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NISSEL ORLY

HARNESSING OF THE "NEW STUDY PROGRAM IN SCIENCES" FROM GENDER PERSPECTIVE IN ISRAEL

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Scientific advisor: **Bodrug-Lungu Valentina**,
Doctor Habilitatus in Pedagogics, Associate Professor

Author: **Nissel Orly**

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NISSEL ORLY

VALORIFICAREA „NOULUI PROGRAM ÎN ŞTIINŢE” DIN PERSPECTIVA DE GEN ÎN ISRAEL

Specialitatea 531.01 – Teoria generală a educaţiei

Teză de doctor în pedagogie

Conducător ştiinţific: **Bodrug-Lungu Valentina,**
doctor habilitat în pedagogie, conferenţiar universitar

Autor: **Nissel Orly**

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ADNOTARE

Nissel Orly, "Valorificarea noului program în ştiinţe din perspectiva de gen în Israel", Teză de doctor în pedagogie, Chişinău, 2016

Structura tezei: introducere, trei capitole, concluzii generale şi recomandări, bibliografie din 213 de surse, 10 anexe, 141 pagini de text de bază, 39 figuri, 9 tabele. Rezultatele au fost reflectate în 9 publicaţii ştiinţifice.

Cuvinte cheie: dimensiunea de gen, diferenţa între fete şi băieţi, sensibilitatea de gen, abordarea integratoare de gen; ghidarea în carieră sensibilă la gen; motivarea/încurajarea fetelor, clasa de excelenţă (de rezervă) ştiinţifică şi tehnologică, diplomă de promovare şi calificare ştiinţifico-tehnologică, noul program în ştiinţe şi tehnologii în Israel, şcoală „prietenoasă la gen".

Domeniul de studiu: Teoria generală a educaţiei

Scopul cercetării constă în fundamentarea teoretică şi praxiologică a metodologiei de valorificare a noului program în ştiinţe din perspectiva de gen în instituţiile de învăţământ din Israel.

Obiectivele cercetării: analiza evoluţiei programelor de studii în ştiinţe din Israel în contextul dimensiunii de gen; stabilirea conexiunilor dintre programul de studii în ştiinţe, dimensiunea de gen şi performanţele elevilor; determinarea valenţelor formative a noului program de studii în ştiinţe în vederea valorificării dimensiunii de gen; elaborarea metodologiei de valorificare a noului program de studii în ştiinţe axate pe dimensiunea de gen; validarea experimentală a metodologiei de valorificare a noului program de studii în ştiinţe în vederea realizării dimensiunii de gen.

Noutatea şi originalitatea ştiinţifică a cercetării este asigurată prin: determinarea tendinţelor în dezvoltarea curriculumului şcolar în plan istoric şi de gen; identificarea factorilor şi condiţiilor de valorificare a noului program de studii în ştiinţe din perspectiva de gen; stabilirea potenţialului şi a valenţelor formative a noului program de studii în ştiinţe, în vederea realizării dimensiunii de gen în cadrul procesual; elaborarea Metodologiei de valorificare a noului program de studii în ştiinţe din perspectiva de gen axate pe Abordarea constructivistă de învăţare, Modelul instructiv de încurajare a elevelor în ştiinţe şi tehnologii, Profilul învăţătorului de excelenţă sensibil la gen, Modelul instructiv pentru părinţi.

Problema ştiinţifică soluţionată în cercetare rezidă în fundamentarea teoretică şi praxiologică a metodologiei valorificării noului program de studii în ştiinţe şi tehnologii din perspectiva de gen asigurînd diminuarea stereotipurilor şi prejudecăţilor de gen cu referire a disciplinele respective, dar şi eficientizarea performanţelor elevilor.

Valoarea teoretică a cercetării: dezvoltarea teoriei curriculumului educaţional prin introducerea dimensiunii de gen în unităţile/disciplinele în ştiinţe prin integrare, fuzionare şi completare a componentelor structurale ale domeniilor respective; conceptualizarea dimensiunii de gen cu referire la valorificarea noului program de studii în ştiinţe şi tehnologii; modelarea teoretică şi praxiologică a metodologiei de valorificare a noului program de studii în ştiinţe şi tehnologii din perspectiva de gen; dezvoltarea conceptului de ghidare în carieră a fetelor şi băieţilor în cadrul studierii disciplinelor reale /în ştiinţe şi tehnologii prin descoperirea abilităţilor proprii pentru profesiile legate de ştiinţe şi tehnologii.

Valoarea practică a cercetării: Metodologia de valorificare a noului program de studii în ştiinţe din perspectiva de gen reprezintă un demers validat prin experiment, fiind util pentru eficientizarea activităţilor instructiv-educative din instituţiile de învăţământ, a relaţiei profesor-elev-familie. Rezultatele cercetării sînt adresate şi pot fi de real folos cadrelor didactice, supraveghetorilor, formatorilor, părinţilor şi altor persoane interesate de domeniu.

Implementarea rezultatelor ştiinţifice s-a efectuat în două şcoli în clase de excelenţă (de rezervă), din Ierusalem, în care cercetătoarea activează în calitate de cadru didactic şi ca formator şi au fost prezentate instructorilor şi managerilor în ştiinţă, prin comunicări la conferinţe ştiinţifice naţionale şi internaţionale, publicaţii ştiinţifice etc.

АННОТАЦИЯ

Ниссель Орли, "Реализация новой программы точных наук в гендерной перспективе".
Диссертация на соискание ученой степени доктора педагогических наук, Кишинэу, 2016

Структура диссертации: введение, три главы, выводы и рекомендации, библиография из 213 источников, 10 приложений, 141 страниц основного текста, 39 фигур, 9 таблиц. Результаты отражены в девяти научных публикациях.

Ключевые слова: гендерный подход, различия между девочками и мальчиками, гендерная чувствительность, гендерно чувствительная профориентация, мотивация / поощрение девочек, передовые классы (резервов) в области наук и технологии, степень научно-технической квалификации и продвижения, новая программа в области наук и технологии в Израиле, школа дружественная "гендеру".

Область исследования: Общая теория воспитания.

Целью исследования является теоретическое и методологическое обоснование методологии реализации новой программы в области наук в гендерной перспективе в учебных заведениях в Израиле.

Задачи исследования: анализ эволюции учебных программ в Израиле в контексте гендерного измерения; определение взаимодействия между программой в области наук, гендерным измерением и успеваемостью учащихся; определение формирующих составляющих новой программы в области наук с целью включения гендерного измерения; разработка и экспериментальное апробирование методологии реализации новой программы в области наук в гендерной перспективе.

Научная новизна и оригинальность исследования заключается в: определении тенденций в развитии школьной программы в историческом и гендерном разрезе; выявлении факторов реализации новой программы в области наук в гендерной перспективе; определении потенциала и формирующих составляющих новой программы в области науки с целью включения гендерного измерения; разработке Методологии реализации новой программы обучения в области наук в гендерной перспективе, сфокусированной на: Конструктивистский подход к обучению, обучающую Модель поощрения студенток в области наук и технологии, Профиль гендерно чувствительного учителя передового класса, обучающую Модель для родителей.

Научная проблема, решенная в данном исследовании заключается в: теоретическом и методологическом обосновании методологии реализации новой программы обучения в области наук и технологии в гендерной перспективе, обеспечивающей снижение гендерных стереотипов в отношении соответствующих наук, а также повышении эффективности успеваемости учащихся.

Теоретическая значимость исследования: развитие теории образовательного куррикулума посредством включения гендерного измерения в точные предметы путем интеграции, слияния и заполнения структурных компонентов; концептуализация гендерного измерения реализации новой программы в области наук и техники; теоретическое и практическое моделирование методологии реализации новой программы в области наук в гендерной перспективе; разработка концепции профориентации девочек и мальчиков в рамках изучения точных предметов / науки и технологии посредством раскрытия персональных навыков для профессий, связанных с наукой и технологией.

Практическая значимость исследования: Методология реализации новой программы обучения в области наук в гендерной перспективе представляет подход подтвержденный экспериментально, необходимый для улучшения образовательной деятельности образовательных учреждений, отношений учитель-ученик-семья. Результаты исследования могут быть полезными учителям, тренерам, родителям и другим заинтересованным людям.

Внедрение результатов исследования было проведено в двух школах в передовых классах Иерусалима, где исследовательница работает в качестве преподавателя и в качестве тренера, и были представлены тренерам и менеджерам в сфере наук, посредством докладов на научных национальных и международных конференциях, научных публикациях и т.д.

ANNOTATION

Nissel Orly, "Harnessing of the new program in sciences from gender perspective in Israel",
PhD Thesis in Pedagogy, Chisinau, 2016.

The research includes introduction, 3 chapters, conclusions and recommendations, bibliography – 213 titles, 10 appendixes, 141 pages of main text (until Bibliography), 39 figures, 9 tables, 9 publications on doctoral thesis.

Key words: gender dimension, gap between boys and girls, gender sensitivity, gender mainstreaming; gender-sensitive career guidance; motivation / encourage girls; scientific technological reserve class, quality scientific-technological matriculation diploma, the new program in science and technology in Israel, "gender friendly" school.

The study field: General Theory of Education.

The aim of the research is setting of the theoretical and praxiological foundation of the Methodology of implementation of the new program in sciences from a gender perspective in educational institutions in Israel.

Objectives: analysis of the evolution of studies programs of Israel in the context of gender; establishing of connections between the curriculum in science, gender and students' achievements; determining of the training components of the new science program of study aimed at integration of a gender dimension; experimental validation of the methodology of implementation of the new program in science from a gender perspective.

The scientific novelty of the research relies in the identification of tendencies of the school curriculum development from a historical and gender perspective; identification of factors and conditions related to the implementation of the new program in science from a gender perspective; determining of the perspectives and training components of the new program in science for integration of gender in the process; development of a Methodology to implement the new program in science from a gender perspective focused on: a Constructivist approach to learning, a Instructional Model to encourage girls students in science and technology, a Profile of excellent teacher who is gender-sensitive, a Instructive Model for parents.

The scientific problem solved in this research consists in setting of the a theoretical and methodological foundation of the Methodology of implementation of the new program in sciences from a gender perspective, reducing of gender stereotypes related to these subjects, and improving of students' achievements.

Theoretical value of the research: the development of theory of educational curriculum by mainstreaming of a gender dimension in units / subjects in science through the integration, unification and and completion of the structural components of these areas; conceptualization of gender perspectives in the new program in sciences and technology; theoretical and praxiological modeling of the methodology of implementation of the new program in sciences and technology from a gender perspective; developing the concept of career guidance to girls and boys in science and technology by discovering their skills for professions related to science and technology.

Practical value of the research: The Methodology of the implementation of the new program in sciences from a gender perspective is an approach validated by experiment, is useful for improving educational activities of educational institutions, the relationship teacher-student-family. The research results are addressed and can be of real use for teachers, supervisors, trainers, parents and others interested in the field.

The implementation of the scientific results: was conducted in two schools in scientific technological reserve class in Jerusalem, where the researcher works as a teacher and as a trainer and were presented to trainers and managers in science, through papers at scientific national and international conferences, scientific publications, etc.

LIST OF ABBREVIATIONS

1. "ALMA" – Hebrew initials for "encouragement of sciences".
2. CLASES STRC – Scientific technological leadership reserve classes or Reserve for scientific technological leadership
3. E.L.T – Evaluation, Learning, Teaching.
4. IEA – international organization for assessment of education achievements.
5. KYTKE – Finland into the information society. Project in Finland in technology and entrepreneurship.
6. LSS – Learning Skills for Science.
7. "MABAT" – program Science in Technological Society.
8. "MAMASH"- Hebrew for TLC- Teachers Leads a Change.
9. "MEIZAV" – National tests in class 8^{th}
10. OECD – Organization for Economic Co-operation and Development.
11. OFSTED – Office for Standards in Education.
12. P.E.O.E – strategy: P-predict E- explain O- observes E-explain.
13. PISA – Program for International Student Assessment.
14. QCDA – Qualification and Curriculum Development Agency.
15. "RAMA" – Hebrew for name- National Authority for Measurement and Evaluation.
16. SEGT – School Efficiency and Growth Tests.
17. S.T.S – Sciences, Technology, Society
18. TIMSS – Trends in International Mathematics and Science Study.

INTRODUCTION

"Very few girls apply presently, to technological study courses, and not just in Israel, it is a huge human resource. I believe that a country that finds a way to introduce more girls to the high-tech industry would be the first one to have an economic breakthrough and would rapidly advance technological education within it. In a visit to a High-school where electronics department was opened, I asked one of the girls what field she would want to work in, in the future. Her answer was, "electronics engineer". You don't see that a lot. Those girls can be definitely educated for a technological future. The idea is to arouse curiosity in them from an early age, so that they find the magic and beauty in technological subjects" [158].

The actuality and the importance of the problem addressed

Against the background of the political and socio-economic contemporary transformations, major changes of human habitat occur, affecting values and human relationships, determining daily life and behaviour of women and men. International studies show a direct connection between sustainable economic development and women's empowerment [18].

We stress attention on Israeli researches position that „Modern Israel continues to be far from progressive here the status of women is concerned. At the beginning of the twenty – first century, it is more conservative than most other Western Democracies on women's issues". Despite significant achievements and a high level of education, Israeli women continue to earn less than their male counterparts, are less visible and influential in the political arena, do not share equal responsibilities or privileges in the military, have unequal rights and freedom in family life, and are secondary in shaping the nation's cultural orientation. This inequality results, in significant part, from entrenched attitudes about women's appropriate roles in Jewish tradition in general, the influence of ultra-Orthodox Judaism on the larger society, and the impact of conservative Middle Eastern cultures on many Israelis from Muslim countries. One consequence of Israel's emphasis on national security is that „women's issues", particularly on areas on health, education, and welfare, have received low priority (Judith R. Baskin, 2013 [74]).

We note that, in the last few decades, several discussions have been held referring to the importance of engaging girls in science and technology and creating conditions and modalities of learning, which would result in attracting more girls to study and practice science [7; 67; 97]. Several researchers invoke the necessity to strengthen gender equality and eliminating educational institutions barriers, noting the significant under-representation for girls and women in mathematics, science and technology in schools and on the labour market, indicate as

determinants: stereotyped attitudes, "gender neutral" school practices, and social conditions while, maintaining traditions, reproduce stereotypes etc. [7; 154].

Meanwhile, the problem of access and participation of women and girls to education, training in science and technology is still one of the priority themes of international organizations. The strategic documents, outlining global policy on gender equality, for example the Beijing Platform for Action, the Resolutions S-23/2 and S-23/3 of the UN General Assembly, etc., include several references to science and technology. The UN Secretary General recognized, within the 55th session of the Commission on the Status of Women (2011), that providing opportunities for women to gain knowledge and scientific and technical skills is also an economic imperative [16].

To compete successfully in the global economy, countries need to develop the potential of all citizens, governments must ensure men and women equal opportunities in order to develop appropriate skills and their exploration. Given that high technology industries in Israel are the locomotive of economic growth and these require a quality personnel, for Israel is important to strengthen the teaching of science disciplines in order to qualify citizens, men and women, thus ensuring the functioning of the whole society.

However, as part of the second international study (1980-1989), in Israel, differences in the boys and girls results, from the 8th grade, have been identified, all in favour of boys. Israel could lose its relative socio-economic advantage in time, if there are no interventions in education.

In this context, these factors, together with other factors, led to the development, by the Ministry of Education in Israel, of a new program (curriculum) to improve academic achievement in science and technology. The program was aimed to redender more efficient the performance of students of excellence class (the reserve), pursuing the purpose of achieving a 20% eminent students, girls and boys in nine years [64; 156].

In implementing the program, in parallel with the progress, the existence of several limitations were observed, determined also by gender stereotypes. Thus, many teachers were faced, from the beginning, with difficulties in valuing gender issues regarding the teaching process, the attitudes and valuation of girls and boys, during the lessons. The following limitations were mentioned: insufficient involvement/ motivation of girls to science and technology, the parents reluctance in guiding the girls to the referred discipline, the lack of gender-sensitive technology of teaching-learning/organizing extracurricular activities.

Therefore, a contextualized approach to the perspective/gender dimension in the context of the new program (curriculum) in science is important both for meeting the challenges of the education system, as well as to improve the performance of boys and girls in science and technology.

Description of the situation in research and identify research problems. Concept of gender harnessing in education is actively discussed worldwide. However, its practical implementation is determined by socio-cultural and political context of each country, taken separately. We join the position of the researcher Bodrug-Lungu from Moldova, stating that, its establishment as a scientific field can be conceived only in the context of gender issue development in general and in particular, in psycho-pedagogical science [1; 6].

In Israel, as in other countries, including Moldova, gender studies have gone through several stages of formation and development. Conventionally, works dedicated to gender equality in Israel can be classified as follows:

a) General publications, with theoretical and practical approaches to the topic/policy analysis and documents addressed to ensure gender equality: P.Steinberg [172; 173], H.Tzameret-Kertcher, Y.Basin, O.Glybchenco [185; 186]; N.Teshner [182] etc. Among researchers who explored the gender / women's issues we can mention: Judith R. Baskin [74]; M.S.Rich (women Holocaust survivor); N.Graetz (Gender and Judaism); I.Umanit (violence against women as result of gender inequality & public education) [apud 28], etc.. Also, the publication with focus on Jewish Feminism in Israel (K.Misra and M.Rich, M. Freedman [28]), on Science in Feminism (N.Yanai [193]) can be mentioned.

b) Publications dedicated to education, which lists some additional genders elements: M.Barak, Y.Ofarim [72], J. Head [27] etc.

c) Publications where gender aspects of education in science and technology are researched: V.Lavy and E.Sand [126], S.de Cheveigné [86], A.Baram-Tsabari and A.Kaadni [73], C.C.Miller [38], H.Ayalon [62], Y.Fridler, P.Tamir [99], P.Tamir [179], S.Bachar [67], O.Nissel [39-46] etc. Authors H.Hanson [25], S.Harding [26], J.Kahle [29] focused attention on women in sciences. A.Zohar, D.Sela analyzed gender issues in Israeli advanced placement physics classes [202].

We note the appearance of works that explores Judaism doctrine in the light of gender. However, beyond the attention paid to the subject of gender equality, gender exploration theme in education is underdeveloped, especially in science and technology. Approach specific of the gender equality topic is strongly influenced by socio-political, cultural and religious context.

In Moldova the gender aspects of education is the focus of several researchers. Thus, the theoretical and methodological foundations of gender education in education institution are analyzed in the works of V.Bodrug-Lungu [1] L.Handrabura [5]; family gender education is

approached by T.Mutu [3]; maternity education researched by N.Ovcerenco [4] etc. The experience in this field has a unique interest for comparative studies.

Internationally, prominent among specialists who have contributed significantly to the development of women's studies / gender studies, reported directly or indirectly to education, to be mentioned: M.Arnot [8; 9], S.Bem [10], E.Capmenni [13], N.Chodorow [15], R.W.Connell [17], A.Eagly, A.Koenig [20; 21],C.Luke, & J.Gore [34], Frances A. Maher [35], E.Maccoby and C.Jacklin [36], D.Ruble, & C.Martin [51], G.Weiner [57], C.Paechter [47], M.Penn [48], J.Sanders [52], C.West, D.Zimmerman [58] etc. Stressing the growing interest of specialists in the gender and education topic, it is noted a shortage of works on the subject of gender equality in education for science and technology.

Gender studies from several countries show that educational institutions are social entities deeply marked by gender rules and stereotypes, which makes gender patterns are very important for the formation and the integration of the individual in society [1; 7]. Traditional cultural models on femininity and masculinity, reproduced by the school through training/education, often put limits on the effective socialization of the young generation.

Considering the above said, it is obvious that education, as a pedagogical phenomenon, and the education system in general, require a re-evaluation of the mentioned contradictions and an adjustment of concepts and methodology related to the introduction of the gender dimension in the school curriculum.

At the same time, we would like to reinforce the ideea that teachers can become agents for the perpetuation of gender-based selection mechanisms or, on the contrary, for social change, and that it is essential to involve schools and the various participants in the education process in promoting gender equality [49].

In the context of the above, it is clear that education, as a pedagogical phenomenon, the educational system in general, require reevaluation of contradictions mentioned above and adjustment of concepts and methodology related to the inclusion of the gender dimension in education of the young generations.

Appreciating the importance of the theoretical and practical research conducted, we can mention, however, that certain aspects of the problem remain still little explored. So, the problem of this research lies in the exploration of new education program in science and technology from a gender perspective in order to improve students' performance.

The aim of the research is theoretical and praxiological foundation of the Methodology of implementation of the new program in science from a gender perspective in educational institutions in Israel.

The research objectives:

1. To analyze the evolution of the science programs in Israel, in the gender context.
2. To establish the connections between the curriculum in science, gender and students' performance.
3. To determine the training components of the new science program in order to integrate the gender dimension.
4. To develop the Methodology of implementation of the new program in sciences from a gender perspective.
5. To experiment and validate the Methodology of implementation of the new program in sciences focused on gender achievement.

Research methodology includes: theoretical methods (scientific documentation, comparative analysis, generalization, systematization); empirical methods (questioning, observation, pedagogical experiment); mathematical and statistical methods of data processing.

Scientific novelty and originality of the research lies in:

1. Determine trends in the development of school program (curriculum), on a historical level: prioritization of science and technological disciplines based on objectives, diversification of teaching-learning methodology, motivation and stimulation of the interest in learning.
2. Identifying the determinants factors of implementation of the new program in science from a gender perspective: insufficient motivation of students to study science and technology, the discrepancy concerning the attitude of boys and girls to science and technology, low level of professionalism of teachers in guiding girls and boys into learning the subjects in question.
3. Establishing pedagogical opportunities of the new science program in order to achieve gender's procedural framework: individualization and diversification objectives, complementing the subjects/learning units with specific and motivating information for girls and boys, orientation towards active/interactive and cooperative learning.
4. Developing the Methodology of implementation of the new program in science from a gender perspective, focused on: a Constructivist approach to learning, Instructional Model to encourage girls students in science and technology, a Profile of excellent teacher who is gender-sensitive, a Instructive Model for parents.

The scientific problem solved in the investigated area lies in the theoretical and praxiological Methodology of implementation on the new program in science and technology from a gender perspective, ensuring the reduction of gender stereotypes and prejudices with regard to the respective disciplines, but also, ensuring the efficiency of students' performance.

The theoretical significance is provided by:

- Developing educational curriculum theory by mainstreaming of gender dimension in the units/disciplines in science through integration, merger and complement of the structural components of the respective areas.
- Conceptualizing gender dimension in implementing the new program in science and technology, focusing on preventing and overcoming the stereotypes and prejudices of gender, related to attitudes and learning of disciplines in science and technology by girls and boys, and ensuring the students success and performance.
- Theoretical and praxiological modelling of the methodology of implementation of the new program in science and technology from a gender perspective: constructivist approach, curricular approach, technology approach in interaction with gender.
- Developing the concept of career guidance for girls and boys within the science and technology study of real disciplines by discovering and developing their personal skills for professions related to science and technology.

The main scientific results submitted for defense:

1. Gender prioritization, within the implementation on the new program in science and technology, is determined by socio-cultural, economic and educational environment in Israel, as well as trends in educational policies connected to gender equality.
2. Making the connection between the "new science program", gender and teaching strategies is a prerequisite and important factor: 1) learning motivation for girls and boys, 2) reduction of gender stereotypes and prejudices in teaching-learning-assessment in science and technology disciplines, 3) career guidance for girls and boys, 4) obtaining higher academic results.
3. The Methodology of implementation of the new program in science and technology from a gender perspective is a paradigmatic construct consisting of components / patterns in interaction: theoretical component - constructivist approach; curricular component – gender integration; educational component - strategies to encourage girls students, students activity strategies, students advancement strategies; community component - including the family; psychological component - providing success.

4. Developing the Methodology of implementation of the new program in science and technology from a gender perspective is conditional upon: the preparation/special training of teachers, but also the creation of psychological conditions and effective communication in educational institutions.

Implementation of scientific results. Implementation of research results was done on the basis of experimental research; through notes at international conferences, scientific publications, practical activities. Experiment finding was conducted on a sample of 93 students. The formative experiment involved 54 students - 29 boys and 25 girls from reserve class in science and technology, of two junior high schools from Jerusalem (the experiment being carried out over three years). Also, activities were conducted, involving 10 teachers from science profile classes and 5 managers. The research results are implemented in some educational institutions in Israel, were included in the program of teachers training. Some conceptual and praxiological benchmarks of the subject were reflected in 9 publications (including 2 in Israel), being presented in 4 international conferences.

Approval of scientific results. Basic dissertations of ongoing research and conclusions are reflected in scientific articles and notes presented at the national and international scientific conferences in Israel and Moldova: International Scientific Conference "*Modern School: Challenges and Opportunities*", 5 to 6 November 2015, the Education Sciences Institute, Chisinau; the International Science Conference *Education efficiency - vector of modern educational policies*, 11 to 12 December 2014, the Science Education Institute; International Scientific Conference *INTEGRATION THROUGH RESEARCH AND INNOVATION*, 28-29 September 2013, Moldova State University etc. The results were presented at the teachers Congress dedicated to science teaching, which took place in the Pisga centre in Jerusalem; Annual's Congress of junior high school Teddy Kolek in Jerusalem and within a meeting of teachers trainers at a meeting of Jerusalem district.

