Millennium Prize Gala, participating in the Amazing Race of Science, and visiting a science center. The formal social activities consist of an international evening, a sauna night, a tour of Helsinki, evening entertainment, and welcome and farewell parties (for more details, see Tolppanen & Aksela, 2013). In addition to the formal program, campers have free time to interact with their teachers and one another. They also work on a project assigned two months before the camp begins.

The MYC project

The campers begin working on an online group project assigned by a specialist in a given field. Each project varies in content, but all follow certain general principles, explained in more detail below. In the first stages of the project, the specialist teacher provides the campers with reading material to familiarize them with the topic. Then the campers begin working on their own on a project whose purpose is generally to create a solution to an existing problem. The projects are given checkpoints to ensure that the work is well underway by the time the campers arrive in Finland.

During the one-week camp, the campers continue working on their projects two to four hours a day. At the end of the camp, the participants present their work at the Millennium Youth Camp Gala to an audience of experts from universities and ambassadors from the campers' home countries.

Student experiences in MYC.

A recent multiple case study (Tirri, Kuusisto, & Aksela, 2013) explored meaningful learning and interaction in the MYC as experienced by five international students who were working together as a team to determine how ICT (Information and Communications Technology) can improve literacy in developing countries.

The results showed that the learning in MYC met the criteria of meaningful learning. The students were purposeful, constructive, and active, and they profited from challenging and authentic learning tasks that could be transferred to real-world scientific problems. The study also confirmed that MYC offers an excellent opportunity to meet like-minded friends and to be challenged both academically and socially. During the intensive one-week period, the students worked hard on their academic projects, which also improved their social and interactive skills. In addition, the projects addressed ethical issues with a strong moral emphasis on global responsibility. Thus, during MYC the students actively focused on and discussed not only science, but also moral questions. MYC thereby

seemed to cover aspects of social, emotional, and moral education that have been neglected in programs for gifted students (Tirri & Kuusisto, 2013).

Methodology

The Aim of the Study

This study investigates the expectations of gifted students for a Science Enrichment Program and how these expectations were actualized during the program by their expert teachers.

Data Collection

Student Data

The student data were collected in 2010-2011 by means of an online self-report survey. The camp was advertised directly to gifted programs and schools around the world on the Internet and through diplomatic channels. The survey was also advertised on the webpages of the organizers, as well as through their email lists. The applicants came from a variety of schools, and because the schooling system in each country varies, a cross-cultural comparison of the level of giftedness in the sample is not possible. However, given that most of the students came from specialized schools or had shown success in national and international science or math competitions, we assumed that the applicants were gifted.

The survey contained three demographic questions regarding the respondents' gender, age, and country of origin. The participants (N=1935) included 53.6 percent females (N=1037) and 46.4 percent males (N=898), and their ages varied from 16 to 19. They came from six different continents. More than half of the applicants were from Europe (N=1133 or 58.6%) and one-third from Asia (N=509, 26.3%). Fewer than 15 percent of the applications came from other continents, namely, Africa (N=123, 6.4%), North America (N=68, 3.5%), Oceania (N=75, 3.9%), and South America (N=27, 1.4%).

The students were required to choose one field of interest from the following categories: *climate change, water, renewable energy and natural resources, ICT,* and *mathematics*. In the whole sample, males and females were almost evenly represented, but within the groups, gender bias occurred, given that females were more likely to choose the climate change and water groups, while males often chose the ICT group (for details on distribution, see Table 1).

Table 1: Distribution among fields of interest.

Themes	Male (N)	Female (N)	Total (N)	Percent (%)
Climate change	153	340	493	25.5
Water	85	158	243	12.6
RE&NR*	286	273	559	28.9
ICT**	181	96	277	14.2
Applied mathematics	191	172	363	18.8

*Renewable energy & Natural resources
** Information and Communication Technology

In the main section of the survey, the applicants were asked to give a maximum of three expectations they had for the Millennium Youth Camp. This was done with open-ended questions.