Summary of thesis components

The paper consists of introduction, three chapters, conclusions and recommendations, bibliography and appendices.

In the Introduction, the timeliness and the importance of the research topic is substantiated, the research issue is brought up and the solution alternative proposed, the purpose and the objectives are specified, the epistemological benchmarks of the research, the application and scientific value of the research is presented, confirming the theoretical and methodological novelty and scientific originality of the investigation.

Chapter 1, "Theoretical references of the evolution of the program in sciences", provides a theoretical synthesis regarding the historical and conceptual evolution of the program (curriculum) in science in Israel, outlining key periods and explaining the progress and the limitations within the education system.

This chapter includes a comparative analysis of the science study programs in Israel, the UK and Finland. Research of national and international practices in this area was necessary, serving as a reference framework of our concerns to the implementation of the program (curriculum) in science and technology from a gender perspective. At the same time, we come up with an overview of science education evolution over the years; of three basic approaches to gender equality in science and technology education, as follows: "gender neutral" education, "women friendly" and "gender-sensitive".

Chapter 2, "Theoretical and methodological approaches of the "new program in sciences" from a gender perspective", is focused on the analysis of the new science program. We invoke new categories such as scientific promotion diploma and the structure of the reserve class in science and technology, observing the way of teaching sciences and advanced technologies in Junior High School, with particular focus on gender - involving boys and girls. Theoretical approaches in learning are presented: constructivist approach, Bloom's taxonomy model, gender-sensitive career guidance/ gender based approach. The study covers boys and girls education, exploring several aspects. This is why we have presented and developed some basic concepts: *the gender education perspective in science, gender-sensitive career guidance*, *gender sensitive education in science, gender sensitivity of teachers etc.*

We elaborated and validated the Methodology of implementation of the new program in science from a gender perspective includes: Constructivist approach to learning, Instructional Model to encourage girls students in science and technology, a Profile of excellent teacher who is gender-sensitive, a Instructive Model for parents.

Chapter 3, "Experimental approach to improve the performance of boys and girls based on the new program in sciences", proposes an experimental approach to verify the hypothesis that states that the connection between "new program in sciences", gender and teaching strategies is an important factor, namely: learning motivation in science for girls and boys; diminishing gender stereotypes in learning science and technology disciplines; career guidance for girls and boys, developing methodology that will contribute to achieve the highest academic results/ girls and boys advancement in science and technology.

Meanwhile, based on national statistics it is ascertained the improvement of students' results in science, following the implementation of the new science and technology program in high

schools. We note that organizing multiples gender awareness activities for the girls students, teachers and parents contributed to the creation of a unique favourable environment (gender friendly), motivating, especially girls, to study science. Thus, by applying the strategies reflected in the Instructive Model to encourage girls students in science and technology, the motivation and active involvement of girls in science (especially physics) was achieved, opening them more to science as a field of professionalization in the future.

The main research findings show that:

1. As a result of the activities, the students' attitude towards the advancement of science in future changed; the interest in science of boys and girls increased.
2. Since the program began in 2009, the students' achievements in the discipline of science in Israel increased. The gender gap between boys and girls was reduced.
3. The study confirmed that children, especially girls, whose families offer support, including emotional support, demonstrate increased interest and achieve greater success in school.
4. Inclusion of gender dimension in the "new science program", expressed in the application of gender-sensitive strategies, it is an important condition in order to improve academic performance in high school

Conclusions and recommendations summarize the theoretical concepts with reference to the results of the experimental research conducted, recommendations and suggestions for further research.

We note that the connection between "new program in sciences", gender and teaching strategies is an important factor of motivating girls and boys to learn, of diminishing gender stereotypes and prejudices in learning science and technology disciplines, education and career guidance for girls and boys, obtaining higher academic results/ diminishing the differences in scores of boys and girls in learning.

In light of this, recommendations are drawn for three levels, at decision-makers level and at the educational institutions level, as well as at family level in order to ensure progress towards effective maximal utilization of gender sensitive educational strategies.

The research opens new horizons for comparative studies of educational strategies through gender prism in various studies' fields at national and international levels.

I. THEORETICAL REFERENCES OF EVOLUTION OF THE SCIENCES PROGRAM

1.1 Development of sciences' program in Israel – changes in purposes, contents and teaching methods

1.1.1 Evolution of sciences' program: historical perspective

The state of Israel was founded in 1948, and exists for 67 years. The education system is the state of Israel was and still is based upon purposes and challenges of the organizational structure of the "old" settlement, which existed prior to the founding of the state.

In the first years since the founding of the state, the emphasis has been placed on the establishment of primary schools, which almost all Israeli children, ages 6-14, have been attending for eight years. Later on, as there were more and more students in the state of Israel, Tertiary Education schools, attended for 4 years, have been addressed as well.

In the 60's, the focus has been put on school structure. In 1968, the Israeli parliament (the Knesset) has decided upon a change in the educational system's structure. It was determined that primary schools would be attended for 6 years in 1^{st} to 6^{th} grades. The post-primary school would be consisted of 2 stages: 7^{th}-9^{th} grades of Junior High school and 10^{th}-12^{th} grades of High school. In those years, scientists, Ministers of Education and educators have stood up and expressed the need for a fundamental change in the sciences' curriculum. The educational and important value of sciences' subject teaching has been stressed, which qualifies pupils for a life in scientific-technological society while integrating the graduates in the development and prosperity of the state [197].

Concurrent with the structural change, energy has been invested and new contents have been written: new programs and teaching methods, training and qualification of teachers, the structure of schedules and physical infrastructure.

From the 70's and on, the trend of sciences' program (curriculum) is being altered approximately every decade. Occasionally, the change is prominent and significant and at times it is minimal. New ideas are being constantly proposed, teachers perform experiments and adjustment on the ground, evaluation studies are being conducted, new concepts are being proposed regarding teaching and learning processes and a deeper understanding regarding the way pupils learn and assimilate scientific terms is being acquired. All these result in a different phrasing of purposes, contents and teaching methods specifications, to the length of formulation of a new study program. The sciences' curriculum is being shaken and tossed by each approach, changes its structure and teaching-learning processes over and over. Five periods can be observed in the

changes of conceptual approaches and trends in sciences' curriculum. Changes in the trend can be tracked throughout the years, according to the considerations affecting the design and formulation of the study program: pupil's needs, society's needs and study subject needs. In the different periods, each of these sources has been given a different value in determining the character of the science subjects. It is worth mentioning that the needs of society and the pupil are not set and undergo constant changes [39; 45].

Thus, the essence of science, its fields of involvement and the meaning of innovations and discoveries to the life of an individual and the society can be understood. All these, in different constellations and values determine the conceptual approach regarding subject's character and methods of teaching it.

First period – 1948 up to the 60's: "nature studies"

In 1923 (25 year prior to the founding of the state of Israel), a study program was written by the Department of Education of the Zionist management in the Land of Israel. Society's need was the main affecting factor on the study-educational activity of that time. The publication of a new study program for all teaching subjects in the school was legislated in the Knesset in 1953. The Minister of Education of those times, prof. Zion Dinur said that: "… the study program will be based on the values of Israeli culture, scientific achievements, patriotism, loyalty to the state, training in agricultural and craft work, pioneers' training, aspiration for a society built on freedom, equality, tolerance, mutual assistance and love for a fellow man …" (State Education Law, 1953) [88]. This means that in the first study program formulated in the state of Israel, the focus was put on the emerging Israeli society and its needs integrated with the needs of a pupil. The program was called "Nature and Agriculture Program". Science studies were called "nature studies" or "nature knowledge". The term "nature" had two meanings: the first: the nature of homeland, flora and fauna; the second: general science, meaning a combined study of the subjects of biology, chemistry and physics in their practical aspect for an individual, the society and the state.

The first purpose was the supplying of children with knowledge of the regularity of natural phenomena, observational methods and scientific thinking.

Additional purposes:

- Instilment of knowledge for working in agriculture.
- To plant in their heart an intimate feeling towards a plot of land … a desire to work in agriculture … pioneer fulfillment in the establishment of homeland and manufacturing in the state of Israel.

- Recognition of agriculture as the primary factor for nation's economy … primary means for the resurrection of our people as a healthy nation in its land.

The state-religious education has added three additional items:

- Stressing the fact that nature is God's creation, to educate them to feel the harmony of nature.
- To develop affinity for all men and living creatures, an emotion that would prevent the suffering of animals and destruction of plants.
- To evoke a desire for familiarizing with all creatures of Creation … and the rules set by God (State Education Law – the purpose of education, 1953) [88].

Despite the clear and pinpointed wording of the first item "regularity and observational methods and scientific thinking", it is not prominent enough in the content specifications of the various grades program. The focus of study activity was around the phenomena of nature related to weather and seasonal climate changes. The program includes a long list of animals a child has to be familiar with. Amongst these subjects, the agricultural subjects such as: the garden, the hen, the poultry coop, the sheep, the bread, the dairy barn, etc., have been integrated.

In 1^{st}-4^{th} grade, there was practically no addressing of the physical sciences subjects. In 5^{th}-8^{th} grades the general purpose remained to be: the training of a pupil for preservation of the nation in its homeland. An attempt was made in systematic and focused studying – man and its basic needs: food, shelter, cloths and health. The program has presented the pupil with information from the world of science related to the conquest of nature and control of its forces with the purpose of improving the living conditions of man and country. The relation to flora and fauna was theoretical. 70% of the contents were from the fields of general biology and human biology, and the rest of them – physics and chemistry, as a background for subjects related to human needs [196; 195].

The books were written privately, on the most part by experienced teachers. There have not been official study programs in existence in those times, for scientific subjects' curriculums in High school. Matriculation exams programs have been published from time to time. In 1957, general purposes for sciences' curriculum were published. Studies in High school were, on the most part, frontal studies of facts and laws. The laboratory has not been a part of the study and has carried the nature of authorization laboratory.

Second period – from mid-60's till early 80's – "Revolution in the world of sciences"

About 10 years since the foundation of the state of Israel, a feeling of dissatisfaction with the nature and sciences program for primary and High schools has increased. Concurrently, a

discontent has developed in the Western world regarding sciences' curriculum. As a result, the best scientists and educators have taken the task upon themselves. A revolution in sciences' curriculum has occurred in Israel. It has begun in the 60's (following Russians' success with the launch of the first "sputnik" to outer space and the waking up of people to the change of sciences' study curriculum in USA), and its repercussions are recognized until this day. We are talking about the integration of senior scientists in the field of teaching and the establishment of institutions for improvement and support of sciences' curriculum.

The late 50's and early 60's were characterized by scientific-technological progress. In their research studies, scientists have open new avenues and frontiers in regards to every human being. This condition has brought the scientists to assuming further responsibilities and to realizing the immense impact they have upon a citizen's life. Since the mid-60's, the construction of study programs and study materials has moved to the hands of professional educators who have undergone special training for that purpose. The highlight of the reform, by the initiative of the scientists, was the establishment of institutions for improvement and support of sciences' curriculum: the Sciences' Curriculum Promotion Committee, the Israeli Center for Sciences' Curriculum, the University departments of sciences' curriculum, Science Oriented Youth and others. Scientists have been involved in the Sciences' Curriculum Promotion Committee in post primary schools. 10 professors from different subjects of science have served as members of that committee. Its duty was the examination of study programs in High schools, the condition of curriculums, teaching methods, study materials and teachers' specialist trainings. The committee has got the impression that the contents of the old program fit the spirit of science from end of 19th century. In that period, the needs of the subject were the essential source for the purposes of the science study program. The focus was put on the structure of knowledge of science subjects. The needs of society and pupils have allegedly been neglected. The science subjects lacked topics that allow for the understanding of the scientific principles of our time. The state was aspiring to reach a financial independence which is supposed to be based upon scientific technological development. Scientific education needs first to stress the "homeland nature", and then the principles of fields of scientific knowledge – thus it bears an important contribution to the needs of a pupil and the society as well.

A program by the name of "Matal" (Hebrew for NSP – Nature Sciences for Pupils) had been developed in primary schools. Orientations of development of general science terminology and of scientific thinking processes in a pupil were especially prominent in that program. Four study

subjects have been developed around the purposes: matter and its states, action and force, the concept of a system and its components and energy and its sources.

With the establishment of Junior High schools, there was a need for training teachers. Programs and standards were set for laboratory classes and equipment. The intention was to have the science classes in laboratories. In order to make the task easier for teachers, kits for teaching of different subjects had been compiles, thus a teacher was able to teach the appropriate kit in the laboratory.

Third period – from early 80's till early 90's – "Science, Technology and Society (STS)"

The revolution taken place between the 60s and the 80's has brought about an impressive development of study programs and materials. The focus was put on knowledge materials; however, the focus on pure science (with no practical aspect) has become radical.

The third period was new to scientific education. Scientific principles were integrated in social technological aspects. A generation of programs has been evolved with focus on investigatory study and familiarity with investigatory ways. However, the accomplishments have not fulfilled the expectations, and the number of pupils turning to science studies in a university has not increased. It turned out that many pupils did not grasp the scientific principles to amount to anything. The lack of relevancy of studied materials to the life of a pupil and his daily routine was apparent. It has turned out that familiarity with "the structure of knowledge" does not ensure a better understanding of matters of the daily life. In research studies on the field of sciences' curriculum in the 70's, it was found that there have been misconceptions amongst pupils. It was found that involvement with principles and methods of research requires a great deal of simplification, so that research according to scientific principles was difficult for many of the pupils. Study materials have been gradually introduced to different populations that have not managed to cope with the ordinary material.

Towards the end of the 70's, books have been published that held in common the fact that scientific and technological concepts studied, bear relevancy to the individual and the society. The principle of theoretical study combined with laboratory activity has not been neglected. The changes have taken place in Israel following the changes in the Western world. The argument was that technological developments following scientific discoveries and moral questions would present the pupils with relevant challenges in science studies. The needs of pupils and society are a source of judgment regarding the character of science studies. This approach is termed STS – Science, Technology and Society. The scientific education in STS contributes to the preparation

of future citizens for taking part in decisions in the matters of: quality of life, environmental conservation versus development, genetic engineering, etc.

The main turning point was in primary schools where the "Mabat" program (Science in Technological Society) was developed, and in Junior High schools where science and technology program was developed. These programs have had a merging of "structure of knowledge" and the needs of pupils and society. The reception of these programs was relatively without difficulties, the transition from "structure of knowledge" to the STS generation was easy. Preparatory activities have been performed, as well as specialist trainings and training systems. The required training equipment has remained practically the same (as opposed to the significant revolution of the transition from "homeland nature" programs to "structure of knowledge". In High school, an approach that each scientific field should be studied as a "pure science" (with no practical aspect) was adhered to [89].

In the 80's, an additional important didactic tool had been added – the personal computer. In its first years, the use of computers was poor and disappointing. They have not managed to have the sense to develop educational software and put the study potential of the computer to use. In the late 80's the trend changed. Open educational software, simulations and data bases were designed. Computers were put into science classes and teachers have undergone specialist trainings in computer's curriculum. Study patterns have consolidated in which computers assist in receiving information from world data bases (internet) and performing on-line research activities, in cooperation with other schools in Israel and around the world. An impressive momentum in computers' usage in sciences' curriculum had appeared to be after the publication of "tomorrow 98" report [136].

Fourth period – from early (90's till the 21st century – "Tomorrow 98"

In 1991, a committee was convened by the Ministry of Education, which duty was to examine what was being done in the scientific technological education and recommend ways of promoting them towards the 21st century. Professor Haim Harari, president of the Weizmann Institute at that time, has headed the committee which was called "tomorrow 98" (published in 1992). It has also included scientists, industrialists, technologists, an IDF representative and a representative from the Ministry of Education. Report's abstract: view of science and technology as a whole, technology as a practical aspect of science and stressing of scientific principles for each pupil in each age group.

Following are some of the recommendations published in above report:

- Science and technology for all: scientific education and scientific thinking has to be instilled in every citizen, every pupil from kindergarten up to High school, including those not doing matriculation exams in courses of science and technology.
- Integration of science and technology studies for pupils who do not choose science or technology subjects in High school.
- Increasing of specialist trainings for science and technology teachers.
- Expanding the use of computers particularly in nature sciences.
- Cultivating of scientific journals, science museums, 2009 [84].

The Harari committee had recommended the use and expansion of the STS approach, to the extent of subjects' merger. Meaning, the cancellation of technology subjects as independent study subjects. Regarding the primary school, there is not much new, the committee has embraced the Mabat program (Science and Technology in the Society). Cancellation of technology and agriculture subjects which previously had been part of the school curriculum. A decision had been made to prepare a new program not essentially different than the previous "Mabat" program, while observing and stressing technological and agricultural aspects. The change in Junior High schools is of significance – the committee had recommended a merger of the subject of science and technology that would be studied over 6 weekly hours for pupils in each Junior High school grades. The new program, written by the committee, is essentially based on the biology, physics and chemistry program from 1988. New topics had been added as well as chapters on technology. The interdisciplinary approach allows for the liberty of constructing related teaching sequences for the teacher. From now on, the "Mafmar" (Hebrew for "supervisor central") will be in charge of the curriculum of the unified subject of "science and technology".

In High school the change is significant in the introduction of a new subject – Metzav (Hebrew for "Science and Technology in Modern Society"). This subject was to be studied in all schools in the theoretical technological courses for pupils who have no intention to continue in a scientific-technological orientation in their studies. In this study program, interdisciplinary subjects are proposed [130]. In the studies, there are integrated opportunities for considerations between values and scientific-technological developments and the development of an ability to sensibly approach decision making curriculum in Israel [196; 194].

1.1.2 Conceptual Approaches -Conceptual Perspective

At 1968 the Junior High school was established. With the establishment of Junior High schools, there was a need for training teachers. Programs and standards were set for laboratory classes and equipment. The intention was to have the science classes in laboratories. In order to make the task easier for teachers, kits for teaching of different subjects had been compiles, thus a teacher was able to teach the appropriate kit in the laboratory.

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In 1996, a curriculum was written in the science subject. Teachers studied advanced studies but not out a compulsory policy but on the basis of a desire to study advanced studies and to accumulate rewards, which are equal to money in salary .The teachers' science staff have written lesson drafts and collections on various subjects according to the character of the group which was formed in every school and according to the interest of the staff. A situation was created that all the schools in the country have taught different subjects, at a different level if any (There were schools that did not teach science at all). The difference was great and the subjects taught were

according to the tendency of the teacher. This is according to the field of knowledge which the teacher has taught and dealt with: biology, chemistry or physics. As a result of the lack of uniformity and from neglect of the subject, which is a reduction of hours and a removal of science from the order of national importance, the grades of the Israeli students both on the national level and also on the international level, have worsened. The achievements in the national and international tests decreased from the high places and lagged far behind the first places. *Prof. Ruth Zuzovski* – a lecturer and researcher in the unit for Research and Assessment in the Ministry of Education, has written articles dealing in the view of a curriculum in sciences, on perspectives of teaching and curricular orientations of experienced and inexperienced teachers [205].

Prof. Ruth Zuzovski has even compiled reactions of students to open questions in science she has investigated and wrote various articles analyzing the way of writing open faulty answers of science pupils in the state of Israel in the national and international examinations as well as what, to her opinion, the state, the education system and teachers should do in order to restore it to its former status [204; 206].

In addition to all the problems in the subject of science it was evaluated that the number of girls who have chosen the subjects of science for matriculation is low in comparing to the number of boys who have chosen these subjects – chemistry, physics, biology, biotechnology, which over the years have become "masculine subjects" [182]. The old programs in science and technology *was not addressed by gender*.

In 2009, following the elections to the government and to the 32nd Knesset, *Gideon Saar* was appointed, on the 31st of March 2009 as the Minister of Education. Gideon Saar has worked to increase the budget of the Ministry of Education by a scope of 3 billion NIS. In this framework the Minister worked towards the reinforcement of the core subjects. Through his actions he has allocated thousands of study hours in mathematics, sciences and mother tongues. As a result of a political change and change in the educational conception in March 2009, the situation has changed regarding the teaching of sciences in Israel. Science subject has become one of the core subjects which are taught compulsorily in all the schools in the country. [117; 162]. This flow chart presented all an explanations for writing the new program of Science and Technology in 2009 (figure 1). More details can be read in Appendix no 1.

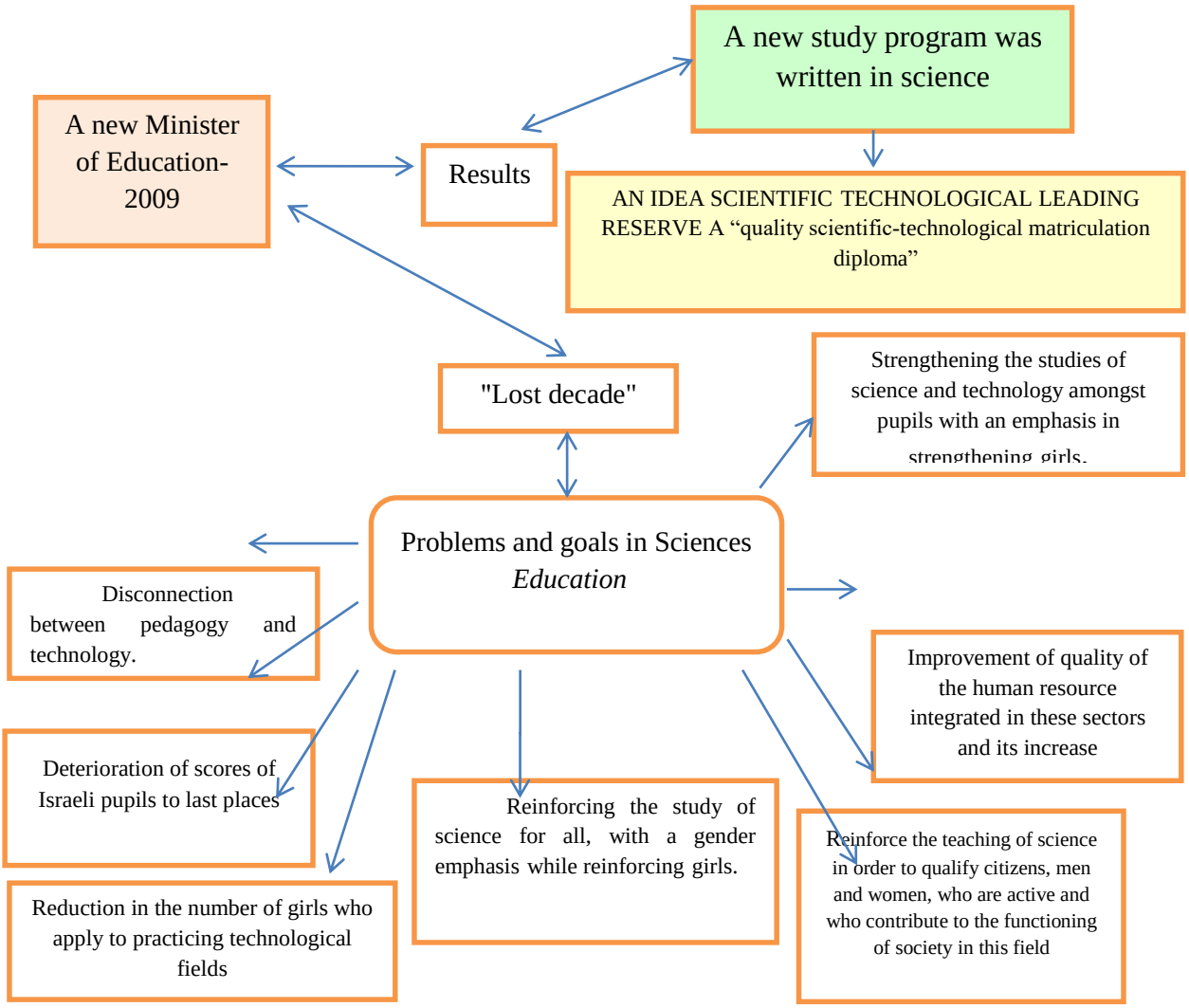


Figure 1.1. The model to reasons of writing a new study program in science at 2009

An interim document was written as a prototype document, extending the curriculum and dictating clear and uniform lesson drafts. Similarly all the schools in the country were compelled to teach teaching sequences according to the new prototype document, to keep timetables and to perform sit examinations of the Ministry of Education testing every age group. The teachers of sciences, veterans as youngsters, were compelled to participate in annual advanced studies including presentation of work with a marks [128]. Many hours were added in sciences [134]. Many instructors have been trained in order to enter schools and follow the assimilation of the program by organizers and teams in various schools in the country. The instructors have undergone annual trainings in the Weitzman Institute. The training of instructors has continued in a sequence for five years [93; 94; 95]. New kits have been written for all the teachers called by the name Assessment Learning Teaching details of assessment, how to examine the students in the same way in order for them to learn how to answer the questions in various tests. Assessments have been written by teachers from the field together with professors in the field of science education from

Davidson institute in the Weitzman Institute [174]. In the new program in science and technology was mentioned to strengthen the girls' participation.

1.2. Approaches referring to the sciences' program through gender prism

Gender inequality in the fields of science, technology, engineering, and mathematics (STEM) has been ingrained into many societies since human civilization first began. While more and more women have gained access to education and expanded their professional career options, there is still a stigma against women in STEM fields arising from traditional gender roles and persisting stereotypes about women's competence [37]. Because technical and scientific innovations continue to drive the global economy, educators and scientists seek to promote students' interest and achievement in the STEM (Science, Technology, Engineering, and Mathematics) [30]. Many researchers have studied differences in male and female students' attitudes toward and performance in STEM courses and assessments. While some research shows that gaps in male and female performance on STEM-related assessments have narrowed or even closed (Lindberg et al. 2010), other research continues to report gender differences in student affective dispositions (i.e., interest) toward mathematics and science, as well as differences in student performance in mathematics and science, especially in math-intensive science fields (Ceci et al. 2014; etc. [apud 30, p.1].

Initiatives concerned with gender equity, some of which focus on access to or outcomes in technology and science, have become fairly common in recent years in number of countries.

This paragraph includes general overview of the evolution of sciences education / sciences programs. We updated the theoretical framework that shows three different approaches to increase gender equity in science education proposed by A.Sinnes [53]. She used feminist critique of science as a point of departure to present the different understandings of how sex/gender impacts on pupils' approaches to science education. The framework shows how different understandings of how sex/gender impact on pupils' engagement in science education require distinct initiatives to increase gender equity, but also to address gender inequality in science education.

Using the term sex to represent biological sex and gender to represent social sex, two different visions can be explored as basic point. One of the visions refers that girls and boys have exactly the same abilities to succeed on equal terms in science subjects, and that gender inequities in these subjects are caused by discriminating attitudes towards one of the two sexes. Other vision might assume that girls and boys are different and that these differences need to be addressed and catered for in order to reduce the gender differences in science education. Although all visions reflect certain understandings of how girls and boys may differ and how these differences might

impact on how they engage in science education, these understandings are seldom formulated explicitly by gender initiatives [53].

Based on different points of view on how sex/gender might impact on pupils' engagement in science education, we would like to mention the three alternative approaches that initiatives might choose to secure increased gender equity in science education; a *gender neutral,* a *female friendly and* a *gender sensitive approach.* These concepts are widely used within literature on gender issues in education, including science education.

A gender neutral science education removing all references to sex, apparently refer equally to the two sexes, but it can easily represent a false picture of reality. Most societies are not gender neutral, most societies are in reality strongly gendered. Particularly in traditional societies, males and females do have very distinct roles to play. Gender equity in science are influenced by social norms. It has also been criticized for not challenging the oppressive and discriminatory practices within scientific inquiry (Harding, 1992). As Howes (2002, p. 23) puts it: "This approach assumes that if women were to think, behave, learn, and work more like male scientists, the problem of women in science would be solved" [53, p.81].

A female friendly science education is focused on women/ girls interest and needs. Brickhouse et al. (2000) accuse female friendly science education of reinforcing stereotyped images of females. An additional drawback to a female friendly science education could be the effect such an education might have on boys.

Gender sensitive science education is based on the assumption that the variations between pupils of the same sex might be more important than differences between pupils with opposite sex. Such an education would acknowledge the existence of masculine and feminine pupils, but not take for granted that masculinity and femininity necessarily are determined by a person's biological sex.

A science education that is designed in order to accommodate various interests and abilities without assuming that such varieties are a result of having different sex, was labeled as a "gender sensitive" science education (Sinnes, 2006 [53, p.267]). Science education reform programs operating under this understanding of gender and science might explore differences in interest found among pupils of the same sex and develop teaching materials to accommodate such a broad variety of interests. A teacher operating in a postmodern feminist classroom would be expected to be cautious about the varieties in interests and abilities that exist among pupils in the classroom without separating them into categories based on their sex. Groups should rather be developed based on the pupils' individual interests and needs.

The suggested characteristics of a gender neutral, a female friendly and a gender sensitive science education are outlined in Table 1.

Table 1.1. Approaches related to science education (through gender prism)

Approaches	**Curriculum**	**Educaţional Materials**	**Teacher's Profile**
a "***gender neutral" science education***	Curriculumul a "gender neutral" not include express the interests of girls and boys; apparently it is addressed to both sexes without any difference. Gender neutrality may be a last resort a form of sexism.	- Abstract illustrations clearly predominant (no people). - There is a major gender discrepancy between successful models promoted. Textbooks abound with famous men. - Is induced gender segregation rather than collaboration etc.	- Pay apparently equal attention to girls and boys in the class without specifying gender-specific needs - View the traditional models in science (men), resulting in involuntary reproduction of prejudices and stereotypes etc..
a "***female friendly" science education***	Curriculumul: - Oriented specifically to women / with a focus on women - It includes the manner in which girls learn science - Responsive to feminist critique of science and incorporates the contributions of women and other oppressed groups etc.	- Built on specific interests and experiences of girls - Incorporating scientific knowledge developed by women - Presents models of women in science etc.	- It is responsive to the special interests of girls and sensitized about the manner in which girls learn science - Teach in small groups / separating girls and boys - Creates a non-competitive environment in science class - Connection between science education and girls' experience outside the school etc.
a "***gender sensitive" science education***	Curriculumul: - Adjusted to the wide range of interests of girls and boys - Reflects the social, political and psychological aspects of science - Incorporate other systems of knowledge etc.	- Reflects the differences in interest for science - View the relationships between science and society and the impact of social and political factor on science - Include sciences developed by minorities and viewing other cultures and differences between different types of scientific research / Promote gender collaboration etc.	- Based on the experiences of boys and girls / apply constructivist teaching methods / equal opportunities for g / b in laboratory - Specifies that scientific knowledge are constructed by humans and therefore influenced by its creators women and men - Introduce questions about gender, race, class, when relevant etc.

Because gender bias pervades societies throughout the world, we can expect to find gender bias influencing girls' choices in many ways. As Vasilios Makrakis put it, "a gender biased society teaches girls to have gender-stereotyped interests." [apud Sanders, 52, p. 5], including in sciences and technology.

Reflecting the origins of technology&sciences, most research has focused on female deficits: their lower experience levels, less positive attitudes, and failure to persist and perform well in educational programs, as compared with males. Research on gender and mathematics, science and engineering, further along than technology, repeatedly points to the value of including

‘different” people — women, people of color, people with disabilities, and others —to expand the scope of the questions asked and paths followed. We support the ideas to re-imagine technology [52, p.23] and sciences, to shift it from what it can do to what it can serve, and in so doing to free ourselves from the conceptual constraints posed by business as usual according to the male model. At the same time, the issue for education is to remove the barriers that are interfering with girls’ access to sciences and technology and success in it.

At the same time, other different approaches should be mentioned. Thus, Bryson and de Castell [apud 7, p, 265] have described four discourses concerning gender and technology. The first discourse, “positivism/technicism,” focuses largely on efforts to encourage girls to increase their representation in technology and education. Clearly, many innovations described in the literature could be characterized as operating out of such a discourse. Most concentrate on altering textbooks and curriculum materials on one hand, and providing role models and better career guidance on the other (Julien, 1987)[apud 7], with a strong emphasis on convincing girls that science and technology provide appropriate destinations for women. Such interventions might also be said to use a liberal feminist model of change, one which aims to alter attitudes and to reduce stereotyped thinking rather than to mount fundamental challenges to social structures. A problem with such an approach might be that increasing girls’ interests in science without enabling them to acquire appropriate skills and learning strategies could be counterproductive (Kahle, 1987)[apud 7]. Another problem is the implicit suggestion that girls’ choices are irrational and rooted in individual characteristics (the “deficit model”), rather than socially shaped (we adhere to S.Acker & K.Oatley position [7p.266]).

The second discourse, which Bryson and de Castell call “constructivist,” stresses the incompatibility between “women’s ways of knowing” (Belenky, Clinchy, Goldberger, & Tarule, 1986) and typical practices of technology. Feminist accounts of women’s “ways” tend to suggest that women, by nature or socialization, have preferences for cooperative, caring, connected approaches to learning and working. Certainly some feminist critiques of science teaching have drawn upon such perspectives, for example, in noting that girls are less interested than boys in imposing their “will over the machine” (the computer) or competing to finish a task first (Bernhard, 1990). Such writers as Morrell (1991) believe that the uncritical equation of scientific and technical advance with economic prosperity rationalizes a neglect of such traditional (caring) women’s occupations as social work and nursing, which remain underpaid and undervalued. Some interventions follow the constructivist approach in taking up the notion that girls or women should

learn separately from men, according to different principles. Others attempt to devise "female-friendly" curricula and pedagogies (Rosser, 1990) [apud 7, p.266].

Bryson and de Castell's third discourse is the "critical" approach to equity, where in gender and other social divisions are regarded as produced and maintained by such institutions as schools. Kessler, Ashenden, Connell, and Dowsett (1985), for example, develop a concept of "gender regimes" to describe patterns of practices that define "acceptable" masculinity and femininity within schools. These patterns are hegemonic (taken for granted, like the air we breathe) but simultaneously open to resistance and change. Whether scientific and technological subjects are seen as an appropriate part of gendered expectations for young women would be a feature of a gender regime in a particular school at a particular point in history [apud 7, 266]. Despite of many discussions we consider that mentioned interventions from a critical perspective would be a long way from simply encouraging girls to elect science as career's options.

The fourth discourse is "postmodernism," taken-for-granted dualisms—such as male and female—and normally accepted bodies of knowledge (including "science" and "technology") are themselves under question. Identity no longer resembles the essentialist descriptions in the constructivist accounts and is seen as constantly shifting and made up of multiple inputs based on sex, race, class, age, sexual orientation, and so forth [7, p.267]. In this context more relevant for us is the problem related the teacher's profile, the teacher's capacity responding to competing class, gender, and race sensitivities and subjectivities of her students raises thorny issues for innovators.

Finally, we would like to mention some gaps on gender and educational interventions in science and technology. We support the S.Acker & K.Oatley position that there is a difference; one highly significant for prospects for change *in practice,* between what researches so far has told us, and what we actually need to know [7, p.268].

1.3. A comparison analysis of the study programs in science in Israel, United Kingdom and Finland, and Republic of Moldova

In the last decade, the achievements of the Israeli pupils in national and international tests have been low in comparison to the rest of the participating countries.

In 2009, upon the assumption of duty of Minister of Education, Gideon Saar, a new study program was decided upon. In 1992, following the Harari committee – "tomorrow 98", a science study program was formulated, that upgrades the level of science study in Israel in all age groups. In 2009, Junior High schools began teaching according to the new program. A master document was written delineating the study program with its sub-subjects that integrates contents and skills

and assigns the number of study hours for the subject. All teachers in all sectors were obligated to teach according to the subjects and to meet the schedules. Following, is the new detailed study program for science, for Junior High school. The change initiated in Junior High schools has advanced to High schools and as of 2013 also to Primary schools.

Following the program, from 2009 and until present time (2013) there have been changes for the better in pupil's achievements in science in Israel, in national and international tests; there was a significant improvement in the TIMSS scores from 2011. Israeli Hebrew speaking pupils reached the 9th place worldwide! Together with Arabic speakers they reach 13th place worldwide. There is still a gap between Hebrew speakers and Arabic speakers and a gap between a high socio-economic background and medium-low one.

The figure 1.2 shows the improvement of Israeli pupils' achievement in the years 2007-2011 in science subjects.

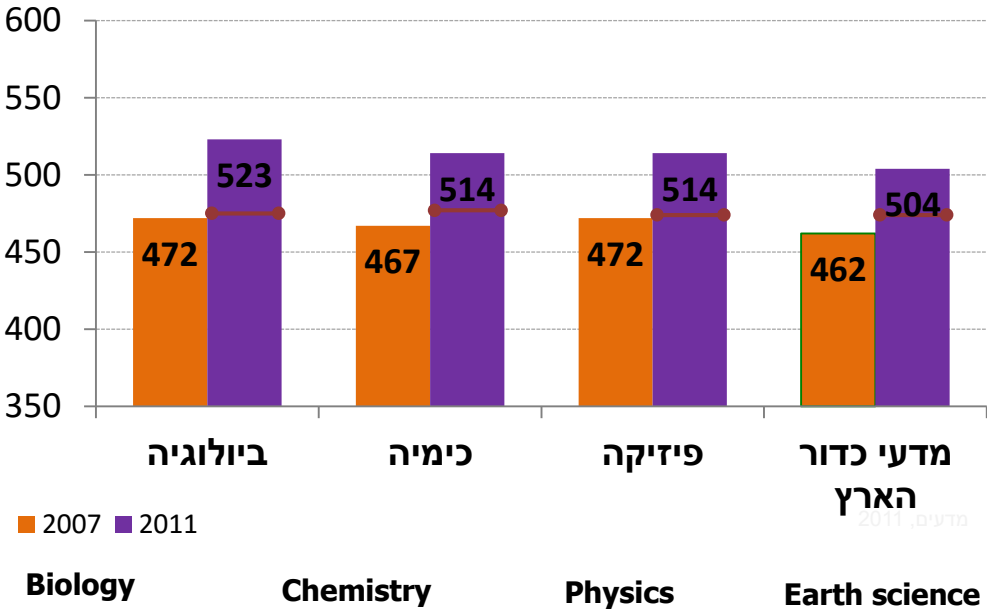


Figure 1.2. Pupils' achievements by content fields in TIMSS test of 2007, 2011

The studied subjects are: biology, chemistry, physics and Earth science. It is evident from the data, that the achievements of pupils in biology are the highest and in Earth science are the lowest. In all four fields there was a significant improvement between 2007 and 2011. The rise between 2007 and 2011 in biology and chemistry (about 50 points) is higher than the rise in physics and Earth science (about 42 points) [77; 82].

In the past, science teachers have taught the subject of Earth science. Due to the great load of the study subjects, this subject was passed over to geography teachers. On one hand this has

facilitated science teachers; however geography teachers do not master well enough the scientific contents which brings the average down.

Physics is an extinct subject. Since the inception of the new program, there are attempts to strengthen this subject. Every year, physics courses on an academic level are being opened for science teachers with state funding. The length of course is 18 months, in which they specialize in the teaching of physics. Science teachers are obligated to teach physics. The teachers are frustrated as most of the graduated science teachers are biology or chemistry graduates, very few of them are physics graduates. In High schools, due to their size, there is a separation in studying of the fields. Each teacher teaches according to his specialization. In Junior High school, a teacher is obligated to teach all three fields. A teacher who is not enrolled in the academic course in physics has to do an alternative course that is studied after working hours [44; 45].

Following is some data: Only in 36% of the High schools there is a physics orientation department (in one out of every 3 High schools). From 2001 to 2010 the number of physics teachers has increased by only 28, which is a rise of just 3% as compared to the increase of the number of pupils and teachers. In physics, 918 teachers are employed in the system, their average age is 49. Many of the teachers are immigrants from the past Soviet Union and approach the age of retirement. 57% work more than a full-time job. The number of boys who study physics is double than that of girls [176]. 91% of the pupils do not choose physics due to the difficulty of study material. The choice subjects are diverse and more appealing than physics and chemistry. Presently, the challenge the state faces is to pull pupils to this orientation and prevent drop-outs during the studies. Another initiative is the establishment of "scientific technological reserve" from 7^{th} till 12^{th} grade in order to get pupils of young age closer to these fields of knowledge and instill a strong foundation that would encourage pupils to choose physics and chemistry orientations and graduate with honors. The pupils under discussion are those with potential and motivation who study in special classes. In addition to enhancement in science they study extra 2 weekly hours of physics and 2 weekly hours of robotics. As they advance in their age group, the number of weekly hours in the subject of physics increases. Girls are also accepted to these classes with a gender encouragement. The number of girls in a class comprises 50% and above.

In addition to improving pupils' achievements in science and the core subjects, the Israeli educational system wishes to adjust studying in a school to the requirements of the 21^{st} century due to the economic and social processes taking place in the world. Presently, knowledge is accessible and learning occurs any place and at any time. Schools and the educational system must get prepared for reorganization towards developing high-order of thinking abilities. Education is

required to meet the challenges of the 21st century that are characterized by: dynamicity, increased technological development, creation of new professions and cancellation of existing professions, globalization processes and economic and social changes. This challenge occupies many countries around the world in recent years including the US, the UK, Singapore and Finland that are in a process of long range change processes. In order to train young pupils for the economic requirements in the 21st century, they need to develop new qualifications and skills: creativity, ability to solve problems, interpersonal communication, team-work, self-management, flexibility and fast adjustment ability, personal development and systematic thinking. These skills are required for and encompass all subjects and all of the population. The duty of a school presently, in the 21st century, is to navigate pupils in the developing world, when they are in possession of a tool box that suits the era. The use of digital technology is assimilated presently in the lives of pupils and becomes an inseparable part of their life. As a result of the fast rate of technological changes, a gap is created between a pupil's world and the study environment offered by the school. The school status, as an institution that prepares pupils to the life in current era, is undermined.

Prof. Schleicher, who heads the Department of Indicators and Analyses in the OECD Board of Directors, claims that prior to the results of TIMSS tests of 2011, the educational system in Israel hadn't instilled its pupils the skills they would need in the future…[167, 175].

Table 1.2. Comparative data on education in Israel and in the OECD

Number of pupils – 2012		**Pisa* 2009 score**	**Rate of High school graduates – 2012**	**Access to computer and internet in school - 2012**
Primary school – 942,000	Israel	460	81.7%	84%
Junior and High school – 644,000	Average – OECD	500	68.1%	
	Top 10 OECD countries average	525		
Total - 1,586,000			Finland - 69.3%	Holland - 88% Qatar -73%

The following table shows the data of the State of Israel in relation to countries in the OECD (table 1.2) [90; 91].

From above table it is evident that the Pisa score of Israeli pupils is not high. In the world, pupils are adult at the age of 15 whereas in Israel pupils are eligible to matriculation certificate

after 12 years of study at the age of 17-18. There might be a leap in their ability between the age of 15 and 18 that is not expressed in the Pisa study. The number of computers in Junior High schools is very low and if there are any, they are very old.

PISA study, 2009 findings

The study was conducted in Israel in Mach 2009, a random and representative sample of schools around the country. 5,761 pupils have participated from 176 schools, at the age of 15. The following table shows the Israeli students achievement in the international Pisa test (Jews and non-Jews) with the core subjects - language, math and science skills [55; 56] (table 1.3).

Table 1.3. Pisa achievements of Israel 2009

	Language skills	**Mathematics skills**	**Sciences skills**
Hebrew language	498	470	476
Arabic language	392	367	382
Israel average	474	447	455
OECD average	493	496	501
The UK	494	492	514
Moldova			**428**

According to the above table:

* There are apparent gaps in Israel between the achievements of Hebrew speaking pupils and Arabic speaking pupils. As a result of these gaps the average of the score of Israel drops with a significant gap.

*The comparison of Israel to the Western countries is not valid due to the great heterogeneity in the Israeli population. The short existence of the state of 67 years and the political, religious, sectorial and security complexity of the region.

* Following the conclusions in Israel and European countries, a new test is under consideration that would be interactive, conducted by means of a computer, would call for reasons and explanations and maintain interaction and debate with the pupils.

*In the Pisa test of 2012, exercises in solving problems and economic literacy will be added to the traditional tests that demonstrate dealing with routine dilemmas in the field of finances, solving problems as a team – examination of skills of the 21st century.

These changes confront the Israeli educational system with difficult coping, as it lags behind the OECD countries. Prof. Ami Volenski, from the Department of Education in the Tel-Aviv University explains: "the changes in international tests are a signal for the educational system. It will take years until it would permeate to the teaching methods. In Finland and other countries the approach is – 'less is more' – less subjects, less material and more going deep into. We are not there yet" [189].

Reforms in the world: Israel, United Kingdom and Finland

In the last decades, in most of the developed countries such as: the United Kingdom, Japan, Finland and Canada, an awareness of international comparison has risen. As a response to changes and critique on the quality and ability of the educational system comprehensive educational reforms have begun.

In this study were selected compared to United Kingdom and Finland due number of common themes lines in several areas of education in Israel. At United Kingdom from 2009, teaching is according to the new program, the changes are as follows: study skills technology. "Learning skills for Sciences-LSS" written by Dr. Scherz from Weizmann institute Israel. The goal objective improvement in student achievement and rise in the number of excelling teachers. And in Finland in the early 90's, Finnish pupils were mediocre in their achievements. The educational system was similar to the educational system in Israel. Change in perception led achievements highest in the world. Studying is done in small groups, an idea taken from Israel –Interview with Dr. Scherz from Weizmann instated Israel [164].

Most of the reforms have common principles:

1. A transition from quantity to quality – transfer of knowledge, subjects and hours.
2. Focusing on results – outcomes.
3. Assigning schools with authorities and autonomy. Directing most of the resources to the school and decreasing bureaucracy, decentralization of authorities, improvement of training of teachers and principals.
4. Being familiar with each individual pupil with various and different abilities, skills and difficulties.

Reform in the educational system in the United Kingdom

United Kingdom is the most populated country in Europe and with a vast ethnic diversity. Its population numbers over 52 million people out if which 10% are minorities [60]. The largest minority groups in the United Kingdom are: Irish, Indian, Pakistan, German, Caribbean and American. In addition there is internal-British immigration from Scotland, Wales and Northern Ireland. In England and Wales there are 7 million pupils [100].

In 1988, the British Parliament for the first time has awarded an authorization to a national study program; three core subjects were determined – science, math and English as well as 7 basic subjects (for complementing the studies): history, geography, technology, music, Arts, PE and modern foreign language. The study program has defined unique subject for each age group. The study years were divided into 4 stages: 5-7, 7-11, 11-14, and 14-16. With completion of each stage a pupils must undergo an evaluation process according to adjusted standards. The program suffered of too many tasks and multiple achievements levels.

In 1993, teachers have boycotted exams and the government was forced to limit the contents of the study program and simplify the exams. The government recruited a senior businessman to organize the study program. The result was a limitation of the study program and its exams. After the elections of 1997, the government has published a document that gathers the main points of the educational policy in the United Kingdom. The approach is centralistic and the government is at a center of control. From the year of 2000, the subjects' delineation was limited and changes have been few. In 2004, the national study program was divided into 4 study stages, according to the decision of above school sequence. This change made it possible for schools to offer a wider choice for pupils.

Current study program in the United Kingdom: Presently, the program is comprised of 10 compulsory subjects; it includes directions and obligates schools to supply experiences in the field of study as a preparation for future career. Religion studies are according to the discretion of parents. The program update of 2008, allows for more flexibility in schools according to the personal needs of pupils and their perception of position in the study program. It makes sure that evaluation would support effective teaching-learning processes. Standards were formulated that assist pupils in coping with challenges in the changing world. The study program has raised the level of achievements in all subjects; it presents clearly the skills and knowledge a pupils must acquire at school, mainly in the core subjects: science, math and English. It has created motivation amongst pupils that encourages continuance of studies in higher education [61].

The autonomous national study program for schools and teachers is a work framework for schools. A school decides which subjects to focus on and at which stage of the year.

What is different about the new study program? In 2005, the ministry of Education has published a document for promotion of schools by the name of "The white paper: Higher Standards, Better School for all -More Choices for Parents and Pupils" [60]. The change in the standards policy:

1. Wider freedom of choice for schools and parents.
2. Inclusion of parents in the study planning and formulation of standards' processes.
3. Leaning on public systems and the private economy in education forces.
4. Involvement and assignment of authorities to local authorities to make decisions in the field of education.

The prime minister at the time, Tony Blair, has attributed to the standards' based reform the success in the improvement of study achievements in schools in the United Kingdom and forwarded several moves that have contributed to the achievement:

- Financial reinforcement of teachers, a significant 20% raise in their pay.
- Reinforcement of school teams, an addition of 32,000 teachers and 130,000 consultants.
- Doubling the number of computers in all of United Kingdom.
- A rise in the number of excelling teachers in post-Primary schools from 59% to 78% [50].
- OFSTED (Office of Standards in Education) – a center that directs the standards' development process and act for their evaluation. An external unit to the Ministry of Education and the academy system.
- A teacher has received support and assistance, a pupil has received personal guidance that suits his needs.
- The achievements of pupils have significantly improved. For example, in 2009 the Pisa tests in the United Kingdom have reached a score above the average of the OECD in literacy of science.
- There was a 50% improvement in the number of pupils who have successfully passed the matriculation exams.

Points of emphasis

In the United Kingdom:

* The standards of assisting schools in teaching of certain contents in a clear manner were redefined. Schools were given the autonomy to decide upon the study program and the means to evaluate it. These have helped in the improvement of study achievements of pupils.