Specialist data

The specialists came from universities and companies and were selected for their achievements in STEM subjects (Science, Technology, Engineering, and Mathematics). The background information on the specialists is presented in Table 2.

Table 2: Background information on MYC specialists.

Specialist (Male/Female)	Work experience (in years)	Degree	Group	Current employer
Jukka (M)	10	Ph.D. (Math)	Applied Mathematics	Aalto University
Matti (M)	15	Ph.D. (Technology)	Energy	Aalto University
Sonja (F)	30	Ph.D. (Science)	Water	University of Jyväskylä
Mikko (M)	14	M.Sc. (Technology)	ICT	Nokia
Ismo (M)	28	Ph.D. (Science)	Food Science	University of Helsinki

After the camp, the specialists were asked to complete an online survey containing questions on the implementation of the curriculum. The questions were planned by two researchers and included queries about which curriculum goals had been implemented and how and whether the specialists had additional goals not mentioned in the curriculum. The specialists were asked to give specific examples in answering the questions.

Data Analysis

The student data were analyzed with qualitative content analysis. The students' expectations were calculated by the number of expectations in five categories: academic, social, ethical, socio-ethical, and other. Socio-ethical expectations are a composite variable containing both ethical and social reasons. The inter-rater reliability of the established categories was r = .83 between two raters, which indicates good reliability. Qualitative examples of the students' expectations are provided from each category to demonstrate the variety of expectations within each category.

The specialists' answers were analyzed inductively without any specific theoretical framework; however, the curriculum goals and the categories established by the students' expectations guided the researchers' understanding and provided theoretical concepts for use in the analytical work. After the first reading of the specialists' answers, the researchers drew themes from the answers for further analysis. Each researcher established the themes autonomously. After the selection, the researchers checked the reliability of the themes by comparing their analyses. In mutual discussions, some of the themes were dropped and others emphasized. All disagreements were discussed until the researchers reached a common interpretation of the themes selected.

Results

Students Expectations for the Millennium Youth Camp

The data contained a total of 4,348 expectations from 1,935 applicants. Among the students, 1,749 (90%) had academic expectations, 1,312 (68%) had social expectations, and 727 (38%) had ethical expectations. Among the applicants, 560 (29%) also mentioned at least one other expectation, while one-fourth of the respondents (*n*=473, 24.4%) expressed socio-ethical expectations. Of the 4,348 expectations, 1,992 were expressed by male students and 2,356 by female students. These data are presented in Table 3.

Table 3: Distribution of expectations among the applicants.

Question type	Academic	Social	Ethical	Socio-ethical	Other
Male	813	598	303	(186)	278
% of male expectations	40.8%	30.0%	15.2%	-	14.0%
Female	936	714	424	(287)	282
% of female expectations	39.7%	30.3%	18.0%	-	12.0%
Total	1,749	1,312	727	473	560

The expectations were labelled *academic* if the applicants talked about their own research, their school success, their interest in science, their desire to learn more about science, or their interest in the Finnish school system. For instance, a female student from North America wrote:

> What interests me the most is science and technology. To prepare myself for a career in these fields, I must explore and become knowledgeable about the possibilities and careers open to me for my future.

The expectations were labelled *social* if the applicant wanted to meet new people, share ideas with others, or make new friends. A male student applying from Asia described this expectation in the following words:

> I want to introduce my country and know more things from teenagers of other countries. I am very communicable [sic], and I want to bring everything I will learn to my friends in order to enlarge our knowledge

The expectations were labelled *ethical* if the applicant talked about wanting to change the world, wanting to affect the people around them, or wanting to learn more in order to know how to better protect the world. A male student from Europe expressed this desire as follows:

> Even though there are many theories about global warming, I believe that humans have changed our planet drastically. I think there are a lot of things to be changed, starting with ourselves.