*The sense of ability and change has swept teachers' teams and parent who have expressed much willingness to invest in the promotion of pupils. Parents are involved in processes that take place in a school. The situation has created a consistent study atmosphere in which teachers have seen the study program and education as a whole unit. Teachers treated pupils in person and supplied their needs.

*A study of the national study program in the UK has shown that there was very little time to learn thinking skills. However, the study of high-order thinking skills has brought about a rise in the thinking standards (OFSTED). The problem in the United Kingdom is the high level of involvement of government in the field of education. The country struggled with finding a balance between centralism of the government as an exclusive entity for making educational policy and between decentralization of authority and awarding autonomy to teachers and the school.

*In the 90's the educational system was subjected to tests in order to raise standards.

*Teachers in the United Kingdom feel obligated to focusing on contents and studying for exams and there is practically no time left to deal in the studying of subjects that catch pupils' interest. This leads to superficial study, a limited and short-term assimilation of the acquired knowledge.

*In 2010, the responsible entity for determining the national study program was the QCDA – Qualifications & Curriculum Development Agency. It was replaced in 2011, by the Standards & Testing Agency, which is responsible for developing of all the means of evaluation in the educational system in the UK. It is still early to evaluate the changes from this move [48].

*From 2009, teaching is according to the new program, the changes are as follows: study skills' qualifications, genetics, astronomy and on-line technology. Pupils are required to be familiar with producing web information, blogs and advanced technologies such as Twitter. There are critiques of the purposes of the new program, mainly in relation to the emphasis on technological tools in the place of technological terminology, and on the other hand there is a positive critique "finally the educational system understands that there is a new technological reality that our

children have to be familiar with; this is an achievement in itself and should not be ignored…" [108].

*Recently, a book was published in the United Kingdom – "Learning Skills for Science – LSS", an extension of the study program "scientific technological communication", written by Dr. Scherz, Z. Dr. Spector-Levi and Prof. Bat-Sheva Eylon from the Weitzman Institute in Israel (at the late 90's) [95]. The program deals in study ability skills. "Learning how to study science", which includes methods to locate and process data, critical scientific reading as well as data representation and presentation.

The representatives of the Gatsby Foundation (which belongs to lord Sainsbury) have identified the potential in the program of instilling science study abilities for pupils, and asked Prof. Eylon, B. and Dr. Schertz to translate the program of "scientific technological communication" while adjusting and expanding the program to the needs of the British educational system, with the purpose of integrating it in the new study program "21st century science" [94] In the publication of the book, the prestigious publication company, Nuffield Curriculum Center, which directs and affects science studies in the United Kingdom for the past 40 years, has taken part as well. The program was studied in in the United Kingdom in 3000 schools (2013). The book, intended for a pupil, is accompanied by a theoretical instruction book for teachers as well as a related website. The program's implementation necessitates the training of teachers, an action performed in the last two years. In this framework, Dr. Scherz gives seminaries to teachers and to teachers' teachers in several centers in the United Kingdom. In the current study year (2013) the program is being studied in an extended pilot in 75 schools throughout the United Kingdom, towards a wide distribution of the program in the next study year. The program arouses interest in the educational systems in South Africa and Holland as well. For the purpose of a launch of the book and of the study program, a modest ceremony has taken place recently in the scientific center in the Institute of Education of the University of London [113; 164].

Study program and the reform in Finland

Finland is a cold country in Northern Europe with population of 5 and a half million. It invests 6.5% of the national product in education (in Israel – 8%). The society is relatively homogenous, with a small number of pupils – less than 600,000 [100]. It is a modest and moral society. The gaps between rich and poor are not big [139].

In the early 90's, Finnish pupils were mediocre in their achievements. The educational system was similar to the educational system in Israel and the world. However, a change in

perception which they have undergone in recent years has advanced tem to having the best scores in the world – first place in all indexes: in science literacy (Israel – 13), math literacy (Israel – 9) and language (Israel – 7) (2007).

The Finnish model is opposite to most of the educational models customary in the Western world; a different direction was decided upon: cancellation of exams and giving choice to the pupils. Information about reform in Finland is available on [213].

In 1994, Finland has changed the entire educational system and the study programs and awarded teachers with autonomy in the development of school study programs. It was decided that pupils should not study all the subjects being studied in the world and that they cut down their number. Pupils study less hours – 25 weekly hours (in Israel – 38 hours) and experience study experiences. The teacher does less than 50% of frontal teaching (in Israel – 85%). In rest of the time pupils teach pupils or learn dealing with tasks and problems from daily life. Studying is done in small groups, an idea taken from Israel – Interview with Dr. Scherz [164] and by teamwork. The study supplies tools for learning and creativity, it develops skills for life in the studier – should they encounter problems they would be able to resolve them. The development of the Finnish educational system integrates research and University. The program is approved by the government every 4 years.

The economic principles of the program for the promotion of education are: high quality, equality of opportunities and lifelong learning. The preferred fields include: diversification of the language program, information strategy, basic security in education, improving mathematical and scientific know-how and cultural school.

The pupils learn how to produce information form a computer, develop scientific and mathematical thinking and writing of reading diaries. A class numbers 15 pupils and the relation to pupils is very personal. 3 teachers teach in each class. The improvement in professional education has brought about an opening of new technical colleges; the country has increased its investment in education, mainly in colleges. A pupil studies till the age of 16-17 in the same school. At the age of 16 the pupils finishes the Junior High school (matriculation) (40% finish the matriculation), and can choose to go to a vocational High school (electricity, construction, etc.) or theoretical that prepares one for life or further study in the University. The exams have been cancelled as well as homework. Learning takes place in a study environment with no pressures or anxieties and it is not dictated by an external regime of exams. Relationships between teachers and pupils are fine and calm. A teacher trusts his pupils and so do parents. There is trust in the system,

the principal, teachers and pupils. Faith leads to the success of all. A teacher has autonomy in the teaching and learning processes. The teacher is responsible for the study contents (there is no single standard program). The system sets targets and teachers' team with the principal develops study programs together. Studying always aspires to be related to life and the application of the studied material, there is an emphasis on various skills required in life; solving practical problems of life.

Most of the lesson is conducted by pupils doing and studying by themselves. At least in half of the lesson, a teacher goes between pupils them and assists them personally and not frontally. In practical lessons mature pupils teach younger pupils or pupils work in pairs or teams just like in real life. The educational committee is comprised of professional, experts and researchers from the field of education only. There are no supervisors in the educational system, just the teachers and the principal in self-management (which saves a great deal of money). There any many vacations and the big vacation last for 10 weeks.

Attributes of a teacher

The degree of a class teacher is one of the popular study subjects in Universities. Admittance exams are of high standard with only 10-15% being accepted to these studies. Regarding other teaching professions – the situation is different; there is a lack of teachers. In Finland, the teaching profession is feminine. The challenge is to pull young men to the profession. In 1996, the average age of teachers was 43. Those that are accepted, undergo a strict selection procedure, they are extremely well rewarded (5,000$ a month), they like the profession; they are excelling and must have a Master's degree. The teachers in the process of their works undergo quality and strict training; the guiding line of teachers in Finland is: "we do not teach our children for results in exams but instill in them abilities and skills that are not measured by exams". A teacher leads his class several years in a row [206].

The science study program

Since the first grade a pupil has 6 weekly hours of science. Three hours are dedicated to the science content field and 3 additional hours deal in subjects interfacing with science – agriculture, environment preservation, health, technology. One of the ways to realize this goal is to combine industrial manufacturing based on high technology and nature science. The science study programs encourage pupils to choose these subjects in school. Thus, the professionalism of science teachers is being invested in. Teachers do not assign homework to their pupils; there are no exams [208] Technology and entrepreneurship are new subjects in the general education in the Finnish educational system, and as such they still do not have an official status as study subjects. These

subjects are greatly supported through national and international educational strategies. This support is expressed in an action plan declared by the Ministry of Education, under the slogan of: "Finland into the Information Society".

KYTKE [24] 2005, is presently the most comprehensive educational project in Finland in the field of technology and entrepreneurship. The project began in 1997 and it is funded by the Ministry of Education and the Social-European Fund. The project purposes are: a. using the skills of the agents of change (a test group of teachers and teachers' coachers) in entrepreneurship, technology and marketing in an enterprise and a local business; b. to consult to enterprise or business owners in their specialization; c. to use the entrepreneurship and technology specialists as an aid to promote the employment of the test group [148; 149].

Points of emphasis

*The study presents a victory of the Finnish educational system due to excellent teachers and leaders. It is evident from the study that Finland develops excellence through its teaching forces.

*Until the 60's of the 20th century, the level of educational achievement in Finland was relatively low: only one out of every 10 Finnish adults has completed more than 9 years of study of basic education and the achievement of a University degree was not a common thing.

*Presently, more than 98% of the population in Finland study at the age of 6 in a kindergarten; 99% of them complete the compulsory basic education. Boys and girls study both in the mixt classes. At the age of 16 three out of five young Finnish people enroll for post-High school education with state funding; 50% finish these institutions.

*Finland openly acknowledges the value of its teachers and trusts their professional judgment in schools. According to public opinion polls amongst High school graduates, teaching is considered as the most admired profession amongst young people in Finland. Becoming a teacher in a Primary school in Finland is an extremely competitive process. Only the best and the most brilliant in Finland can realize this dream.

The accomplished candidates must have good grades, excellent interpersonal skills, deep personal commitment to teaching and working in a school. Each year, only one out of 10 candidates would be accepted to studies in order to become a teacher in a Primary school. Every year about 2,000 student teachers are chosen for studies out of 20,000 candidates. The most qualified candidates that were chosen complete a rigorous teachers' study program on government expense. The young Finnish are attracted to teaching due to the prestige of the profession, the

public and society service and the professional autonomy in schools. They consider it a profession with equal value to the subjects of law and medicine.

*All teachers in Primary schools, in Junior High schools and High schools in Finland must have a Master's degree. Pre-school age teachers must have a Bachelor's degree. The Universities in Finland issue the teaching license. Teachers' training is based on a combination of research, practice and reflection, which must be supported by scientific knowledge and must be focused on thinking procedures and cognitive skills. The teacher is obligated with a five-year practical training in a school.

There is no central management of education in Finland. The principal and the school team together with the managing committee of the school usually make the decisions regarding employment of personnel and recruitment of teachers. In Finland, the teachers receive a feedback from the school principal and team. A good teacher helps all his pupils to progress and grow in a holistic way. "Holistic" is from the word "whole" which means "complete, including everything in it, a tight connection between body, mind, soul and the entirety of items in the structure of a person". This is a studying that includes several intelligences at the same time according to the perception of Gardner that identifies a variety of 8 basic intelligences of a pupil and not just one or two, as nurtured by many High schools. This is recognizing the difference between studiers, advancing them as individuals and as team members and their advancement as independent studiers who listen, trust and count on themselves. The teaching is differential in a rich, diversified and technological environment [203].

Teachers who are accepted for teaching, mostly remian in the field for their entire life. According to an official estomation, only 10 to 15% of the teachers leave the profession during their career [64]. The work environment of a teacher in Finland is calm, autonomous, appreciated and inspiring of trust as different from other countries where there are bureaucratic systems of reporting that make teacher feel threatened and with over-supervision. The study program is approved by local educational authorities, teachers and school principals. Teachers have a key role in the evaluation of pupils.

*Reasons for non-existence of exams:

1. Priority for learning, personal progress and creativity.
2. Pupils' evaluation is connected to the teaching and learning process and improves the work of teachers and pupils during the study year.
3. Teachers are the best judges of pupils' progress in the school.

The teachers in Finland devote less time to teaching than their colleagues in other countries. For example, a teacher in the Junior High school in Finland teaches a little less than 600 hours annually. In the US, on the other hand, a teacher in a similar rank devotes 1080 hours annually to teaching. However, this is not to imply that teachers in Finland work less than their colleagues in other countries. An important part of work of Finnish teachers is devoted to improvement of practice in class, to the progress of the school in general and to work with the community.

The education and international tests in the Republic of Moldova

Over the past two decades, there has been a pronounced demographic decline in the Republic of Moldova. The low birth rate led to a significant decrease in the number of pupils enrolled in schools, mainly in the rural areas. The number of students enrolled in primary education has decreased by more than 40 percent since the early 1990s. At the same time, the number of school has remained virtually unchanged. As a consequence big Soviet era schools1 are still

Maintained, but used only at half of their capacity**.** Students' performance still requires much improvement. According to the international tests in mathematics and science (TIMMS 2003) and reading literacy (PIRLS 2003), Moldova scored significantly below the international and regional means (UNICEF 2008). The results have slightly improved overtime based on PISA plus 2009 with regards to science, but there has not been a positive change in mathematics and reading: among all participants in PISA 2009 and PISA plus 2009 projects, Moldova scored poorly.

Students, who already have low attendance rates, may go to school even less often or even worse, they may dropout. Especially for socioeconomically vulnerable groups of children, mostly kids whose parents left them at home usually with grandparents, while working abroad or kids from bigger families who may experience the lack of parents' supervision**.** Recent studies show that approximately 31 percent of Moldovan children under 15 years old do not live with both parents**.** Statistical official data in Moldova shows that there is a difference between enrollment rates for primary school children from urban and rural areas with lower rates for the latter**.** A similar pattern is observed in case of secondary education too, where the difference in enrollment rates between urban areas (89.7%) has widened substantially in comparison with rural areas (73.1%) for the last decade.

On average among OECD countries, there were no statistically significant differences in competence in science between boys and girls. Among PISA 2009+ countries, boys performed some better results were than girls in science in Israeli, U.K. etc. Girls show significantly better

results than boys in science with a verity from 10 to 20 points in the Republic Moldova and Georgia [56]. In sciences girls demonstrated 420 score and boys - 406 score.

At the same time, despite of the some progress the discrepancies between boys and girls in the sciences at national and international level remain as big challenge. More details can be read in appendix no 7.

1.1.4. Conclusions the first chapter

In this chapter, a theoretical synthesis regarding the historical and conceptual evolution of the program (curriculum) in science in Israel was provided, outlining key periods and explaining the progress and the limitations within the education system.

Also, comprehensive educational reforms in developed countries in the world were reviewed, for improvement of the achievements of pupils in science: Israel, the UK and Finland. Additionally, some aspects related to science education in Moldova were analyzed. The study program in science was changed while adjusting to the 21st century.

This study were selected compared to United Kingdom and Finland due number of common themes lines in several areas of education in Israel. We notice similarities caused by the reforms in the educational systems in Israel and in the United Kingdom. These programs were formulated due to the international standards in national and international tests. The study program in Israel is busier, more diverse and is studied with more weekly hours. There is an emphasis on the subjects of biology, chemistry and physics, whereas in the United Kingdom the emphasis in on Earth science and astronomy. In Finland it is different; the reform there has brought about creative thinking. Research of national and international practices in this area was necessary, serving as a reference framework of our concerns to the implementation of the program (curriculum) in science and technology from a gender perspective.

With reference to Moldova, stressing the importance of transferring knowledge and experiences in the relevant field, pointing out the gender equality expertise exploration in education in Moldova, following this research, we find some benefits for the educational system in Moldova. Thus, according to the researcher N.Birnaz from the experience of implementing the program in "Sciences and Technologies" in Israel the following aspects can be useful for the educational system in the Republic of Moldova: the conceptualization of an integrated school discipline "Science and Technology"; the experience of the education system in Israel in preparing students for PISA assessment etc.

As we have shown the three approaches (a “gender neutral”, a “female friendly” and a “gender sensitive” science education) that are described can be seen to represent quite different types of initiatives to increase gender equity in science education. All the three approaches do, however, have their strong and weaknesses. It can be mentioned that actions that are recommended as suited to increase gender equity should be analyzed according to what perception they reflect of what role gender/sex plays for pupils engagement in science education.

Clarifying and describing the characteristics of the different ideal types might, however, enable initiatives to become more conscious about their own perception of how girls and boys engage in science education and thereby enable such initiatives to plan more consistent actions to increase gender equity in science education.

2. THEORETICAL AND PRAXIOLOGICAL APPROACH OF THE "NEW STUDY PROGRAM IN SCIENCES" THROUGH GENDER PRISM

2.1 Description of the "New program in sciences"

In 2009, following the elections to the government and to the 32nd Knesset, Gideon Saar was appointed, on the 31st of March 2009 as member of the Knesset and as the Minister of Education by the Prime Minister Benjamin Netanyahu. Gideon Saar has worked to increase the budget of the Ministry of Education by a scope of 3 billion NIS. In this framework the Minister worked towards the reinforcement of the core subjects. Through his actions he has allocated thousands of study hours in mathematics, sciences and mother tongues.

The new science program was implemented since 2009. In 2010, the first technological reserve classes in Israel were opened. In current study, participating the classes that have begun studying in this course from 2011 and until today. The findings of the study reveal that as the state gives a better response to studying according pupils' needs, the higher would be the incidence of success in the tests, and achievements improve and the satisfaction of pupils, parents, teachers and the management staff rises. As the country supplies a better response to pupils, their motivation rises due to the obvious support of family. As experience accumulates in these classes, the demand for these classes rises, and as a result, achievements improve, the number of pupils who choose the science courses as enhanced ones grows and there is satisfaction from the economic investment in those pupils. However, according to current study, the number of pupils who choose to learn the subject of physics – boys and girls, reduces. There is a slight trend of improvement, but a lot needs to be done to change this situation. There is a significant gender gap in choosing of this subject in favor of boys, for every three boys that choose to study this subject; there is one girl who chooses to study it [67].

In this context should be mention that the countries of the European Union are also worried about the condition of future employment. Due to a flood of immigrants and lack of employment they fear that already in 2020, Europe would sink economically. That is the reason they are getting ready, in our time, with strategies intended for instilling of technological education, which is accompanied by security of employment for the younger generation, a strategy called "Europe 2020" [184; 187].

The trend is to improve the image of technological education and make it attractive through national programs, legislation changes, media campaign, autonomy for technological schools, integration of teachers with a high profile, excellence centers, implementation of needs of modern

economy in the study programs, flexibility in study courses, instruction in career development, meetings of youth with industry entrepreneurs, the business owners themselves, as part of a personal training program, as well as granting of equality of opportunities to all sectors of the population [184].

"The new study program" – updating of the study program, operating of training and specialist Lead trainings system, reinforcing of knowledge, skill and improvement of achievements [97]. The main purpose of the updated program was and remained "scientific-technological education for the entire pupils' population" with the purpose of training of active citizens who contribute to the functioning of the society and its growth. The program is presented in the appendix no. 5.

For this purpose, a master document was originated – a work plan for each study year including a file of annual spreading of study topics by grades [134]. "Hala" kits (Hebrew for TLE – Teaching, Learning and Evaluation) were prepared, in which there are teaching sequences and experiments for teachers according to study topics [174].

5-6 additional hours were added for science pupils in each grade. Teachers are obliged to undergo a 60 hours of specialist trainings each year. A leading teacher-instructor is routinely assigned to 7 schools during each year. He meets with science teachers once a month and didactically enriches the teachers' team. He meets with the principal and school supervisor in order to improve the achievements level of the school. A leading teacher must undergo specialist trainings every year, in sciences' curriculum institute, the Weizmann Institute, in the city of Rehovot.

The new science and technology study program is based on the faith and confidence that the country has good science and technology teachers, with ability and motivation to lead changes.

Pupil's achievements in national and international tests and evaluation study findings of Department of Study Programs [174], show that when a study program is not specific, is studied partially with no spiral study sequence from primary to High school, brings about a forgetting of the subjects amongst youth. Many of the Israeli educational system's graduates have insufficient scientific technological foundation. This fact is prominent in the TIMSS-2007 international test findings that show that 25% of the pupils in Israel have not passed the minimal level in sciences. This is an exceptional finding amongst Western countries participating in this test [165; 190].

The new program, begun in 2009, wishes to promote movement in two directions:

1. Updating of the study program: according to the layout prepared by the professional committee, so that the outcomes in knowledge fields and expected skills of pupils in each age group would be defined. A spiral study model would be defined in the program that would create a study sequence according to the contents studied in primary and High schools. From 2009 and onward, the improvement process and updating of the study program would continue in cooperation with the leading teachers and academy personnel. For this purpose, the study topics required in the different grades were spread and the study topics to be studied in each semester were defined. A special effort would be required to integrate these topics in the science and technology school work plans.
2. Implementing of instructions and specialist trainings setup: parallel to the spreading of the study topics an instructions and specialist trainings setup will be implemented. Reference materials, Teaching-Learning-Evaluation kits ("Hala" – Hebrew for TLE) which were developed, would be used by teachers for drilling, elaboration, deepening and evaluation of the studied topics.

The main study topics are taken from 5 content areas: material sciences, life sciences, earth and universe sciences, environmental sciences and technology sciences. Investigatory studies were stressed as well as chemistry and physics investigation. The study program realizes the reciprocal relationships between science, technology and society which feed one another. The study subjects are aimed at instilling of scientific literacy according to subject – physics, chemistry, biotechnology and biology. The program's purpose is: "to cultivate a citizen with knowledge and skills that allow him to deal with a rapidly changing reality…" [132; 133]. The targets are: implementation of science and technology study program and the raising of pupils' achievements while reducing gaps [211].

Success is important. The accomplishments of teachers and achievements of pupils are examined throughout the year. In March and May, national and international tests are conducted, which examine the achievements of pupils of different grades and levels. In addition to the regular program, there are 30 schools which study according to a special program called "Scientific technological leadership reserve". These pupils are being reinforced in addition to the regular study (5-6 weekly hours) with 2 weekly hours in physics and 2 weekly hours in robotics (about 10 weekly hours of science). It is a challenging study program which cultivates creativity and technological thinking [41; 42].

The main question in current study is – whether the new program from 2009 and the structural changes, would succeed in raising pupils' achievements in the subject of science in Israel, while reducing the gaps between boys and girls.

On December 12, 2012 was notified the State of Israel and her considerable improvement in student achievement in science International test TIMSS. After years of decline down the graphs in the grades of Israeli pupils in international tests, a success was registered in the subject of science for 8th grade pupils, who ranked in the 13th place internationally.[65]

The new program and changes have caused the Israeli pupils to succeed in the TIMSS international tests in the subject of science that have taken place in 2011. The results were published in Israel and concurrently worldwide. Minister of Education, Gideon Saar, held a press conference, in which he announced with great joy, the significant achievements of the pupils of the state of Israel in the subject of science; from 25th place out of 49 countries in 2007, to 13th place out of 42 countries in 2011. Hebrew speakers have reached 9th place in the world. The test results of the last TIMSS -2015 (math and science tests) indicate that the average scores of students in mathematics and science in Israel is very high by international standards. Mathematics, Israel ranked first among Western countries, and seventh place in the world. At the same time, the relative gaps between the strong and weak are also among the highest. Outstanding were able to "cover up" the weak and to contribute to the higher average [75; 144].

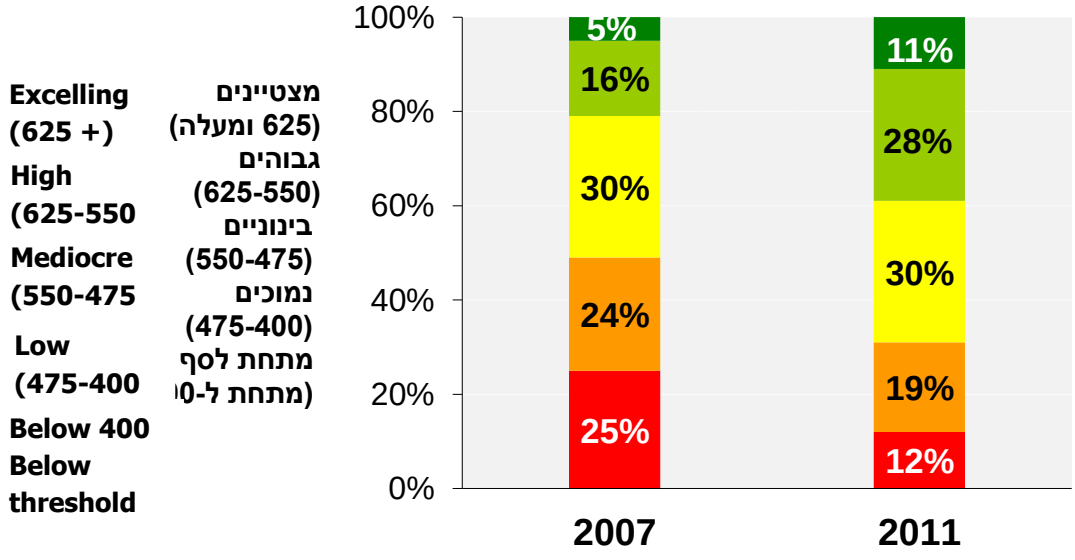


Fig 2.1 Rate of pupils in proficiency levels – 2007, 2011 [75, 145]

The figure (2.1) shows the steep increase in the outstanding achievements of students from Israel at the international TIMSS test. Israeli students made the biggest jump among groups of

countries with high achievement (2007, 2011). From these data it can be learned that between 2007 and 2011, the percentage of excelling pupils has significantly risen while the percentage of low and below threshold pupils have significantly dropped.