An example of a socio-ethical expectation was given by a female from North America:

> The environmental problems facing the world require interdisciplinary and international solutions; these problems don't stop at national borders. At the camp I would have the opportunity to interact with other people from around the world who share similar interests and be exposed to diverse perspectives that may result in new ideas for the future that I may never have considered. I would be building a global network of peers that would last beyond the time we spent together at the camp.

The remaining expectations were categorized as "other" and were related to expectations that were not directly connected with the camp. For instance, a female student from Africa wrote:

> I would love to visit Finland to get a once in a lifetime opportunity to travel overseas to experience the handover of the Millennium Technology Prize.

Gender differences in students' expectations of MYC

Gender differences were not seen to apply in academic and social expectations, but results of the Mann-Whitney *U*-test showed that female respondents clearly provided more ethical expectations (n=424, 58.3%) than males (n=303, 41.7%), $Z(1, n=1935)=-3.236$, $p=.001$. A gender-related difference was even more obvious in the number of socio-ethical expectations: females reported 287 reasons (60.7%) and males only 186 (39.3%), $Z(1, n=1935)=-3.554$, $p<.001$.

Age differences in students' expectations of MYC

Analysis with Kruskal-Wallis *H*-test revealed that the oldest respondents (19 years of age) most often reported socio-ethical expectations for MYC (n=101, 29.1%), $\chi^2(1, n=1935)=8.338$, $p=.040$.

Field of interest differences in students' expectations of MYC

The results showed that applicants with ICT (n = 262, 96.4%) and mathematical (n = 353, 97.2%) interests mostly had academic expectations for participating in the Millennium Youth Camp, $\chi^2(4, n = 1935) = 40.492$, $p<.001$. However, interestingly, the opinions of these two groups differed in social expectations: the mathematically-oriented respondents' interest was the lowest (n = 232, 63.9%), while the ICT-oriented respondents' was the highest (n = 203, 73.3%), $\chi^2(4, n = 1935) = 11.088$, $p = .026$ of all the groups.

However, these two groups shared a low interest (n = 69, 24.9% and n = 78, 21.5%, respectively) in ethical issues compared to the three other groups (climate change, n = 219, 44.4%; water, n = 124, 51.0%; renewable energy and natural resources, n = 237, 42.4%), $\chi^2(4, n = 1935) = 93.097$, $p<.001$. Applicants who were interested in climate change (n = 154, 31.2%) and water (n =

80, 32.9%) were the ones who most frequently reported socio-ethical expectations, $\chi^2(4, n = 1935) = 65.014, p<.001$.

Specialists and the Implementation of the Curriculum Goals of MYC

The camp curriculum was planned to meet the students' expectations; therefore, the curriculum included academic, social, and ethical goals.

The academic goals were:

- To encourage the 16- to 19-year-olds to study mathematics, natural sciences, and technology;
- To introduce the students to the academic and professional opportunities that Finland has to offer in the areas of mathematics, natural sciences, and technology, as well as to help strengthen the image of Finland as a great country in which to study and work;
- To make the Millennium Technology Prize better known;
- To devise a research question with more than one right answer; and
- To devise projects that encourage students to think creatively.

Social goals in the curriculum were:

- To help the students people network with one another;
- To provide the students with opportunities to meet researchers and stakeholders in Finnish companies and organizations; and
- To provide opportunities for the students to have fun with like-minded young people and enjoy their experience in Finland.

Ethical goals in the curriculum were:

- To devise projects related to sustainable development; and
- To devise that deal with an ongoing discussion between science and society.

The five specialists were given this curriculum and asked to implement it in the projects they were directing. After the camp the specialists were asked how they realized these goals. The results are presented in Table 4.

Table 4: Curricular goals of the specialist teachers.