At the same time the rate of excelling and high pupils has significantly risen amongst Hebrew speakers and Arabic speakers (more details in appendix 7). The achievements of Hebrew speaking Israeli pupils, who have reached the 9th place internationally, are seen in above table. The achievements of the Arab sector have surpassed the international average and reached 18th place worldwide. The gaps between sectors are still big, despite the big progress in achievements of Arabic speakers. As a result, Israel has reached the 13th place internationally (42nd and last place – Lithuania) (figure 2.2) [43].

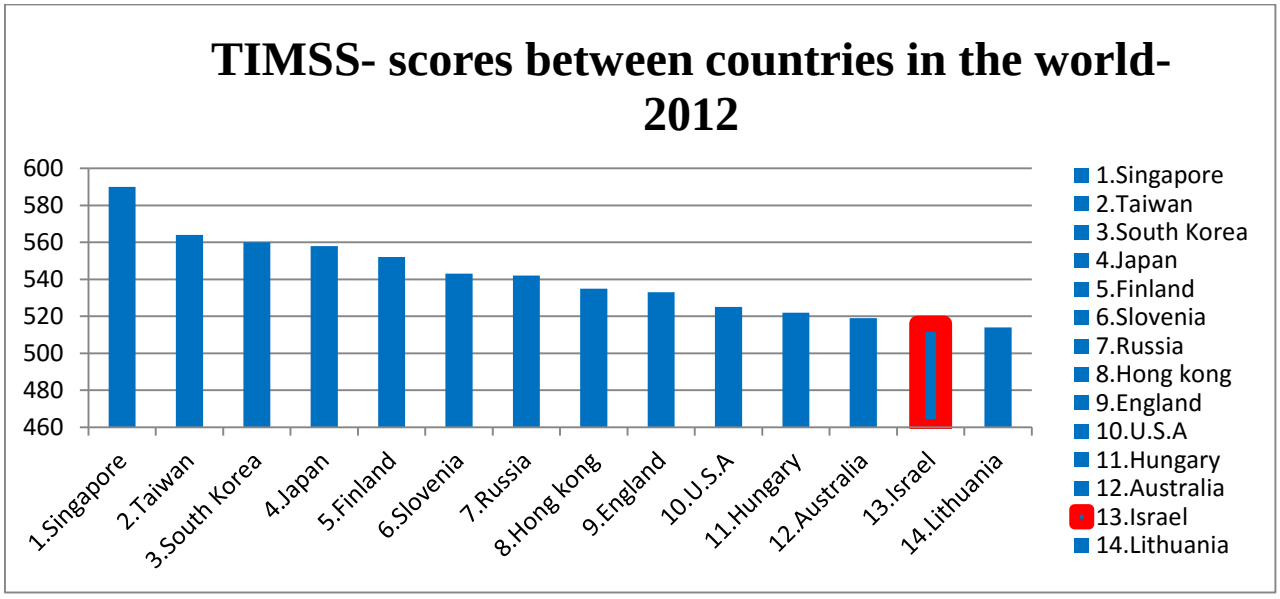


Figure 2.2 International comparative TIMSS results 2012

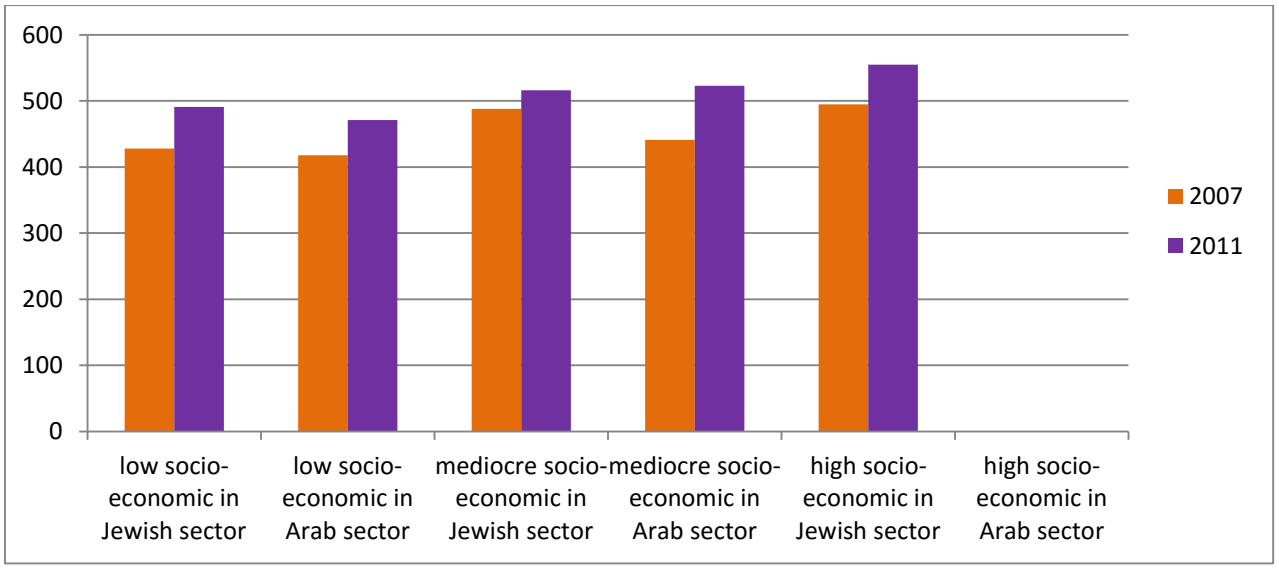


Figure 2.3 Comparison between TIMSS results by sectors&socio-economic status (2007, 2011)

The below graph (2.3) depicts social –economic status between Jewish sector and the Arab sector in TIMSS test-(2007, 2012) [43; 144].

Despite the nice results, a rise of dozens of points and a score above the international average, there are still big gaps between Jewish and Arabic sectors. The gaps have not increased but they also have not been reduced. In the Arabic speaking sector, the high socio-economic graph does not appear at all. The gaps stem from cultural differences and the socio-economic condition. The positive change in grades in the Arabic speaking sector stems from change in the study program and studying according to the new program from 2009 and the addition of high budgets and hours. Parallel to this, teachers undergo training apprenticeships and receive instruction just like in the Jewish sector. It is worth mentioning that Arabic speakers in the state of Israel were prominent in high position and scores in relation to all the Arab countries. Israel should proceed in improving the achievements and reducing the gaps between Arabic and Hebrew speakers in achievements and socio-economic condition. The state should invest in the field and purchase the required lab equipment. Should the gap be reduced, the international score of the state of Israel would advance to the top-ten [161]**.**

Factors of success: Setting of measurable targets – from Jan. 4, 2009, the Minister of Education set forth the international tests as a target while stressing outputs. He has created an organizational culture based on measurable targets.

1. Huge investment – 15 hours were allocated for each pupil for the studying of the subject of science as a core subject in Junior High school (7^{th}-9^{th} grades). In 10^{th} grade 3 hours were added. In total, 18 weekly hours were allocated per pupil in 4 years for the studying of the subject of science. Individual hours were added as well. A teacher teaches up to 5 pupils (excelling or those with difficulties according to needs) and improving their skills. The individual hours attract an educational, study and disciplinary change, improve achievements and reinforce the reciprocal relationships between a teacher and a pupil [91].
2. A continuous study routine – a focused and consistent learning. The educational system operated without strikes as was in the past, strikes which have damaged the study sequence and affected results.
3. Change of the study program – adjusting the work plan for skills required in the international tests. In the past there were subjects which have not been part of the study program and have not been studied in the school.

4. Much a hard work – the work of science teachers is hard and very complicated – meeting schedules and outputs. Obligates the school managements to accept an instructor – a leading teacher, and obligates all science teachers to undergo training apprenticeships. The system is monitored at all times.

Points of emphasis

There is no doubt that the new study program, from 2009, has significantly improved the achievements of pupils in the state of Israel in the subject of science, in the Hebrew and Arabic speaking sectors. The unity in studying, contents and accompanying changes have brought about this significant change. Additional improvement is amongst the achievements of girls in relation to boys in the Jewish and Arab sectors.

This graph 2.4 depicts the narrowing scores between boys and girls in science at 2007-2011. In 2007 the gender gap was nine points. In 2011 the gap between the scores for boys - girls was 7 points. However, in 2011 the total score was significantly above the average of OECD countries, the gap between the courts' from 2007 till 2011 is 50 points each gender .

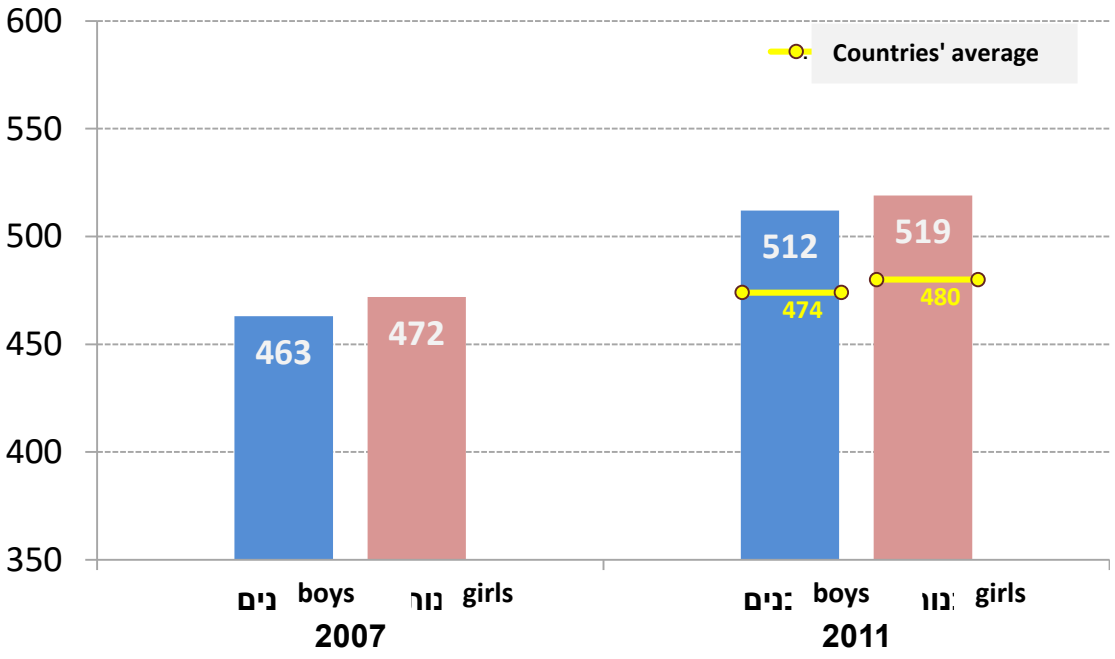


Figure 2.4 TIMSS results by gender – 2007, 2011

We can see a gap in favor of girls and a rise of about 50 points in boys' and girls' achievements between 2007 and 2011.

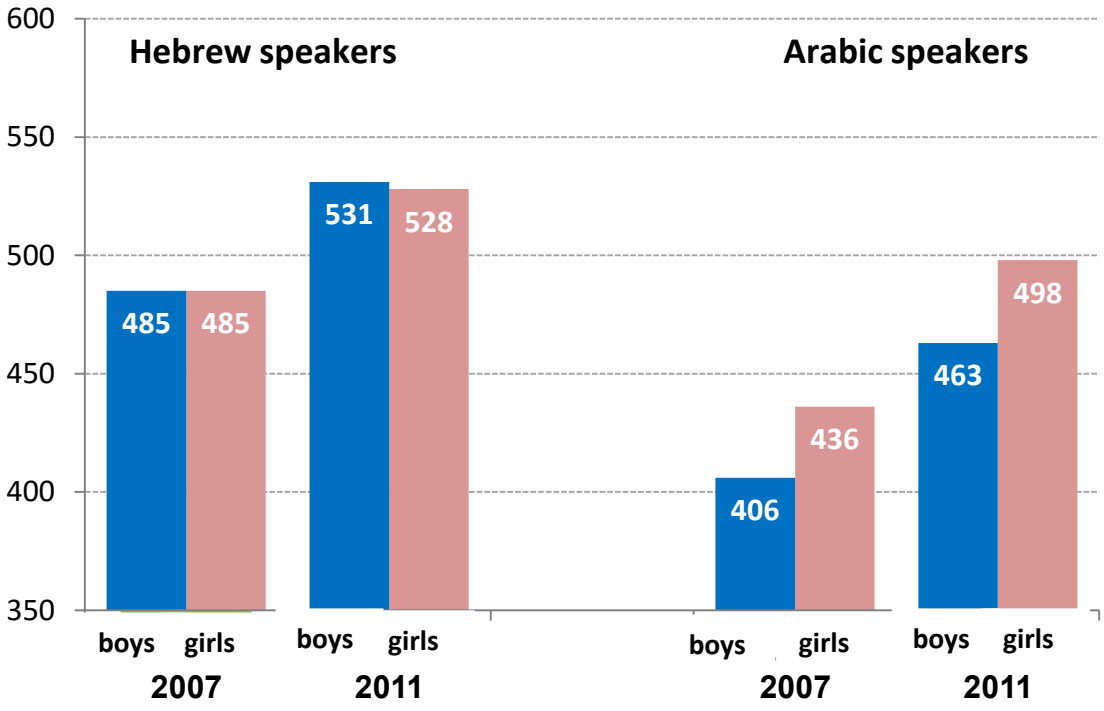


Figure 2.5. Achievements by sector, language and gender – 2007, 2011

This graph (2.5) introduces gender achievements in the field of TIMSS tests language between 2007, 2011, with the Jewish sector and the Arab sector. From above figure it can be learned that the achievements of boys and girls in the Jewish sector have risen, however the gaps are similar between 2007 and 2011. Amongst Arabic speakers, the achievements of girls are higher than those of boys, a gap which is slightly bigger in 2011 as compared to 2007 [112].

Success in tests stems from the hard work of teachers, teaching according to the requirements of the Ministry of Education, fulfilling schedules, the desire to be purpose-oriented and participation in training apprenticeships. The work of a science teacher is complicated. The teacher must teach and master in three subjects: biology, chemistry and physics. The teacher is under much stress and burden. The Ministry listens to the remarks of teachers on the grounds and learns from it.

However, not all educational personnel in Israel are part of this. The former Minister of Education, Yuli Tamir, claims that an intensive preparatory work was performed for the national and international tests. All countries in the world have a common denominator – achievement is above all. When preparing for tests, the results received effect a wrong reflection of the actual condition. International test are supposed to predict economic and social growth, but they have turned into a contest – which country better succeeds in them. To her opinion, pupils should be prepared for life, not for exams; in her term, she refused to prepare pupils for these tests [180].

Several principals from prestigious schools maintain that the international gradation obsession diverts the attention from subjects of no less importance; the system must satisfy the needs of education required by the Israeli pupils. Others claim that the Ministry has invested a fortune in this success which was in the place of other important study subjects in which pupils are not proficient, such as the History of Israeli People and Geography.

It is worth mentioning, that 90% of the pupils sampled, have participated in the tests [207]. However, 22.6% of the relevant age group of pupils of the religious orthodox sector were excluded from the study and have not been tested, as they do not study the core subjects. This population comprises 40% of pupils in the state, who are funded by the state. The rate of participants from other countries in the TIMSS is about 95%. Not a single one of the many participating countries approaches such a high rate of non-tested population the likes of Israel. Therefore, some consider the celebration and the improvement of achievements as a sort of illusion [82].

In February 20, 2013, the High Court of Justice obligated the Ministry of Education to initiate sanctions against the orthodox population: if they do not formulate a program for international tests and Meizav tests within 100 days, they would not receive funding from the state budget [114].

As an instructor on the grounds, I can attest that the success stemmed from a consistent and systematic work. The instructor accompanies the schools 4 years in a row, is aware of any problem, question or request, knows well the teams, strengths and weaknesses and promotes and helps the teams at all times. Everything is reported to the school principal and the Ministry of Education. The monitoring is personal and tight. The Ministry controls the activity in schools and tries to improve learning by assigning written assignments to pupils, tests for location of knowledge and practice by tests of the Ministry. The practice takes place throughout the year. The style of the questions and the character of the tests are constantly revealed for pupils' practice and familiarity. From 2009, the teachers study the program and the learning advances and improves. The results have been impressively realized in this test. The instructors contributed a lot to the change and the success and therefore they are called Change Leading Teachers ("Mamash", in Hebrew acronym) [41; 46].

Program purpose

The program purpose is increasing the target of rate of excelling pupils in the fields of science and technology in a significant manner in scope and quality of graduates who finish High School with an enhanced scientific technological matriculation certificate, while instilling of tools

for the realization of this target and a gender emphasis in relation to girls. For the first time a "quality scientific technological matriculation certificate" was defined. The purpose is to create an excelling six-year course, from Junior High school up to High school, that leads to a quality matriculation certificate in the fields of science and technology that includes: 5 study points in mathematics, 5 study points in nature sciences (physics, biology chemistry), 5 study points in technologies (software engineering, electronics engineering, mechanical engineering, biotechnology or scientific-technological) or an additional subject from nature sciences of 5 study points [158].

In 2010, only 6.5% of High school graduates in Israel were eligible to quality scientific technological matriculation certificate, 4% in math and 5% in sciences; the goal until 2020 is to increase the number of pupils in the field to 20% [152]. For a purpose of comparison, Taiwan, Singapore, South Korea and, Japan reach a level of excellence of 25-35%, 30% in math and 20% in sciences [119].

This table 2.1 shows the number of students who choose to study science subjects in different countries [155]. In Israel only half of the students choose to study science. This statistic is below the average of the OECD countries (2011).

Table 2.1 Comparison between Israel and the world – 2011

Country	Rate of those studying in general education	Rate of those studying in technological education	Rate of those integrating work with studies
Austria	22.9	70.8	35.0
Denmark	52.0	48.0	47.5
Germany	42.5	57.5	42.8
France	55.8	44.2	12.4
Israel	65.5	34.5	3.8
OECD average	54.9	45.1	11.7
EU19 average	47.3	52.7	16.1

According to publication of the OECD, the rate of pupils who study in the technological education in Israel is at 34.5%, while the average in the OECD is at 43% and 47.9% amongst EU19 countries. The steep decrease has begun in the 80's; about 50% of the Israeli pupils at that time have studied in the technological education.

In addition there was a decrease in the quality of education as a result of a steep decrease in budgets, closing of departments and laboratories becoming outdated. The situation has clouded the development of industry and caused a shortage of engineers, technicians and production employees. The table 2.2 presents data on students in Israel who study technology in terms of numbers and percentages [155].

Table 2.2 The number of pupils in Israel, 2011

	2009	2010	2011
Number of pupils studying in 10^{th}-12^{th} grades	325,510	329,500	332,382
Number of pupils studying in technological education	112,846	117,732	120,732
The percentage of those studying in technological education out of all pupils	34.7	35.7	36.3

The trend following the program is to continue increasing the number of excelling graduates in the technological education. That is through a promotional campaign, the IDF and the academy [155].

In 2011, after an appeal of the mayor of the city of Modi'in to the Minister of Education, Gideon Saar, the city was chosen by the Ministry of Education as a demonstrator of the new program of the scientific technological reserve [162]. The city constitutes a model and its purpose is to promote the science and technology excelling program in the city while a gender integration. From 2012, simultaneously, 7 classes of scientific technological reserve were opened in 7 High schools in the city. The goal was to integrate a larger number of girls; in reality, the rate of girls in classes spanned from 10-20% as opposed to boys [110].

Potential of scientific technological classes

In last two decades, the scientific education was harmed greatly due to a consistent cut in teaching hours and in equipment budgets. As a result, the number of pupils applying for these studies has decreased. In 2009, Gideon Saar was elected to be the Minister of Education. One of his targets was increasing the number of pupils that study for an enhanced scientific technological matriculation certificate, from 6.5% in 2009 to 14% in 2016 and to 20% in 2020. The purpose was strengthening of science studies, while giving emphasis to the periphery [158].

For this purpose, a program was developed in the Ministry of Education, which is structured and having targets and purpose, which outcomes can be measured in a several years. The initiator of the idea is Dr. Ofer Rimon, Head of Science and Technology Administration in the Ministry of Education. Intel Company and the Ministry of Education declared on mutual action programs for the advancement of technological education in Israel. This declaration was made in the visit of the CEO and president of Intel international, Paul Otellini in Israel (November 1, 2012). In order to promote education in Israel, the Ministry of Education has invested 260 million NIS and the high-tech company of Intel about 20 million NIS (5 million$). It is a long-term investment in order to develop the high-tech industry that constitutes a vital ingredient in the economy of the state of Israel. The program of "reserve for scientific technological leadership" is a prestigious excellence breakthrough program for the promotion of the future of pupils.

This course exposes pupils to advanced subjects from the field of science and technology and paves the way to being part of the future leadership generation. The Technion has recognized the importance of the program and would award an increased bonus to its graduates (July 18, 2012), [207] and there is a preference to schools that would succeed in drawing in of the largest number of girls to the program. Quote of Dr. Ofer Rimon, Head of Science and Technology Administration: "I would like to think about a brilliant female engineer that would be able to break through" [157].

Connection between science and technology create Israeli companies which are renowned and famous around the world. Presently, in the 21st century a wave of high scientific-technological innovation is coming into being, based on science and university research (Nano-science and technology). In the last decade, Israel was acting in the field of science and technology with a harming policy termed "the lost decade" – 10 years of Israeli pupils studying half the study hours in science, technological schools were closed, research budgets were reduced by 17% as compared to 23% in the OECD countries. Around the world, the scope of study and occupation have increased and begun to change. Global, national and international cooperation was performed (the human genome). Israel is a scientific power in research and development and was positioned in first places after Switzerland and Sweden. Since 2004, there is a slowdown that causes concern. A leader in the field of research is USA with 20% of the global study papers, following it Japan, Germany and France. In recent years, there was a rise in science in China, India and Austria [65]. The goal is that in the long term, Israel would be part of the 10 leading countries in the world in international achievements [161]. For this purpose, a new science program was formulated in 2009. Since the years of 2006, 2009, 2012, in which international PISA tests were held, there is a

trend of improvement and rise of 16 points cumulatively. As the years go by, since the beginning of the program in 2009, the improvement in level of achievements amongst pupils in the subject of science in Israel increases. The more Israeli pupils are invested in, the higher is the rate of excelling pupils. In 2012, the rate of excelling and excellent pupils in Israel, in levels of 5,6 according to PISA tests has reached the average of the OECD – 8%, while reducing the gender gaps between boys and girls with a negligent score. In 2012, the Hebrew speaking excelling boys have received 493 points and the excelling girls – 490 points, only 3 points in favor of boys, a negligent gap. The grading of Israeli pupils with over 490 points as Denmark and Sweden, and therefore it ranks 20th out of 43. 8% of Hebrew speakers are in excelling level [144]. In the TIMSS tests of 2011as well, there is a rising trend in the scores of excellent pupils and excelling pupils – 13%, while an increase in the rate of excelling and a negligent gender gap [75]. Thus, it can be learned that as we continue studying according to the new program, the financial investment is worthwhile, as the state opens additional designated classes, thus the achievements of excelling Israeli pupils improve while creating a negligent gender gap, which refutes the hypothesis, without a need for reduction of achievements. According to current study, there is significance in high incidence amongst the senior management level in significant improvement of achievements in science, in international and national tests amongst the excelling pupils.

Master document

The role of the master document that exists since 2009 is dictating a work program for science teachers. The program includes annual spreading of study subjects in science in the Junior High school for 7th-9th grades. The document outlines the program for a six-year study course of the scientific technological reserve. A course that begins in the Junior High school and leads to a matriculation certificate that includes three subjects in an enhanced level: mathematics, a scientific subject and a technological subject. In the scientific technological reserve class the contents are studies as in all the classes with an addition of additional contents that comprise a study enhancement. In current study, an interesting thing was revealed regarding the new science program, while creating a significant gap between the views of the program by pupils as opposed to teachers. While teachers report a significance in the high incidence of a program being dictated, boring, not leaving time for enrichment, stressful, very difficult for implementation or succeeding in meeting the schedules, the excelling pupils report with significantly high incidence on reasonable pressure in studies, diversification, enrichment and interest in the study contents. This variance stems from familiarity of teachers with past study programs when they have been teaching less subjects, have made studying more profound and an enrichment while creating projects. Pupils

have no ability to compare, and therefore, it might be that in relation to other subjects the pressure is reasonable. On the other hand, a correlation with high incidence was found in relation to the items of diversified program and its being full with study subjects. Pupils see it as an advantage as each period a different subject is being taught. There is a possibility of opening a "new page", giving an opportunity to succeed in studying. A pupil that has not connected to some subject can connect to other contents, if a score is not as expected there is a possibility to improve in another study subject, the year goes by fast. Diversity in study subjects allows each pupil, as well, to improve in at least one subject and develop it (based on the words of pupils). The more a teacher adheres to the master document in the study process, and meets the dictated schedules, the higher is the chance to meet the targets and requirements of the program. However, in order to be in this position, the teacher must excel (not every science teacher necessarily excels). The document as it is, causes a fast speed, mediocre, superficial studying, without leaving time for understanding, enrichment, and experience in the learning processes with an emphasis on weak learners' populations. A high incidence of frustration amongst teachers was found in current study, from the document being loaded with subjects in an irrational manner which leads to many pressures. In 2014, the new Minister of Education, Rabbi Shay Piron, was appointed, and it is possible that towards the next year, due to requests of teachers, study subjects in the document would be cut down by 15-20%.