Specialist	Goals mentioned (N)	Academic goals	Social goals	Ethical goals	Personal goals
Jukka	6	Increase knowledge, Creative thinking, Academic and professional opportunities, Experience in STEM subjects	Peer interaction	---	Timely project
Matti	7	Increase knowledge, Creative thinking	Peer interaction, Meeting experts, Having fun	Socio-scientific discourse	Timely project
Sonja	8	Increase knowledge, Creative thinking, Academic and professional opportunities	Peer interaction, Meeting experts, Having fun	Socio-scientific discourse, Environmental issues	
Mikko	11	Increase knowledge, Creative thinking, Academic and professional opportunities, Experience in STEM subjects	Peer interaction, Meeting experts, Having fun	Socio-scientific discourse, Environmental issues	Timely project, hands-on project
Ismo	9	Increase knowledge, Academic and professional opportunities, Experience in STEM subjects	Peer interaction, Meeting experts, Having fun	Socio-scientific discourse, Environmental issues	Hands-on project

The actualized curriculum goals of the specialists

The goals of the five specialists were analyzed from their answers and classified into four main categories: academic, social, ethical, and other. The academic goals consisted of four subcategories: increase knowledge, promote creative thinking, provide academic and professional opportunities, and give experiences in STEM subjects. The social goals consisted of three subcategories; peer interaction, meeting experts, and having fun. The ethical goals expressed by the specialists fell into two subcategories: socio-scientific discourse and environmental issues. In addition to these goals, the five specialists had some goals of their own for their teaching. These goals were related to the nature of specific projects, including a suitable schedule and hands-on experience. In the following section, these goals are discussed with examples from the specialists' data to show the pedagogical ways in which the specialists met these goals in their teaching.

Academic goals

Increase in knowledge

All five specialists mentioned that the camp provided the opportunity for students to increase their knowledge in STEM subjects. Sonja mentioned that the water team gained knowledge on how urban hydrologic circulation works; Ismo, from the food science group, mentioned that the campers studied different scientific theories related to the project. Many of the specialists felt that becoming familiar with ongoing scientific research was beneficial to the students, and so they assigned scientific publications as reading materials.

Creative thinking

In the selection process, the specialists found that the students were already academically gifted, and so rather than devising projects to increase academic knowledge, four of the specialists wanted to develop projects that promoted creative thinking. Ismo, the expert from the food science group, described the power of this approach as follows:

> Discussing the use of alternative protein sources fired the creativity of the campers.

Creativity was encouraged in several ways. In the ICT group, the students were given the task of building a water rover on a limited budget. The specialist for the group said that the project gave the campers the opportunity to take the project in the direction they wanted, thereby activating their creativity. In the energy group, the students designed their own solutions for integrating solar energy into a building of their choice. The other specialists also mentioned that their projects gave the students a great deal of freedom, encouraging them to come up with new solutions to existing problems.

Academic and Professional Opportunities

During the camp, all the students had the opportunity to visit two universities and at least one Finnish company, such as Nokia or UPM. Four of the five specialists mentioned these visits in their answers. Jukka, from the applied mathematics group, said that during these visits he encouraged the campers to undertake university studies in science or mathematics. Matti, from the energy group, had a slightly different approach: he did not explicitly encourage the students to study STEM subjects, but he believed that this goal was met by the opportunities afforded to network with experts and by visiting universities. Mikko, from the ICT group, believed that opportunities became apparent largely through the project the students worked on. He said:

> In the project we used academic research as a foundation, and this hopefully showed the young people how academic research can be used to solve practical problems.

Experiences in STEM subjects

Three of the specialists also mentioned that they wanted to give the students a positive experience working with STEM subjects. Mikko and Ismo mentioned that, through work on the

projects, they wanted the students to get the feeling that they had achieved something worthwhile. Mikko put it in the following words:

> The project gave the campers the experience of succeeding in doing a STEM project, where they had the chance to do something new and interesting. I believe such positive experiences will motivate the young people to continue working with STEM subjects.