Scientific technological reserve class

Institutionalizing the scientific technological excelling program, that would significantly increase the scope and quality of graduates, who finish with "a quality scientific-technological matriculation certificate". The program is presented in the appendix no 5.

The program intends within five years from 2010 to double the rate of pupils eligible for this certificate. The program is based on exposing pupils of high potential for excelling in fields of science and technology to a challenging and interesting program and of a high study level. It aspires at isolating pupils with excelling potential in fields of science in Junior High school as early as possible, while encouraging of girls and giving an equal opportunity to bridge gender, social and economic gaps (2014). Presently, in the state of Israel, 130 designated classes are being operated. They are 130 schools that us the program. Each year, additional classes are being added. In terms of gender, the hypothesis of comparing the number of pupils studying in these classes in terms of gender was refuted as in the classes study only 20% of girls and the rest are boys. The aspiration for gender equality between the sexes has not yet succeeded. According to the study, pupils in the classes report on significance of high incidence in sense of success, responsibility and

commitment to studying. The reasons for choosing to study in this class have had a high level of significance due to recommendations of parents (intense correlation with parents' involvement), being challenged with study of the science subjects that supply a response to the needs of a learner, prestige, recommendation of friends who study in parallel classes, or its graduates from past years, pupils with serious character for studying and excellent teachers. As the classes grow over the years, thus grows the number of recommending pupils as well. According to the study, 84.5% of the learners presently would recommend friends or family members to choose this study class.

Target population and family

Pupils in the scientific technological reserve class, ages 13-15, have been through strict selections in the transition from a Primary school to a Junior High school. They are considered excelling pupils, imbued with high motivation for study and activity. The pupils of the designated class do not characterize studies on the subject of motivation in Junior High school where it was found that motivation for studying decreases due to diminishing of involvement of parents as pupils advance in the level of their studies (moving up the grades) [105].

In current study, data were found that appear in models of excelling and excellent: pupils with high cognitive abilities (skills) and personal identity based in faith in themselves; motivation brings about commitment and execution of tasks, persistence in the face of difficulties and challenges in a way that amplifies and intensifies the level of performance of an individual [102; 133]. The findings of current study reinforce the findings in empirical studies conducted for the examination of a correlation between parental involvement and motivation of their children. The higher is involvement of parents with emphasis on studies, the higher motivation is. In current study, there is significance in high incidence regarding parents' involvement amongst pupils who study in the technological reserve classes and the persistence in their involvement is apparent with a study emphasis, but not only, throughout the three years of Junior High school. There is significance in high incidence amongst pupils in choosing studying in this class, due to realization of a dream of parents or occupation of one of the parents in the field. The higher is the level of education of parents, the higher is motivation for studying. Education level of parents affects the language style and speech of pupils and contributes to the level of mastery of verbal expression and organizing cognitive thinking. Parents are the first teachers of their children; therefore, they are the factor that affects learning process and motivation, more than intelligence and socio-economic condition. In these classes, the target population in terms of socio-economic condition is diverse and it does not appear as a condition. The higher is level of education of parents, the higher is their level of motivation and they thus constitute a role model for their children.

Composition of a scientific technological class through gender perspective

A scientific technological reserve class is comprised of 25 pupils. The class is comprised of excellent pupils (excelling and gifted together) [138]. The pupils represent all the socio economic layers of the country. The criteria for being accepted in this class are: high grades in all subjects, high motivation, showing curiosity and creativity, preference for participants of enrichment programs in the Primary school such as excelling 2000, participation in diverse enrichment courses in the afternoon, such as sports, music playing, art [94]. The class is integrated with boys and girls. There are classes that the gender gap is in favor of girls but in most classes there is a numeral gender gap in favor of boys. In current study, significance was found in high incidence of 95-100% amongst pupils for the existence of classes of this type that include boys and girls together. The hypothesis of the researcher was that there would be preference amongst girls for studying in classes of a female model in which there is a representation of girls only. The hypothesis was based on the article of Hanson [25]; the reasons for this gender preference are: good functioning of girls in this situation, girls succeed better when there is an encouraging atmosphere in class, there is a constructive feedback, and all express their opinion when the teacher evaluates the scientific ability of girls as that of boys. There is a low incidence for a class of a female model and therefore, the hypothesis in current study was refuted. Girls prefer to study in an integrated class with boys and to gain full support on the part of the teacher as if there are only girls in the class without boys. Due to the desire of girls to study in integrated classes and due to a study gender difficulty amongst girls with boys such as understanding of contents and processes in a profound manner, the recommendation is to establish a nuclear home class and from it the girls would go to lessons in subjects under discussion the likes of physics. At the end of the lessons, the girls would return to the home class and thus would continue to study in the integrated class according to their wishes, with boys.

Choosing the science subjects as enhanced in High school

In 2012, the international PISA tests were held. The score amongst the excelling male and female pupils was high 490 and 493 points. And the gender gap in score was negligent. Thus, it can be concluded that there is no gap between boys and girl and the achievements of Israeli pupils are in a rising trend [109]. Girls have high abilities of studying science subjects [67]. The results in achievements have stemmed from improvement of the educational system and the understanding that each pupil, girls or boy, deserves maximal fulfilment of personal potential. Encouragement of abilities of boys and girls to study the science subjects in an enhanced manner and the choosing of these subjects in High school as enhanced, while continuous view and

development of career in the fields of science and technology that allow a vast variety of occupations that that incur high financial income which brings about financial and personal independence [66].

For this purpose, the designated classes were opened in which boys and girls are exposed to the mandatory science subjects in an enhanced level. At the end of three years of study in the Junior High school, the pupils are asked to choose enhanced study subjects towards High school. The research purpose is to examine the gender distribution in choosing the enhanced subjects in High school at the end of three years of study in this class in the Junior High school. A variance in terms of ender was received in the study in choosing of enhanced subjects, a correlation was found to the data of the Ministry of Education [171; 182]. There is a rising trend with high incidence in choosing of science subjects. Boys have chosen with high incidence the subjects of chemistry, computers. Girls have chosen with significance in high incidence the subjects of Biotechnology and chemistry. The reason for the variance is in gender. Girls prefer to study subjects that are related to like. In the subject of physics in terms of gender, the incidence is mediocre and similar to boys who have a slight advantage. The hypothesis regarding the choosing of subject of physics was confirmed. There is a rising trend in choosing the subject of physics as appears in the data of the Ministry of Education. In 2010, 65% of boys and 35% of girls have chosen to study physics in High school as enhanced subject and in 2012 66% of boys and 34% of girls have chosen so. The average score in matriculation exams is 99 for each gender [182], which indicated gender equality. It should be mentioned that these scores do not represent pupils of the designated classes who would begin the tests in 2014. Thus it can be learned that the more a country invests resources in excelling pupils who study in the designated classes, thus the investment is worthwhile and an improvement can be apparent in the level of achievements and the trend of choosing by boys and girls the science and technology subjects as enhanced in High school. Should these trends continue the state would profit. A consistent policy is of importance that would not be affected by each election campaign.

The program purpose is increasing the target of rate of excelling pupils in the fields of science and technology in a significant manner in scope and quality of graduates who finish High School with an enhanced scientific technological matriculation certificate, while instilling of tools for the realization of this target and a gender emphasis in relation to girls. For the first time a “quality scientific technological matriculation certificate” was defined. The purpose is to create an excelling six-year course, from Junior High school up to High school, that leads to a quality matriculation certificate in the fields of science and technology that includes: 5 study points in

mathematics, 5 study points in nature sciences (physics, biology chemistry), 5 study points in technologies (software engineering, electronics engineering, mechanical engineering, biotechnology or scientific-technological) or an additional subject from nature sciences of 5 study points. The teachers got instructors and help from the ministry education.

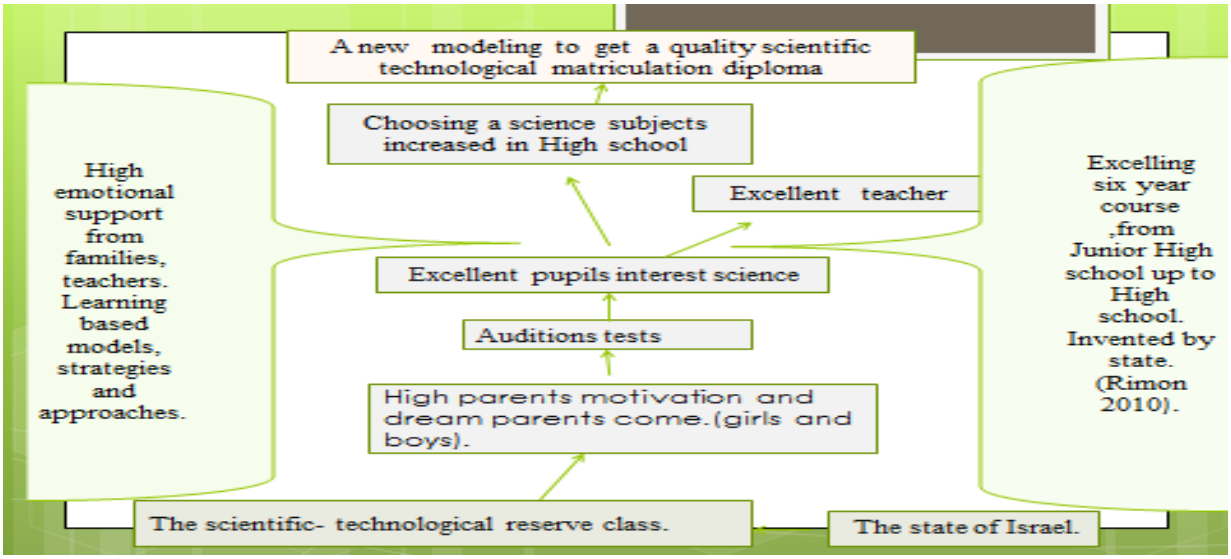


Figure 2.6 A new modeling to get a quality scientific technological matriculation diploma

The model presented in the figure 2.6 describes a scientific technology reserve class factors affecting. The model is based on answers that were written in the questionnaires given during a study research. The model also presented important factors affecting the success of the scientific reserve classroom technology and educational gender.

Program operation: The Model reflects the preconditions of the current studies. We started from the idea that the reason for a low rate of choosing the subject of physics with emphasis of girls: the subject of physics has many stigmas which need to be refuted in order to encourage mainly girls to choose this subject as enhanced in High school. According to the statistical data of the Central Bureau of Statistics, about 70% of the boys study physics and about 35% of the girls study physics. There is a double gender gap in favor of boys in choosing the subject of physics. In recent years with the opening of the technological class, this stigma is attempted to be broken in terms of gender. The scores of boys and girls in the matriculation exams are identical and reach 99 with no gender gap [82]. In current study, the boys and girls and the senior management level were asked as top the reason of not choosing the subject of physics as enhanced. From the pupils' questionnaires a significance in high incidence was received for the non-choosing of the subject of physics due to lack of interest. From the questionnaires of the senior management level significance with high incidence was received on the subject as difficult to understanding and

boring. Reasons with medium level and graded significance: lack of encouragement by the family, difficulty in understanding the studied contents, lack of clarity in studying and lack of employment in the field. This can be attributed to three groups: family, teaching, society. The less contribution there is on the part of family the lower is motivation. There is significance to family support. The less clear is teaching, the pupils sense that the attitudes of teacher in the field are not positive, the contents become not interesting, the pupils is rejected and the teacher has lost his opportunity. The longer society continues with the stereotypes in the field, the more difficult it is to change the face of things. The state should change this situation by setting policy in the educational system that would be implemented since preschool age and until university. The study is compatible with studies in the field in literature [66].

There is a rising trend in choosing of enhanced science subjects in High school. The status of the subject of science is getting strength. There is a gender difference in the distribution of choosing of study subjects of the enhanced subjects. The number of girls who study physics is half the number of boys, although the score in matriculation exam is equal in terms of ender – 99 points. Reasons for not choosing the subject of physics amongst girls – lack of family support teachers who do not teach properly and social stereotypes.

The program is operated in a Junior High school and a High school (current study will be focused on Junior High school). In the Junior High school, program pupils receive extra hours in math, physics, computer sciences and robotics according to unique study programs. Schools received a budget of 40 thousand NIS each, for equipping of laboratories for conducting the required experiments according to the program. In the Junior High school, program pupils receive enhancement in math and sciences adjusted to the needs of a pupil. The enhancement lessons are delivered in small groups and their purpose is to assist pupils to fulfill the obligations they have taken upon themselves in learning of sciences.

In 2010, two groups were opened in about 30 six-year post-Primary schools in all parts of Israel: one in 7^{th} grade and the other in 10^{th} grade; in 2010 there were 4000 pupils, in 2011 about 200 schools and presently (2013) over 10,000 pupils in 229 schools boys and girls in Junior High school – Jews, Muslims and Christians [111], (January 6, 2013).

Teacher training

Big part of the budget was allocated for teachers' training and training apprenticeships. There were training apprenticeships integrated with industry and meetings in factories with managers and prominent figures. The teachers experience a sense of satisfaction and challenge

while an understanding of their mission of being leading teachers in the field of technological education.

Program advertising

A key section of the work program is extensive advertisement, marketing and direction; instilling of the prestige through advertising in all mass media and communication channels. That is in order for the youth in Israel to understand the hidden potential in technological studies.

Examinations

Schools participating in the program are obligated to hold designated examinations in physics and robotics, Meizav and an extended summary examination in sciences as opposed to other classes.

Terms of acceptance for the scientific technological class in Junior High school

Upon completion of studies in the Primary school, 6th grade pupils are signing up for the 7th grade in a Junior High school. Pupils with an average of over 90 in the certificate, with a high potential, that are interested in studying in the scientific reserve class apply additionally and separately. Out of all the excelling candidates in an age group of about 100, about 60 pupils are accepted – boys and girls, in most cases with an equal number and occasionally in favor of girls. Pupils who get accepted, are signing up to the scientific class, after they were accepted to the scientific class, pupils who are interested, those having very high grades in math and sciences, apply to the scientific technological reserve class and go through designated selection tests. Only 25 pupils that successfully pass the selection tests would be accepted to the scientific technological reserve class. The pupils of the scientific technological class study all the subjects with their peers in a scientific class. Only scientific technological subjects would be studied by those passing the special selection tests (meaning only 25 pupils). These pupils would be examined at the end of the year, in addition to regular exams, in designated exams in the subjects of physics, sciences, robotics and math. Pupils who study the scientific subjects in an enhanced level, have studies of math – 7 weekly hours, sciences – 5 weekly hours, physics – 2 weekly hours and robotics – 2 weekly hours. Additionally, there is a high level is various fields of knowledge. Learning speed is fast and profound. The pupils cannot get a grade lower than 75. Pressure, competition and load are great. Teachers who teach in these classes are excelling and leading teachers. They well master the study contents and pay careful attention to interpersonal, pleasant and calm relation with pupils. In addition to studying, pupils receive personal conversations and individual enhancement in order for them to advance, succeed and meet the targets. The teachers are obligated to going to training

apprenticeships throughout the entire study year. Pupils of the classes meet industrialists, visit science museums in the country, the Weitzman Institute and participate in experiential activities that teach continuity in the scientific fields in life. The pupils are included in national competitions in the field of astronomy, robotics – building robots, science, national contests of various research fields, development of thinking and representing the school. The class teacher is greatly focused on the social and study atmosphere in class. The achievements of pupils are measured throughout each day, week, month and the entire year. In case there is any decrease in achievements, the class teacher immediately alerts and solves the problem instantly using the strategies at his or her disposal. The class budget is higher in relation to other classes in the age group.

How can the level of equality in class be improved, with the purpose of encouraging girls and boys in the studies of science and technology? [43; 46]. An important purpose of all the class teachers and professional teachers, who teach in the scientific class and the scientific technological reserve class in particular, is learning of teaching strategies for encouragement of boys and girls in the teaching of science and technology. Often, teachers are not aware of the way they treat boys and girls in the class, for that purpose, training apprenticeships were conducted that deal in the improvement of equality in class, with the purpose of encouraging girls and boys in the fields of science and technology.

2.2. Theoretical approach to Learning: Constructivism, Bloom's taxonomy

It is not a secret that Israeli pupils' achievements in science are not so bright, according to national and international exams. The question is why a subject such as science that deals with diverse aspects of knowledge, rich in research and experiments and very important from an economic standpoint, does not create interest and is not appealing to Israeli pupils especially with girls? Why do pupils report it as a non- interesting subject and emphasize this out by choosing other increased orientations in high schools. In order to understand the motions and the significant changes in study programs and methods of teaching the subject of science I am initially going to elaborate on the Constructive Approach.

Naturally, there are prior approaches. But this approach constitutes the foundation for different reforms in science teaching methods in different time periods. This approach derives from the Progressive Approach from the 18^{th} century, which states that the child is in the center and stresses contextual learning, for example studying geography by traveling outside and not by memorization (Jean Jack Rousseau, John Dewy). This approach was greatly influenced by the approach of Jean Piaget and Lev Vygotzki [188].

The Constructive Approach is an educational theory which explains how knowledge is acquired and constructed. Learning is done through a process of doing, through knowledge structuration and student's responsibility. A pupil's learning ability develops parallel to his cognitive development. This approach was adopted in the study of science. In a constructive environment pupils in a class are involved in activity, conversation and mutual thinking over subjects that are significant for them. The teacher encourages autonomy and a creation of an atmosphere that is convenient for expressing oneself. Learning is based on prior knowledge, experience, thought strategies and motivation. The teacher guides the pupil accordingly. A process of assimilation occurs while learning – a construction of inner-cognitive representation [198]. The STS theory integrates Science, Technology and Society. It stresses the involvement of a person in scientific procedures and strengthens authentic learning. Learning in a group leads to construction of knowledge [174].

Current study is using the "constructivist approach [91; 163; 188], "structuration of knowledge". "Constructivist approach" is a "hot" concept in the educational discussion in recent years, which appears in headlines of articles, books, and internet sites. Constructivism is a comprehensive name to philosophical, psychological, pedagogical, sociological and methodological approaches. What is common to all of the approaches is that knowledge is constructed rather than being revealed or delivered. This is a general claim that is interpreted and applied in different disciplines and is connected to the names of many philosophers and researchers from different fields (for example: Kant, Piaget, Vigotzki). In light of this, the 'father' of constructivism, which is a collection of many approaches, with some overlapping points, that evolved side by side, cannot be looked for [198].

There is a transition from a frontal traditional teaching to constructivist teaching [150] In Piaget's psychological theory (Piaget, 1896-1980) learning is cognitive, the learner active in the center sees in learning an active process of a structuration of knowledge. In the philosophy of [188] (1930), a person is actively constructing meaning for the studied knowledge with a social emphasis. Knowledge is constructed on the basis of cultural experiences that are shaping and developing a child. The constructivist approach brings together psychology and the philosophy of learning. Pupils' abilities of learning are developing simultaneously with the development of cognition and each of the stages is based on a previous stage during interacting with his surroundings in an active process.

Presently, in the 21st century, the technology supplies the means. In the past, with no connection to pedagogy, the educational system has found itself with new technologies that have

not been in line with the philosophical and psychological principles. The system was "chasing" technology that started to take control over teaching demanding education philosophy and psychology to adjust them to it. In the new science study program from 2009, a combination of the three fields was performed. Philosophy supplies the guidance, psychology supplies basic learning principles and technology supplies the means to fulfill men [91]. Teaching that is based on – "learning by research and through projects". The research is done in an interesting way, while integration involvement of the environment and other learners according to the developmental ability of the learner and his responsibility [92]. In the process, the teacher is in the duty of instructor and not a supplier of knowledge (the knowledge is vast and is revealed through the technology). As learning takes place on the basis of the constructivist approach, learning is thuds meaningful and experiential for the learner.

As a result of a political change and change in the educational conception in March 2009, the situation has changed regarding the teaching of sciences in Israel. Science subject has become one of the core subjects which are taught compulsorily in all the schools in the country (the additional core subjects are – mathematics, language and physics) [117]. An interim document was written as a prototype document, extending the curriculum and dictating clear and uniform lesson drafts. Similarly all the schools in the country were compelled to teach teaching sequences according to the new prototype document, to keep timetables and to perform sit examinations of the Ministry of Education testing every age group. The teachers of sciences, veterans as youngsters, were compelled to participate in annual advanced studies including presentation of work with a mark. In these further studies they have learnt subjects which they did not know or enrichment in study strategies and improvement of teaching methods and learning skills [128]. Many hours were added in sciences. The program is spiral and grows over the years [134]. Many instructors have been trained in order to enter schools and follow the assimilation of the program by organizers and teams in various schools in the country .The instructors have undergone annual trainings in the Weitzman Institute. The training of instructors has continued in a sequence for five years already, and now awaits the opening of the sixth year [95]. New kits have been written for all the teachers called by the name Assessment Learning Teaching details of assessment, how to examine the students in the same way in order for them to learn how to answer the questions in various tests. Assessments have been written by teachers from the field together with the Weitzman Institute [174]. Tests have been written by the Ministry of Education, for every subject separately and all the teachers should give these tests to the pupils in different ways – homework, studies, tests, examinations [203]. The questions in assessment items are formulated according to subjects

that the pupils are examined in the international tests, so that pupils are not exposed for the first time to these questions only during the examination [183].

Bloom's Taxonomy

Bloom's Taxonomy (1956) – The new study program in science and technology used new kits named H.L.H- teaching learning assessment or evaluation of learning provision. The kits were written assessment evaluations to examine the internalization of the material. These questions started to strengthen ***gender*** trainees. The based types of those gender questions used the Bloom's taxonomy for the training in the classroom and at home.

This taxonomy of learning behaviors may be thought of as "the goals of the learning process." That is, after a learning episode, the learner should have acquired a new skill, knowledge, and or attitude. Bloom's taxonomy refers to a classification of the different objectives that educators set for students learning objectives. It divides educational objectives into three domains: Cognitive, Affective and Psychomotor. Within the domains, learning at the higher levels is dependent on having attained prerequisite knowledge and skills at lower levels .A goal of Bloom's taxonomy is to motivate educators to focus on all three domains, creating a more holistic form of education. Taxonomy was designed to improve communication between educators on the design of curricula and examinations. A term that is borrowed from the field of biology to the field of education is a formation system organized by a gradient order that has a meaning. Skills in the cognitive domain revolve around knowledge, comprehension, and critical thinking on a particular top. The achievement of a target at a higher level depends upon the achievement of prior targets. The taxonomy is based on the proposition that there is a higher mental skill in existence. The different levels are described by a pyramid [140; 142]. Bloom's Taxonomy has two main targets 1. Study planning. 2. Testing of results. It is made of 6 gradients: knowledge, comprehension, application, analysis, synthesis and evaluation. As understanding is reached in higher levels of the Taxonomy, it is assumable that a better and deeper control was reached on the lower levels of the taxonomy [81].

The connection between learning in the scientific technological leading reserve class and the Bloom's taxonomy are expressed the way teacher teaching those excellent pupils, With reference to ***gender*** on the type of questions, the level of the questions and how asking questions using the Bloom's taxonomy. The subjects are in a very high level, also the questions that must be in a very high level. The pupils also make an experiences and writing a learning inquiry. The taxonomy is constructed of six gradients – as understanding in the high levels of the taxonomy is

reached, it can be assumed that a high and profound understanding of the contents was achieved [81; 140; 141]. In the past decade, in different countries around the world, such as the United States, England, Australia, Finland, a process of updating and changing study programs in science and technology fields is taking place [61; 149]. As the new science program strive at cultivating learners with scientific literacy, who know how to use a variety of study skills and as scientific principles are being achieved, thus grows the functioning as science independent learners [93]. As a result, pupils develop scientific thinking, connecting to the subject and they would want to work at it in the future.

Learning is based on conducting research that intrigues curiosity and understanding of the research stages. In this learning process, personal inter-relationships are forming between a teacher and pupils that will strengthen the appeal of the learner to the fields of science teaching. This connection will encourage the learner in the future and will assist him to select those subjects as enhanced in High school.

The research basic premise in the new science program [64] has created a trend of positive change in the study contents. High motivation for learning [143], reduces the gap between boys and girls (National Authority for Evaluation and Measurement in Education, 2014), due to the establishment of the scientific technological reserve classes while tracking towards the choosing of the science subject as enhanced in High school, in an emphasis on the subject of physics. For the new program's study purpose, kits for the teachers were designed – E.T.L. kits – Evaluation, Teaching, Learning [183] (Science Teachers Center for Science and Technology in Junior High schools, 2009). The contents of the kits, the sequences of teaching and the evaluation details tasks are based on Bloom's taxonomy [140].