Social goals

Helping the students network

All of the specialists felt that the camp provided an excellent opportunity for the young people to network with each other. Three of the specialists mentioned that they encouraged networking by making the group work in pairs or groups of three. Two mentioned that the networking had started already before the camp, through the camp's online platform. The specialists also felt that giving the students the responsibility for advancing the project was a good way for them to network, since they had to solve problems together. Four of the specialists mentioned that they endeavored to devise a project in which everyone could participate. Mikko, from the ICT group, described the success of this as follows:

> Everyone had the opportunity to give their input to the project. At least I got the impression that the project inspired the young people to work together and brought them closer together. It also increased their understanding of the different skill sets that each of them had.

Meeting Experts

In addition to having a specialist teacher in each theme group to guide the students in their project work, the campers also had the opportunity to interact with other experts from universities and Finnish companies. Four of the camp specialists mentioned these encounters in their answers. Ismo, from the food science group, said:

> We did laboratory work in which the students were guided by real experts and students.

And Mikko, from the ICT group, observed:

> The campers asked the experts a lot of questions about their work and experience as researchers. The experts were role models to the young people.

Having fun

Informal activities are important for networking. The Millennium Youth Camp offered such activities through a welcome party and a farewell party, an international evening, and various non-academic competitions, such as the Amazing Race of Science. These activities provided the young people enjoyable activities with like-minded students. However, since the specialist teachers were not involved in the evening activities, it was hard for them to evaluate those programs. Mikko, from the ICT group, did point out that as the young people got to know each other better, they also worked much better on their projects. Ismo, from the food science group, felt that it was very important that the campers have opportunities to have fun together.

Ethical goals

Dealing with socio-scientific discussions

In order to understand the nature of science, students need to learn to deal with the discourse of science and society (Abd-El-Khalick, 2003). All but one of the specialists mentioned that such discussions were included in their projects. Matti, from the energy group, described the work on the projects in the following words:

> The young people had the opportunity to think of solutions for how solar energy could be used in a certain area in the city of Espoo. In their project, the young people showed how feasible solar energy actually is, even in Finland, and I felt that solar energy was a good theme for the project.

Mikko, the expert from the ICT group, explained how their project was related to sustainable development:

> The theme of the project is highly relevant to socio-scientific discourse, and it tackled the theme from the perspective of sustainable development. I hope the project got the students thinking about the possibilities of technology for solving environmental problems.

Jukka, from the applied mathematics group, did not find their project to be relevant to socio-scientific discourse and said that he did not promote ethical discussion during the project.

Environmental issues

Three of the specialists mentioned that environmental issues were also part of their projects. Mikko said that the ICT group discussed the ecological benefits of the water rover they built, and Ismo, from the food science group, mentioned that bringing an environmental point of view was one of his main goals in deciding on the project theme. He also mentioned the discussions with the students:

> The campers were asked to discuss the use of plant- and meat-based proteins…we had a lot of discussion on whether animal proteins are ethical. Happily, the students were not too black-and-white in their opinions.

The water group discussed how environmental problems can be prevented or minimized. Sonja mentioned these discussions as follows:

> We discussed how the environmental effects of medicine compare to other chemicals. The main question was whether environmental risks caused by medicine should be viewed in a different way from the risks caused by other chemicals.

Concluding Remarks

This research shows that gifted students have academic, social, and ethical expectations of enrichment programs. All of these expectations should be acknowledged in order to provide a holistic education for gifted students. Moreover, in planning a curriculum for an educational camp, the camp administrators and teachers should consider aspects of meaningful learning. Previous research has already shown that MYC meets the criteria of meaningful learning for gifted students (Tirri et al., 2012). In this study, our emphasis has been on demonstrating how the expert teachers in different subjects met students' holistic expectations during MYC.

The results of our research show that gifted students apply to enrichment programs primarily for academic reasons. The curriculum for MYC was designed to meet these young people's academic expectations by providing fresh knowledge and creative insights into the themes of climate change, water, renewable energy and natural resources, applied mathematics, as well as information and communications technology. Our results also demonstrate that the students' academic expectations were well met in all these themes in the specialists' curricula. During the camp, the specialist teachers presented ongoing research and various academic and professional opportunities. The students were also allowed to work on a project that required creative thinking. The specialists believed that creative work enhances students' positive STEM experience by fostering their interests in studying these subjects in the future. Furthermore, the specialists set a goal to build students' knowledge during the camp, working on the projects in a timely manner, and making the projects meaningful for gifted students. In so doing, they were able to address the students' abilities, interests, and passions.

In the application phase, almost seventy percent of the students mentioned their social expectations for the summer enrichment camp. They wanted to meet new people, make new friends, and share ideas with like-minded peers around the world. In order to meet these social expectations, the specialists emphasized the importance of teamwork in their teaching. The projects were carried out in teams of six students. The students were also given opportunities to work in pairs or groups of three. With the help of these pedagogical approaches, the students learned to know each other well

during the camp. The teachers also gave the students a great deal of freedom and responsibility in all their work. This approach forced them to rely on each other, building up the team and providing maximum opportunities for peer interaction. In addition to peer interactions, the students had the opportunities to meet scientists in universities and companies, giving them the chance to see what scientists really do and allowing them to ask questions about scientific work. The specialist teachers also acknowledged the importance of the camp's informal programs in meeting the students' social expectations.

In addition to academic and social expectations, almost forty percent of the students wanted to address ethical issues in science during the camp. These expectations usually stemmed from a desire to make the world a better place by making a positive impact on the people and the environment around them. The female students expressed more ethical expectations than male students.

In order to meet the students' ethical expectations, four of the specialists implemented socio-scientific discourse and three implemented an environmental aspect in their projects. The specialist teachers were able to discuss environmental issues, because they had chosen projects with links to sustainable development. Through this link, they were able to meet the expectations of the many students who had mentioned a desire to make their environments a better place. This approach can also be a way of attracting gifted females to science-related careers, since previous research shows that helping others and doing something worthwhile for society serve as powerful motivators for drawing gifted women to science all over the world (Rosser, 2000).

In this study, we have investigated how gifted students' expectations for summer study and the curriculum in a summer enrichment course in science can coincide. According to our findings, a holistic approach in curriculum design is needed to meet the variety of expectations that gifted students bring to their experiences. Academic and social expectations are easy to meet by providing expert teaching in science along with like-minded peers and creative challenges. The biggest challenge in designing summer enrichment courses and camps in science is to address the ethical issues of doing scientific research and the necessity of taking responsibility for global issues. Our results show that ethical issues were addressed in the curriculum of this particular camp by a majority of the specialist teachers. However, this is an aspect of curriculum design that needs further research and attention. Furthermore, in order to understand the holistic development of students, longitudinal learning outcomes of summer programs are needed.

References

Abd-El-Khalick, F. (2003). Socioscientific issues in pre-collage science classroom. In D.L. Zeidler (Ed) *The role of moral reasoning on socioscientific issues and discourse in science education*, (pp. 41–61). Kluwer Academic Publishers, Netherlands.

Adams, C. & Pierce, R. (2008). Science, elementary. In Plucker, J. & Callahan, C. (Ed.), *Critical issues and practices in gifted education* (pp. 563-577). Waco, TX: Prufrock Press.

Adams-Byers, J., Whitsell, S. S., & Moon, S. M. (2004). Gifted students' perceptions of the academic and Social/Emotional effects of homogeneous and heterogeneous grouping. *Gifted Child Quarterly, 48*(1), 7-20. doi:10.1177/001698620404800102

Anderman, L. H., & Anderman, E. M. (2000). Considering contexts in educational psychology: Introduction to the special issue *Educational Psychologist, 35*(2), 67-68. doi:10.1207/S15326985EP3502_1

Benbow, C., & Stanley, J. (1996). Inequity in equity: How "equity" can lead to inequity for high-potential students. *Psychology, Public Policy, and Law, 2*(2), 249-292.