In order to encourage and reinforce the girls in study of the sciences subjects girls were exposed, from the different schools all over Jerusalem, who participated once a week in a female enrichment and empowerment course called "Alma" – the initials for "encouragement of the sciences" (in Hebrew), as well as the word for "a young girl" This course in a gender framework in which they teach girls empowerment of women, within encouragement of the study of the science subjects considered to be masculine [80]. The course was taught at laboratories, in the Hebrew University in Jerusalem. This course began in 2012 –2014, with the girls studying robotics and that would earn 6 units in the matriculation [141]. In this course the girls learn and are reinforced in various fields of knowledge in the science subjects, in order to encourage choice of these study subjects towards the matriculation and in further life [169]. The "Alma" program was formulated by Dr. Ron Blonder, who was exposed to the data dealing with the involvement of girls

in the science subjects throughout the process of study from Junior High school through High school and the Bachelor's degree. As a result of non-encouraging data, Dr. Blonder has decided to promote the participation of the girls in scientific studies with an emphasis on physics, especially with girls coming from a low social and socio-economic background. First period of the project lasted five years ended in June 2014.

In addition to the new study materials **different strategies** have been integrated to diversify teaching with reference to ***gender***.

1) **P.E.O.E. strategy**: P – predict; E – explain; O – observe; E – explain, an Australian strategy with investigatory approach. The idea is that during an experiment it is possible to break down and isolate each step separately which allows for the understanding of the experiment without skipping stages Theories or models are used to help explaining the evidences and measurements This layout assists students to understand the connections in final explanations, causes a change in existing and prior perception. The surprise is by a cognitive conflict while assimilating investigatory skills. It helps the teacher in understanding a wrong rooted thinking or lack in understanding, mixing of missing terms, deep thinking. It helps in understanding a group's character. The teacher thus knows what to stress in future lessons. He will thus diversify his teaching methods, allow for another type of thinking and reveal knowledge levels [169].

2) Silent demo strategy – an experiment is performed silently with nobody talking, not the teacher nor the pupils. It allows for concentration and observation in any stage. Silence allows a pupil to deal alone with its understanding and personally concentrate with focus on each stage of the experiment [124; 168] .

.3) **Explaining Science Model** – a learning model called Explaining Science, which integrating contents and skills. The models are explained to the students through presentations which include sketches, pictures and graphs. The subjects are abstract and also from the field of physics. By this model the student is associated with the subject in an easy and clear fashion [194].

4) **"Construct a molecule"** [19; 68], a simulation model – understanding the spatial structure of molecules and the connections between atoms while using the chemical language and writing of formulas. The outlook is interactive, that enables experiment and trial while relating to the terms that were learned in a way of experiment that stimulates pleasure.

5) **Kolb's study circle model** (1975) [31], [129], an activity requiring interaction between the participants and an opening in which the information reception is being done while active experience and reflective observing. Based on learning styles [159]. As much as the teacher

varies the learning processes with the means of strategies and models so the learner develops scientific thinking. The learning is significant, there is motivation and pleasure amongst the learner and his connection to the subject of science grows.

6) Research project-**Learning in inquiry**- in 9th grade-In the current year of 2012 the subject of research is mandatory for the first time in the 9th grade in Israel. The pupils, in groups of three, have been requested to choose a subject and research it according to scientific rules. Reports have been written and posters made up, and a theoretical paper was submitted. The posters were presented in the school in the highlight day event. Two posters were chosen that participated in a competition in the Israeli Museum on 23.3.2012. Many teachers have been exposed for their first time to writing a research paper and the process of explaining to the pupils was complicated. At the end pupils and teachers reported a pleasurable study. Friendly relationships have been established between pupils and teachers.

In the process of reading various articles in Israel and abroad, the researcher has found similar points in the field of teaching of science. There is a gap between achievements of boys and girls, in favor of boys. Girls are deterred from choosing the scientific subjects due sociological-psychological reasons. Girls fear of failure and therefore, turn to other fields, easier ones that guarantee success, big time. In the field of physics the situation is more problematic. Few girls approach this field, so that the gender problem is of prominence. All around the world, there is a big gap between achievements of boys and girls in international tests. All around the world, there is a decrease in choice of subjects of science amongst girls as opposed to boys. The reasons are similar. In different areas in the world, the gender issue is emphasized and this problem is given attention. Attempts are being made to increase the number of girls in the field by empowering them in various ways. In the world, just like in Israel, the number of girls who study science as an enhanced subject in schools and universities is very low. These subjects were examined in the process of writing the study paper [42].

The purpose of current study was the examination of the correlation connection between the new science study program and attitudes and achievements in science amongst pupils in the technological science reserve class in 7, 8 and 9th grade in Junior High school, while relating to gender and understanding the factors that influence study and up to the choosing of science subjects as enhanced subjects in High school.

More employs models supporting

Current study employs "the third model" [103; 104] and "the three logics model" [127], and "the constructivist approach" [188]. The "community" model is a combination of two previous models. The new science program of 2009 is based on these approaches and models. It is about a community of learners that creates activity, as a pendulum between control and freedom, mutual in the aspect of support and effort to teachers and pupils for the purpose of resolving problems, creating knowledge and understanding "the world". Studying is composed of a number of stages – pre-apprenticeship stage, which gives the pupil knowledge and approaching skills to manage a study, a question, a research and a summary work. [103]. The higher is the partnership between a teacher and a pupil, the clearer is the understanding of the contents, learning is experimental and significant and the pupil is more connected to the teaching of science.

The research basic premise in the new science program [64] has created a trend of positive change in the study contents. High motivation for learning [143], reduces the gap between boys and girls (National Authority for Evaluation and Measurement in Education, 2014), due to the establishment of the scientific technological reserve classes while tracking towards the choosing of the science subject as enhanced in High school, in an emphasis on the subject of physics. For the new program's study purpose, kits for the teachers were designed – E.T.L. kits – Evaluation, Teaching, Learning [183] (Science Teachers Center for Science and Technology in Junior High schools, 2009). The contents of the kits, the sequences of teaching and the evaluation details tasks are based on Bloom's taxonomy [140].

An additional assumption in current study – the study and the emotional support from parents, teachers and the educational system. What causes study motivation? One of the main personality data of a pupil that is required for his study success is study motivation. It can be developed and parents can affect cultivating it [127]. Two kinds of motivations are active upon a learner: external (parents, teachers) and internal (motivation, investment) [105]. One of the significant components that influence a pupil's study motivation is involvement of parents [181; 192]. The more parents are involved in the learning processes, the higher is study motivation and accordingly, achievements in the field. There is a prominent significance in current study to high motivation amongst pupils in the scientific technological reserve class with no gender difference.

Presently, pupils that comprise the designated classes are excelling and exceptional. What are those excelling and exceptional pupils? In Israel, there are 5% of gifted and 13% of excelling (Piaget, 2012). The country sees them as pupils with special needs. Excelling – a way of life, a compound of behaviors aspiring towards constant improvement and extraction of ability. It requires motivation, curiosity, persistence and creativity. Exceptionality – a remarkable ability,

extraordinary, in a level of “expert". Researchring of extraordinary achievements [70]. Isolation of the pupils takes place at the end of Primary school and the transition to Junior High school. In those classes pupils reserve a response for needs based on values, norms and policy that is dictated by the state (2009-2014) [134]. The study in this class is based upon the "excelling scale" model that defines five stages; [70] and the "three stages enrichment" model, dealing with principles of development of science study activities [146]. As a pupil develops the model stages regarding him, he could get to supreme excelling, to work with high professionalism while using knowledge and skills with no external reword [96]. A use of additional model to develop principles of estimation to excelling pupils in interdisciplinary subjects – exposure, deepening, advanced research in the field of contents and in the field of strategy – the variety of research questions, the research question, the research ways – a high order thinking (Renzulli) [146; 147]. According to studies, the excelling and the gifted pupils achieve less from the cognitive aspect in integrative classes than they could have achieved in homogeneous classes of pupils just like them [94]. Excelling pupils that do not realize their cognitive potential, sometimes respond in creating disciplinary problems or boredom. In current study, it can be seen that the state, in public education framework, has decided to give these pupils an answer to their needs with opening of technological designated classes. The initiator of the idea, Dr. Ofer Rimon, head of Science and Technology Administration in the Ministry of Education and their application is in a pilot started in 2010. In these classes, the budget invested is high and there a high incidence to learning environment that supports parents, teachers, and system. Every year in May, a designated test takes place that tests the rate of learning advancement and meeting the Ministry requirement. The more a pupil is suitable to a type of class that operates according to his needs, the more studying is significant, stimulating of intellectual ability and encourages thinking and learning. The pupil is calm and does not create disciplinary problems or gets board. This is the reason this classes are prominent in their significance in lack of disciplinary problems, which draws teachers to teaching in those classes.

Points of emphasis

- Israel should put greater efforts in the young generation, especially in the girls, to prepare a future generation of scientists. They should achieve international achievements like prof. Ada Yonat & Prof. Dan Shechtman who won the Novel prize.
- Since 2009, as a result of political change &shift in the educational conception, the situation has varied in the way of teaching sciences in Israel. Gideon Sa'ar, the minister operated in the reinforcement of the core subjects, he allocated thousands of educational hours in

mathematics, sciences & mother tongues. This stimulus was done to improve the students' achievements, especially the girls' achievements in sciences, in Junior High School.

- Presently, in Junior High schools, 130 classes of scientific technological reserve have been opened around the country in 130 junior high schools. The pilot to this type of classes has begun since 2011 and has taken place in 30 Junior High schools in Israel.
- All over the world, including Israel' there is a big gap in the achievements in international sciences exams between girls & boys. The education system will be focused more on science' education of youth, especially girls. The educational strategies, based on best international and national experiences will be developed [42; 44].

This Dynamic Diagram- SCIENTIFIC TECHNOLOGICAL LEADING RESERVE CLASS (figure 2.7) shows the structure of the sixteenth annual scientific reserve classroom technology from junior high to high school classroom. Rating study methods, theories, experiences, based on learning kits H.LH, Special master document outstanding teachers and parents support end of high school, getting a high school diploma scientific quality.

The analysis of components and the process of implementation of the new program in science and technology demonstrate the importance to engendering the implementation's strategies. Gender prioritization is determined by socio-cultural, economic and educational environment in Israel, as well as trends in educational policies connected to gender equality. Between the factors that determine the implementation of the new program in science can be mentioned: insufficient motivation of students to study science and technology, the discrepancy concerning the attitude of boys and girls to science and technology, low level of professionalism of teachers in guiding girls and boys into learning the subjects in question.

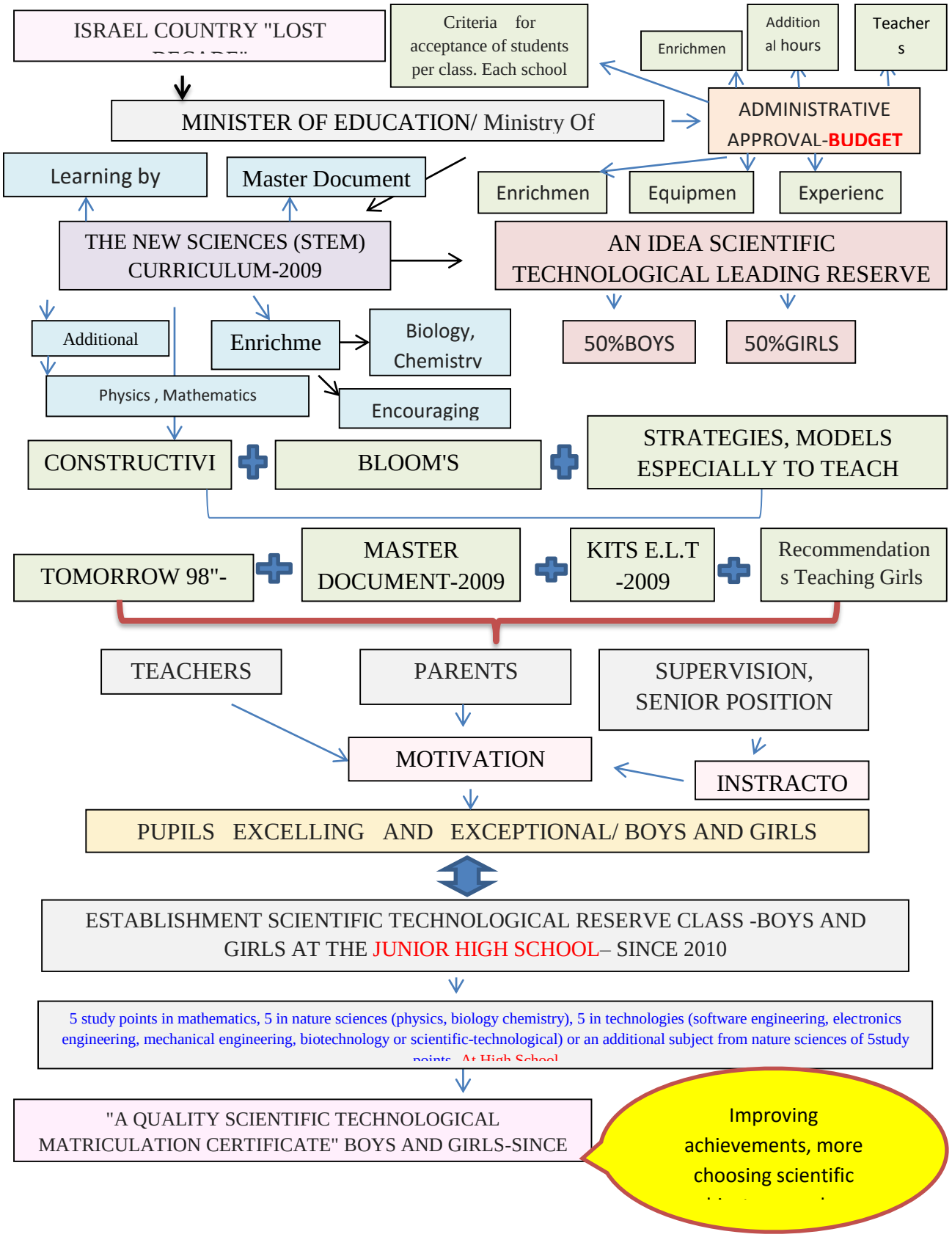


Figure 2.7.Model of scientific technological leading reserve classes from 7th-12th

2.3. Gender based approach

In order to ensure better harnessing of the gender into program's implementation we decided to start with explanation and also contribute to development of the concept of gender.

Gender: In the sixties feminist theorist began designing the distinction between sex and gender. They created a separation between sexes, biological dictated, and system settings and cultural distinctions, we attribute to be a man or a woman. The Hebrew word gender was created in 1997 at Tel Aviv University by a group of professors, fight between the words sex and gender**.** Gender refers to social attributes that are learned or acquired during socialization as a member of a given community. Gender is an acquired identity, refers to the socially given attributes, roles, activities, responsibilities and needs connected to being men (masculine) and women (feminine) in a given society at a given time. Gender systems are institutionalized through education systems, political and economic systems, legislation, and culture and traditions. In utilizing a gender approach the focus is not on individual women and men but on the system which determines gender roles, responsibilities, access to and control over resources, and decision-making potentials. It is also important to emphasize that the concept of gender is not interchangeable with women. Gender refers to both, women and men, and the relations between them. Women and men's gender identity determines how they are perceived and how they are expected to think and act as men and women. Gender determines what is expected, allowed and valued in a woman or a man in a given context.

In most societies there are differences and inequalities between women and men in responsibilities assigned, activities undertaken, access to and control over resources, as well as decision-making opportunities. At 1999 the General Assembly recognizes the competence of the committee on the elimination of discrimination against women and to make conduct inquiries. Discrimination occurs in various forms in everyday life. Indirect discrimination occurs if intrinsically neutral rules or laws negatively affect certain groups female and workers. Gender and Stereotypes goes together because of set and characteristics attributed to a specific ethnic, national, cultural or racial group which gives rise to false expectations that individual members of the group will conform to these traits. For an example women are perceived in society is affiliated with a private space (home, children, family) and men with the public sphere (work, politics, commerce). Accordingly, women are expected to be driven exciting than men who are supposed to be driven logic.

Theories of development propose that educational expansion has a key role in economic development and social transformation, specifically that it can contribute to the narrowing of social stratification along gender and ethnic lines, thereby empowering women and the most

disadvantaged members of subordinate ethnic groups. In contrast to this position, a number of scholars question the power of education alone to narrow inequality or to transform stratified societies.

According to the Recommendation CM/Rec(2007)13 of the Committee of Ministers to member states on gender mainstreaming in education, the education system has the responsibility to educate pupils/students for active participation in the various aspects of democratic life, be they political, civic, social or cultural, and at all levels – local, regional and national. The connection between equality between women and men and the gender perspective in the education and active exercise of democratic citizenship and the building of a genuine partnership between women and men in the private and public spheres was established.

At 2003 in Europe, the Committee of Ministers to member states on balanced participation of women and men in political and public decision making, in which it invites member states to incorporate into school curricula education and training activities aimed at sensitizing young people about gender equality and preparing them for democratic citizenship.

At Istanbul, 1997 the Steering Committee for Equality between Women and Men (CDEG) and the Steering Committee for Education (CDED) focused attention on promoting gender equality education and non-stereotyped education at all levels of the education [201].

According to ECOSOC report: Ensuring that women acquire scientific and technical knowledge and skills are also an economic imperative [16]. As the world economy is increasingly driven by knowledge, countries need a large base of workers who can apply technology, as well as scientists and engineers who can carry out further research and development. Developing women's competencies will widen the pool of human resources available to perform these tasks. This is all the more important as many countries are facing a shortage of science and technology professionals, coupled with a growing disinterest in science among youth. Moreover, environmental concerns are leading to a growth in so-called green jobs, many of which will demand a solid educational background in science or technology. All the mentioned sentences offer argues in favor of girls 'involvement in the science and /or technology.

In the context of current study we would like to introduce some relevant definitions.

The gender dimension is established in various socio-cultural contexts determining the expectations, permissions and appreciation of women/men and girls/boys in these specific contexts. The gender dimension is institutionalized through the educational system, political and economic system, legislation, culture, religion and traditions.

According to international standards, mainstreaming gender approach is the (re) organization, improvement, development and evaluation of policy process, so that the gender

equality perspective is incorporated in all policies at all levels and at all stages by the actors involved in the policy development [49]. In the context of the above, from our point of view, *the gender education perspective in science is presented as an integral dimension of the development, implementation, monitoring and evaluation of educational programs, in order for girls and boys to benefit from them equally, curriculum and learning materials and school environment should be sensitive to gender-specific needs of students, without preserving inequalities/limitations, based on sex.*

Gender roles, attitudes and behaviours are learned through socialization/resocialization; being flexible, they are subject to changes depending on many political, socio-economic and cultural factors, that play a decisive role in preventing negative psychosocial phenomena such as violence and discrimination based on gender, and inferiority complexes. Through the exploration of gender equality in education subject, the school offers girls and boys patterns of behaviour to develop their potential, to identify needs and aspirations, career guidance.

Empowering women/girls with scientific and technical knowledge and skills is also an economic imperative. As science and technology develops, the world economy needs qualified workforce. Developing skills in women/girls will expand the reserve of human resources available to perform these tasks. Moreover, environmental concerns lead to the development of so-called ecological jobs, many of which will require a solid educational background in science or technology.

"Quality education" means: taking account of the following three elements:

- Matching performance to expectations (fitness for purpose);
- Self-improvement and transformation (focus on processes);
- Empowerment, motivation and participation (focus on learners);

All mentioned above points are closely connected to gender equality perspective in education.

We would like to mention the tendency to promote the Concept of "Gender Friendly School" (UNESCO) [11], with goal to challenge and change negative gender stereotyping and gender inequalities in all aspects of learning institutions and to promote equal opportunities for female and male learners to develop a healthy gender identity and complete a quality basic education. Gender friendly school refers to many aspects: school environment and especially relationships between boys and girls and also between pupils and teachers (women and men).

In light of the above, we come with the development of basic concepts. Upon acceding to the position of the researcher V.Bodrug-Lungu, being that the gender dimension in education is a formative educational approach through a series of actions that are based on considering specific influences related to the formation of boys and girls through the educational policies and training

for preventing and overcoming gender stereotypes [1], we propose the supplementing, *by attracting girls and boys in science and technology through encouraging and exploiting their potential.*

From our point of view, *gender sensitive education in science represents the process of ensuring equal access of girls and boys to science, of opportunities for development of personal potential by applying methods of encouragement and eliminating gender stereotypes from the curriculum, teaching materials, and from the whole study process.*

However, we reiterate the term "gender", which involves analyzing the impact of education system influences on the development of boys and girls, their awareness of their own gender identities, ideals and vital goals selection, status in school environment, having as reference the biological sex of individual [1; 6].

Meanwhile, based on existing studies in the field [8; 1; 16], we would like to specify *the main elements aiming gender in education:* access to education (girls/boys); learning content (gender patterns, specific motivating exercises etc. in textbooks, teaching materials); forms and ways of organizing education (involvement of girls/boys, in separate classes/groups or mixed etc.); ways of assessing knowledge (attitudes, assessment of students on grounds of sex, etc.); characteristics of the teachers in charge of the education of girls and/or boys (percentage of women/men, their gender sensitivity, personal and professional level of stereotyping etc.); gender sensitive climate (physical, informational, relational) of educational institutions etc.

The new program in science and technology includes, among its objectives, encouraging girls to study science and technology. Thus, girls selected from different schools in Jerusalem had the opportunity to participate once a week to the course of empowering "Alma" (extracurricular), after which it was concluded the need to include a gender perspective in the educational process, especially in the study of science and technologies. These findings prompted our decision to deal entirely with this topic.

2.4 Methodology of implementation of "New program in sciences" from gender perspective

In order to ensure the implementation of the new science and technology program by ensuring the introduction of the gender perspective, we have focused our efforts on the design and the development of gender exploration methodology in teaching, learning and assessment, which was expressed conventionally, through a series of instructive models as follows: Constructivist approach to learning, Instructional Model to encourage girls students in science and technology, a Profile of excellent teacher gender-sensitive, a Instructive Model for parents.

The methodology is based on the fundamental principles, aiming the educational process, by taking into account gender specific. In this regard, we have followed the principles proposed

by V. Bodrug-Lungu [1] and developed them (in italic): the principle of non-discrimination based on sex; *the principle of using non-sexist language;* principle of equal treatment of girls and boys, *with spotlight on socio-cultural and religious context;* the principle of gender positive experiences exploration and feelings of capable learners; the principle of knowledge and consistent promotion of gender equality in the context of human rights and fundamental freedoms; the principle of fundamental human values unity, national values, gender values; the principle of gender equality respect at personal and society level; the principle of optimal matching of psycho-physiological and gender aspects, socio-political, cultural and spiritual education - ensuring the complex approach of a person to the education process; *the principle of strengthening the self-esteem, relevant for girls; the school partnership principle - gender sensitive family training and career guidance for girls. The gender dimension, with reference to the exploration of the new degree program in science and technology relates in preventing and overcoming gender stereotypes and prejudices regarding the attitude and learning of science and technology subjects by girls and boys, but also ensuring the students success and performance.*

We propose an Instructive model to encourage girls students in science and technology [122; 6], which includes the following strategies - components, pursuing the purpose of raising gender equality awareness in the classroom (Figure 2.8), as follows:

1) Setting a high standard of expectations towards girls, the same as for boys.

2) Encourage girls to participate at the same level activities as boys.

3) Provide equal assistance and feedback to girls and boys.

4) Encourage girls to use the technological means and equipment as much as boys, participating in activities and experiences in the field.

5) Girls tend to a more passive learning than boys. Thus, create a balance between work content and activities based on cooperation.