Birinci, K., Seyihoglu, A., Sezen, G., & Tekbiyik, A. (2011). Evaluation of a science camp: Enjoyable discovery of mysterious world. *Educational Sciences: Theory and Practice*, 1602-1607.

Bliuc, A., Ellis, R. A., Goodyear, P., & Hendres, D. M. (2011). Understanding student learning in context: Relationships between university students' social identity, approaches to learning, and academic performance *European Journal of Psychology of Education, 26*(3), 417-433. doi:10.1007/s10212-011-0065-6

Clark, B. (2002). *Growing up gifted* (6th ed.). Upper Saddle River, NJ: Pearson Education.

Colangelo, N., Assouline, S., & Gross, M. (Eds.). (2004). *A nation deceived: How schools hold back America's brightest students* (1st ed.). Iowa: University of Iowa.

Colangelo, N. & Davis, G. (Eds.) (2002). *Handbook of Gifted Education* (3rd ed.). England: Pearson.

Cross, T. L., & Coleman, L. J. (1993). The social cognition of gifted adolescents: An exploration of the stigma of giftedness paradigm. *Roeper Review, 16*(1), 37. Retrieved from: http://search.ebscohost.com/login.aspx?direct=true&db=ehh&AN=9511241527&site=ehost-live&scope=site

Davis, G., & Rimm, S. B. (1998). *Education of the gifted and talented* (4th ed.). Needham Heights, MA: Allyn & Bacon.

Foster, J., & Shiel-Rolle, N. (2011). Building scientific literacy through summer science camps: A strategy for design, implementation and assessment *Science Education International, 22*(2), 85-98.

Frost, P. (2005). The CTY summer school model: Evolvement, adaptation and extrapolation at the national academy for gifted and talented youth (England). *High Ability Studies, 16*(1), 137-153. doi:10.1080/13598130500115379

Goodnow, C. (1992). Strengthening the links between educational psychology and the study of social contexts. *Educational Psychologist, 27*(2), 177. Retrieved from: http://search.ebscohost.com/login.aspx?direct=true&db=ehh&AN=6370698&site=ehost-live&scope=site

Hany, E.A. & Grosch, C. (2007). Long-term effects of enrichment summer courses on the academic performance of gifted adolescents. *Educational research and evaluation, 13 (6)*, 521−537.

Hébert, T. P. (2002). Educating gifted children from low socioeconomic backgrounds: Creating visions of a hopeful future. *Exceptionality, 10,* 127-138.

LUMA. (2014). Millennium youth camp. Retrieved 2/14, 2014, from: http://www.helsinki.fi/luma/english/millennium-youth-camp

McInnis, C. (2001). Researching the first year experience: Where to from here? *Higher Education Research & Development, 20*(2), 105-114. doi:10.1080/07294360120064376

Pike, G., Schroeder, C., & Berry, T. (1997). Enhancing the educational impact of residence halls: The relationship between residential learning communities and first-year college experiences and persistence. *Journal of College Student Development, 38*(6), 609-621.

Renzulli, J. S., & Reis, S. M. (1997). *The schoolwide enrichment model: A how-to guide for educational excellence.* Mansfield Center, CT: Creative Learning Press.

Rimm, S. B., & Rimm-Kaufman, S. (2001). *How Jane won: 55 successful women share how they grew from ordinary girls to extraordinary women.* New York: Crown Publishing Group.

Rogers, K. B. (2007). Lessons learned about educating the gifted and talented: A synthesis of the research on educational practice. *Gifted Child Quarterly, 51,* 382-396.

Rosser, S. (2000). *Women, science, and society*. New York: Teachers Collage Press.

Schenkel, L. A. (2002). Hands on and feet first: Linking high-ability students to marine scientists. *Journal of Secondary Gifted Education, 13*, 173-91.

Subotnik, R. F., Olszewski-Kubilius, P., & Worrell, F. C. (2011). Rethinking giftedness and gifted education: A proposed direction forward based on psychological science. *Psychological Science in the Public Interest, 12*(1), 3-54. doi:10.1177/1529100611418056

Tannenbaum, A. J. (Ed.). (1983). *Gifted children: Psychological and educational perspectives*. New York: MacMillan.

Tirri, K. (2011a).Combining excellence and ethics: Implications for moral education for the gifted. *Roeper Review 33(1),* 59–64.

Tirri, K. (2011b). Holistic school pedagogy and values: Finnish teachers' and students' perspectives. *International Journal of Educational Research, 50,* 159-165.

Tirri, K. (2012). What kind of learning environment supports learning of gifted students in science? In A. Ziegler, C. Fischer, H. Stoeger & M. Reutlinger (Eds.), *Gifted education as a life-long challenge: Essays in honour of Franz J. Mönks* (pp. 13-24). Lit Verlag: Muenster.

Tirri, K. & Campbell, J (2002). Actualizing mathematical giftedness in adulthood. *Educating Able Children, 6 (1)*, 14-20.

Tirri, K., & Kuusisto, E. (2013). How Finland serves gifted and talented pupils. *Journal for the Education of the Gifted, 36*(1), 84-96.

Tirri, K., Kuusisto, E., & Aksela, M. (2013). What kind of learning is interactive and meaningful to gifted science students? In Tirri, K. & Kuusisto. E. (Eds.) *Interaction in educational domains*. Rotterdam: Sense Publishers.

Tirri, K., & Pehkonen, L. (2002). The moral reasoning and scientific argumentation of gifted adolescents. *The Journal of Secondary Gifted, 13*(3), 120-129.

Tirri, K., Tolppanen, S., Aksela, M., & Kuusisto, E. (2012). A cross-cultural study of gifted students' scientific, societal, and moral questions concerning science. *Education Research International, 2012*, 1-7.
Tolppanen, S., & Aksela, M. (2013). Important social and academic interactions in supporting gifted youth in non-formal education. *LUMAT, 1*(3), 279-298.
Vartiainen, J., & Aksela, M. (2012). The principles and practices of teaching and learning in finnish schools. In H. Niemi, A. Toom & A. Kallioniemi (Eds.), *Miracle of education* (pp. 263-272). Rotterdam: Sense Publishers.
Zhao, C., & Kuh, G. D. (2004). Adding value: Learning communities and student engagement *Research in Higher Education, 45*(2), 115-138. doi:10.1023/B:RIHE.0000015692.88534.de

About the Author

Sakari Tolppanen is a doctoral student in the Unit of Chemistry Teacher Education, Deparment of Chemistry, University of Helsinki. He is also the coordinator of the International Millennium Youth Camp. His main research interests are non-formal education, education for sustainable development, and moral education.

Dr. Kirsi Tirri is a Professor of Education and Research Director at the Department of Teacher Education at the University of Helsinki, Finland. She is the Chair of Doctoral Programme SEDUCE (School, Education, Society and Culture). She is also a visiting scholar with the Stanford Center on Adolescence, USA. Tirri has been the President of ECHA (European Council for High Ability) for the years 2008-2012 and the President of the SIG International Studies at AERA (American Educational Research Association) for the years 2010-2013.

Addresses

Sakari Tolppanen
The Unit of Chemistry Teacher Education, Department of Chemistry,
University of Helsinki,
P. O. Box: 55, FIN-00014,
Finland.

e-Mail: sakari.tolppanen@helsinki.fi

Kirsi Tirri
Department of Teacher Education,
University of Helsinki,
P. O. Box: 9, 00014,
Finland.

e-Mail: ktirri@helsinki.fi