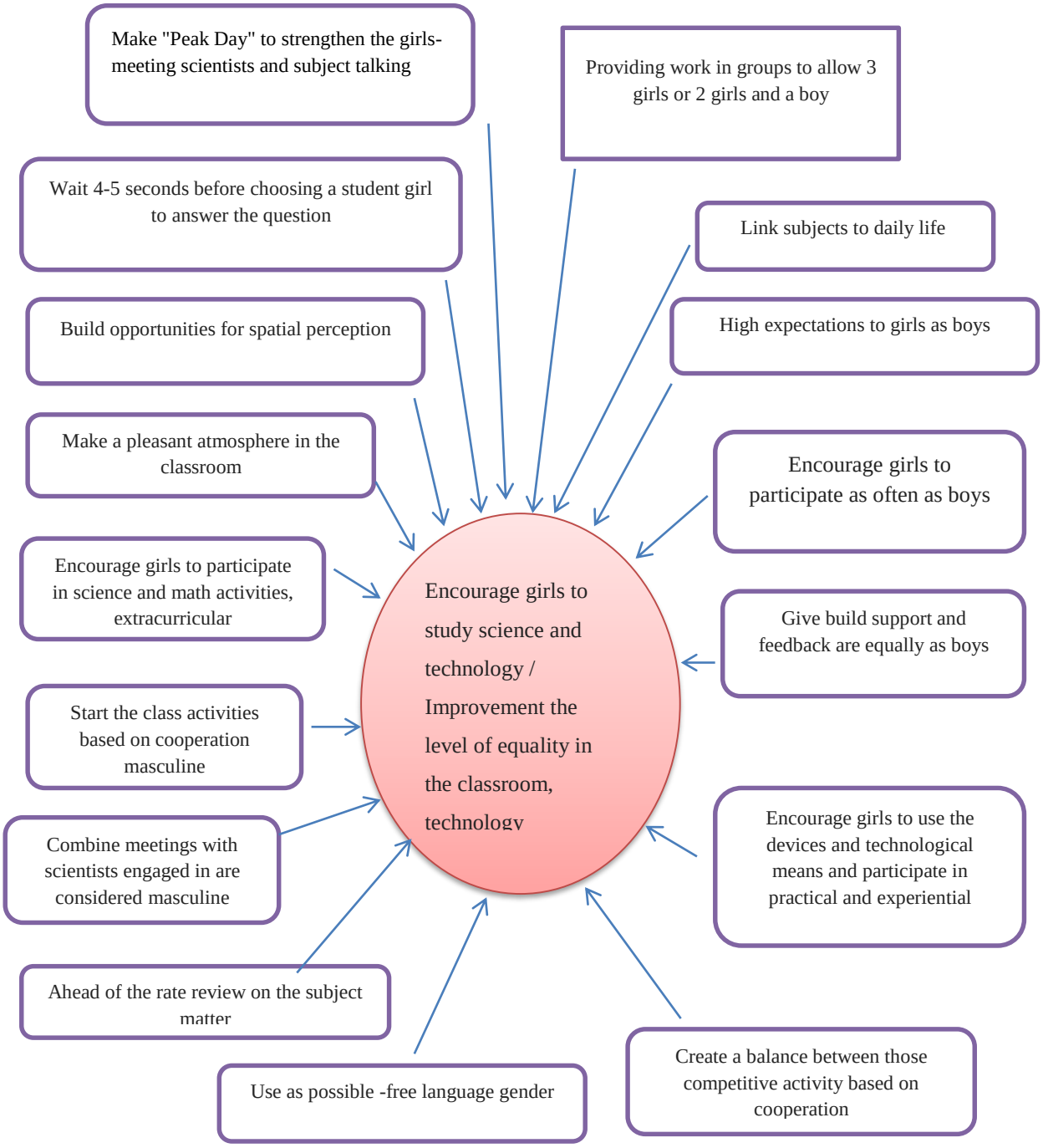
6) Use a non-sexist language within the lessons.

7) During advanced lessons in a laboratory, the recommendation is to strengthen prevention and safety measures in case of emergency, to review the studied material at the beginning of each lesson, to organize meetings with female scientists who practice in areas traditionally considered as male dominated.

8) Organizing classroom activities that are based on cooperation and spatial perception.

9) Assisting students to express and clarify feelings and thoughts in writing.

10) Encourage girls and their cooperation in science and math activities outside the study environment / strengthening self-esteem (leadership).



***F*igure 2.8 Instructional Model to encourage girls students in science and technology**

11) Classroom atmosphere should be calm and pleasant/friendly in terms of gender. Creating a gender-sensitive educational environment (in school, classes) which demonstration materials, stands, posters etc. containing messages/role models of both genders, and not reproducing stereotyped and sexist messages.

12) Organizing the "Peak Day" to facilitate girls meeting with scientists from the relevant fields. The day is dedicated to girls' empowerment in order to attract them to science through the

creation of a communication zone with women in science, using lectures, role plays, exploring professions, economic status from a gender perspective.

13) Appropriate pause: wait 4-5 seconds after addressing the question, before choosing a female student to answer. Girls sometimes need more time to formulate a complete response compared to boys.

14) Encouraging girls to study and engage them in science and technology, carrying out various activities and programs such as visiting Intel, science museums, meetings with scientists, working with Google, etc.

15) At the beginning of each lesson to summarize the previous lesson and establish a connection with the following teaching material in order to facilitate its assimilation more swiftly.

16) Using encounters between different classes of boys and girls. Prepare works and tests involving girls and boys. Encourage girls to speak in class, in front of other students. Organising mixed group activities of 2-3 girls and a boy, etc.

17) Establishing a connection of subjects with everyday life issues, so that the material would be less abstract and more accessible, problems can be more easily understood through concrete examples.

These strategies have been and continue to be applied in the gender sensitive trainings for teachers in science and technology reserve classes in order to consolidate the position of girls and to involve them in science since the 7th grade till 12th grade and additionally to school program [39].

Thus, the introduction of gender in children's education means to build into the child's development and education, his personality and individuality beyond the traditional vision of sex, giving him more freedom of choice and self-realization. Special attention was focused on individualization and diversification objectives, complementing the subjects/learning units with specific and motivating information for girls and boys, orientation towards active/interactive and cooperative learning.

We note that several training modalities were applied: on student's level (activities, exercises with girls and boys) within lessons and breaks; on teacher's level (gender sensitive trainings); on parents' level (gender sensitive activities).

The above model manifests itself through outlined results on specific dimensions: improving the teachers' activities, greater involvement of girls in science and technology, higher efficiency of reserve classes in science, diminishing stereotypes, impact on services within the educational institutions.

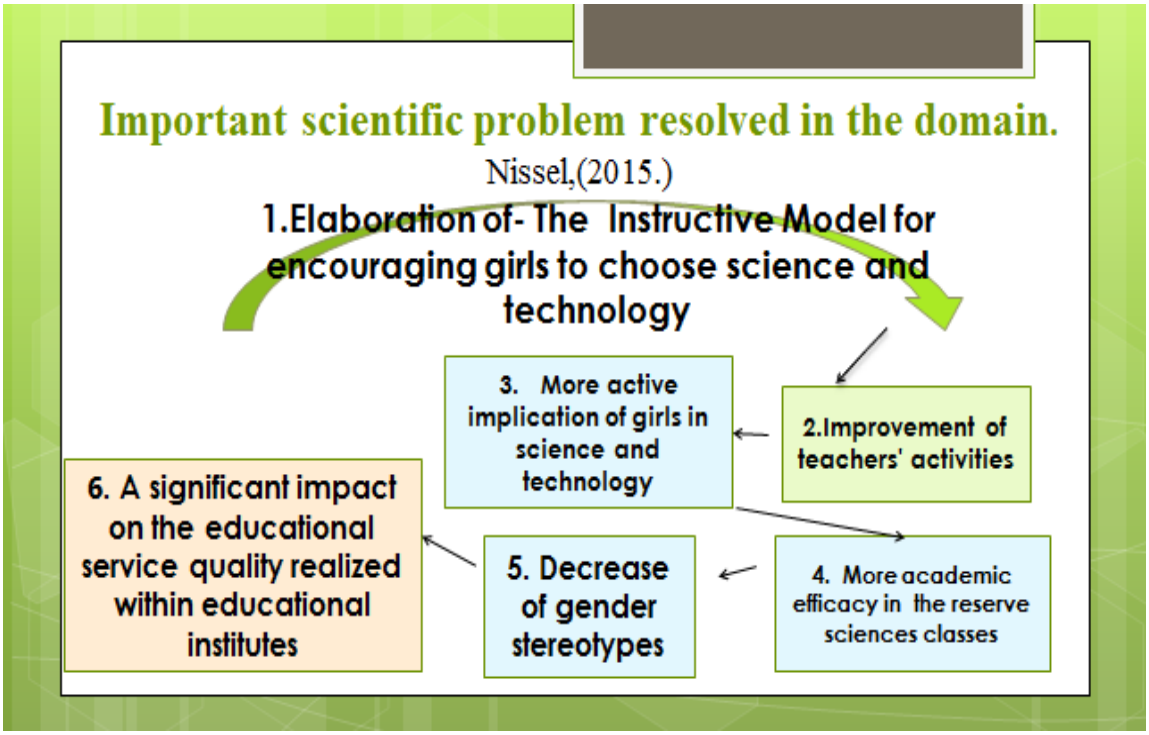


Figure 2.9 Gender solutions in various fields which can promote to understanding learning Science and Technology Teaching

Within the training activities with teachers in Junior High School, the Instructive Model has been validated to encourage girls students to study science and technology, it has been developed through exploration of several strategies, including, that were applied in Moldova. Thus, through the transfer of knowledge and experience, a successful praxiological combination of international standards and national context was ensured. As training, we applied this Model -Program among teachers involved in continuing education courses.

Implementation of the Strategies presented as Model can contribute to improvement of teachers' activities and respectively to more active implication of girls in sciences and technology, to diminish of gender stereotypes (Figure 2.9).

To reiterate the importance of the school - family - student partnership [2], we propose the instructive model for parents as "providers of success", which includes technical support in relation to the support and career guidance of students (for boys and girls). We conclude that the motivation of girls and improving their performance in science is directly proportional to the parents' involvement in the learning process, thus, becoming "providers of success."

We proposed the **Model parents support- model for boys and girls.** Enhancing motivation for learning by parents who support their children throughout all the three years of Junior Highs School. This intense support of parents stems from two reasons: realizing the dream

of parents and practicing in the field of science. Learning in this class, was done with encouragement of parents and therefore, there is a feeling of a need to be involved and interfere in all the learning processes. In research literature on the subject of parental involvement in the study process, the relation of parents-teachers-pupils is given much importance as well as its contribution to the learning process and the study motivation of a learner. Studies indicate a correlation between improvement in achievements and study motivation and the extent of relation between patents and school. The involvement of parents is expressed in the home of a pupil and in school and it includes assistance to a learner in acquisition of learning skills, creation of a suitable learning atmosphere, imbuing of motivation for studies by encouragement and a positive attention to school. In school, it is expressed in cultivation, improvement and revealing interest of parents in what takes place and making contact with teachers. These actions bring about a more positive attention on the part of a pupil towards the school [22; 59]. The more the involvement of parents is done with an emphasis of learning, the higher is study motivation and the more apparent is improvement in achievements [102]. The more educated parents are, the higher is the involvement of parents and the effect upon study motivation of a learner. In current study, the high average of incidence of parental involvement is expressed in conversations and support, help with doing homework, funding of hiring of private tutors, solving problems that arise as part of studying in school, encouragement for volunteering, reinforcing of moral and even watching TV channels that deal in science. It can be learned that the field of parental involvement is diverse and is given in any field.

At the same time, as a big challenges should be mention the persistence of stereotypes. The stereotypes regarding boys and girls, men and women in science, continue despite technological changes, the desire to study in the scientific technological classes and succeed in life. The reasons for the stereotypes-factors related to processes of education and socialization, factors related to differences in learning style between boys and girls and the factor of stereotypes-male profession. The figure 2.10 shows and describes the importance of parents support various fields. This support will enable and lead the students to succeed in scientific technology reserve classroom. Presented strategies as components of the Instructive Model for parents are aimed to parents as purveyors of success:

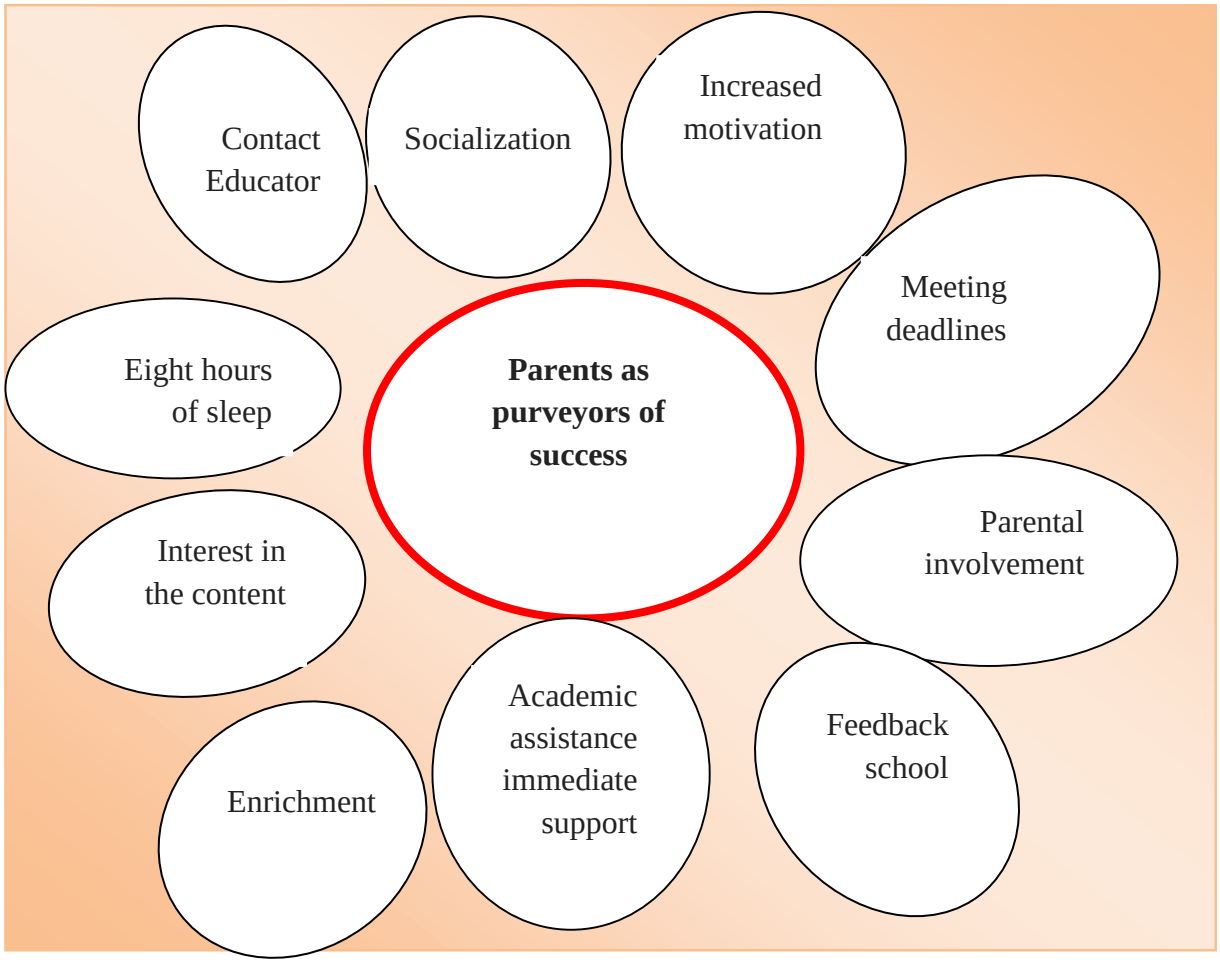


Figure 2.10 Instructive Model for parents

1. Increased motivation.
2. Planning and meeting deadlines**.**
3. Share, parental Involvement.
4. Login feedback school grades.
5. Academic assistance and immediate support private teachers.
6. Enrichment: museums, science films, current events, newspapers, Ted.
7. Interest in the content being taught.
8. Ensuring eight hours of sleep and eating well.
9. Contact Educator.
10. Socialization.
11. Gender sensitiveness in all domestic and social activities.

In this regard, we note the importance of gender sensitivity of parents, especially of girls. Thus, within the parents training program, several topics were addressed: gender equality, transformation of gender stereotypes, needs/specific interests of girls and boys in the educational

process, the self-esteem and the success in school, successful models of women in science/visits, meetings with women in science etc. Considering the impact of parents [181; 192] on the choice of disciplines (notably science and technology) and on the girls and boys decision with regard to career, we have decided to explore the subject of "gender-sensitive career guidance".

Thus, in our work the term of *"gender-sensitive career guidance" refers to the process of supporting girls and boys to make an appropriate choice of disciplines that will form the basis of their professionalization by harnessing individual potential, strengthening self-confidence and overcoming gender stereotypes with reference to sciences.* This process includes multiple actions starting with information to counselling and support (including psycho-emotional) to determine the possibilities and interests, mainly of girls, forming capacities in decision making with regard to livelihood strategies and future career.

*Gender sensitiveness of the parents***:** 1) Support with homework and works. 2) Immediate helps with private lessons. 3) Many fathers help strengthen subjects like Mathematics and Physics**.** 4) Multi prestigious courses that combine scientific professions, arts, sports**.** *Gender sensitive Career guidance***:** 1) For girls-using white illustration of daily life**.** 2) Using diverse technologies like boys. 3) Meeting women's empowerment. 4) Meetings with Women scientists, etc.

In this context, we reiterate another key issue - gender sensitivity of teachers. Besides the fact that every teacher must be a professional in educational field, he should understand the specific needs of girls and boys, apply appropriate working strategies to create a non-discriminatory relationship teacher - student, but also girls - boys relationship. In our view, teacher's gender sensitivity [12; 39] represents the ability to include gender in its activity, *the ability to apply alternative strategies to patriarchal dominant stereotypes, which should encourage boys and girls to education, based on their practical and strategic needs, giving them real opportunities to develop interests and potential.*

Based on the science teacher's dimensions and working strategies study, we have built the Teacher's profile in science and technology reserve class gender-sensitive. The model was design, testing with teachers in the field and implementation 3 Months at the junior high school. Then we compiled the results of the research knowledge exchange between Moldova and Israel-gender dimensions referring to definitions and principles of gender sensitive education. When we eveloped the model "Instructional strategies to encourage girls'", as a Science instructor I was coached the science teacher to emphasized the gender dimensions. By studying the science

teacher's dimensions and the strategies we built a model for profile to the science teacher's scientific technology reserve classes. We even helped further in a questionnaire for teachers.
Teaching in the scientific technological reserve class is done by leading, excelling teachers who are recommended by school management and are required by the pupils. A reference to this is in the professional literature in a model / Profile of "excelling teacher" [15], which includes the following characteristics (figure 2.11):

1) The ability to arouse intellectual excitement amongst learners.
2) The ability to make an interpersonal contact with pupils, exhibiting caring, emotions and support.
3) Amongst boys, high commitment to teaching and promotion of motivation**.**
4) The teacher excelling in studying while mastering the studied contents and increasing motivation.
5) A teacher must be creative and sophisticated**.**
6) The excelling teacher shall study in the classes by teaching that is suitable for reinforcing the girls and boys and thus the teacher would be qualified to teach in the class and be considered a leader and excelling.
7) The excelling teacher nurtured, by environmental factors (parents, teachers, counselors and senior management level) they would expose them to female.

- Empowerment courses.
- Would hold meetings with educated women in the academy and with scientists that would serve a role model for them.

8) They shall study in the classes by teaching that is suitable for reinforcing the girls and boys and thus the teacher would be qualified to teach in the class and be considered a leader and excelling.
9) In the designated class the excelling teacher must have special teaching skills:

- Mastery of the contents and of innovative technologies.
- Diversification of teaching methods.
- Development of intellectual curiosity.
- Self-thinking.
- Positive attitudes and interest in the field.
- Clear learning, integration of experiments related to the contents and to life.

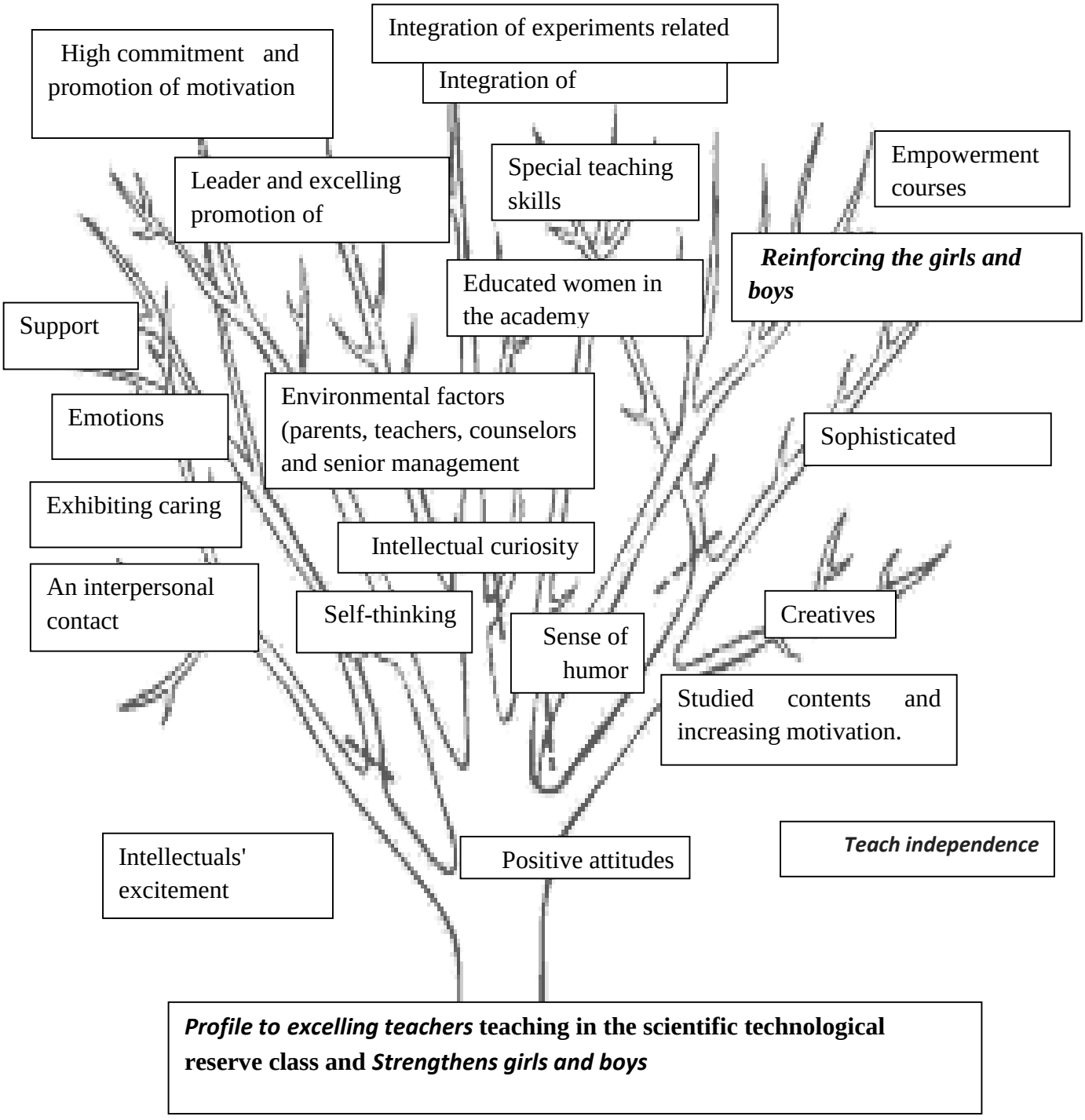


Figure 2.11 Profile of excellence teachers teaching in the scientific technological reserve class and Strengthens girls and boys

- Giving personal attention and reinforcement of teaching of girls while employing interactive strategies.
- Reduction of gaps between boys and girls.
- Sense of humor and flexibility.

10) In the process of training of beginning teachers, the excelling ones would be "marked" and designate them in their training to teachers in the designate classes.

In order to help teachers to explore gender dimension in the professional activity we would like to stress attention on some actions to facilitate the gender sensitive competences: 1) Reference questions by gender. 2) When teachers asking questions they must wait for a few minutes. 3) Sometimes holding meetings on gender. 4) Listening and giving a personal attention. Based on mentioned above characteristic, exploring relevant strategies teacher teaching in the scientific technological reserve class knows reinforce and challenge girls and boys in science.

After implementing the new science program, a significant improvement in student's success was ascertained, reflected in national and international test results. It was created uniformity in study subjects, and reserve classes in science and technology opened. The difference between eminent girls and boys results became insignificant. The number of girls who enrol in physics study has increased. The motivation of students is high and largely influenced by parents. The presence of the child in such a class is the realization of parents' dreams. Also, most teachers have excellent results and dream to teach in such a class, motivated by challenges and interests and by the fact that students are more disciplined and more interested in learning.

Thereby, we can say that the *Methodology of implementation of the new program in science from a gender perspective constitutes a series of interrelated models, focusing on encouraging girls students in science and technology, raising gender awareness of teachers and parents, constructivist approach in teaching and learning, organized on the basis of general principles of gender sensitive learning and gender sensitive socio-educational conditions, psycho-physiological and social characteristics of students, with the educational purpose of performance/advancement improvement of girls and boys in science and technology.* Thus, the Methodology includes: Constructivist approach to learning, Instructional Model to encourage girls students in science and technology, a Profile of excellent teacher who is gender-sensitive, a Instructive Model for parents (Figure 2.12). However, the purpose of education is presented as a precondition for setting up a society with high level of advanced technologies development.

2.5. Conclusions for the second chapter

In this chapter we presented the most important aspects of the "new study program in science and technology". At the same time, we identified many problems that affected its

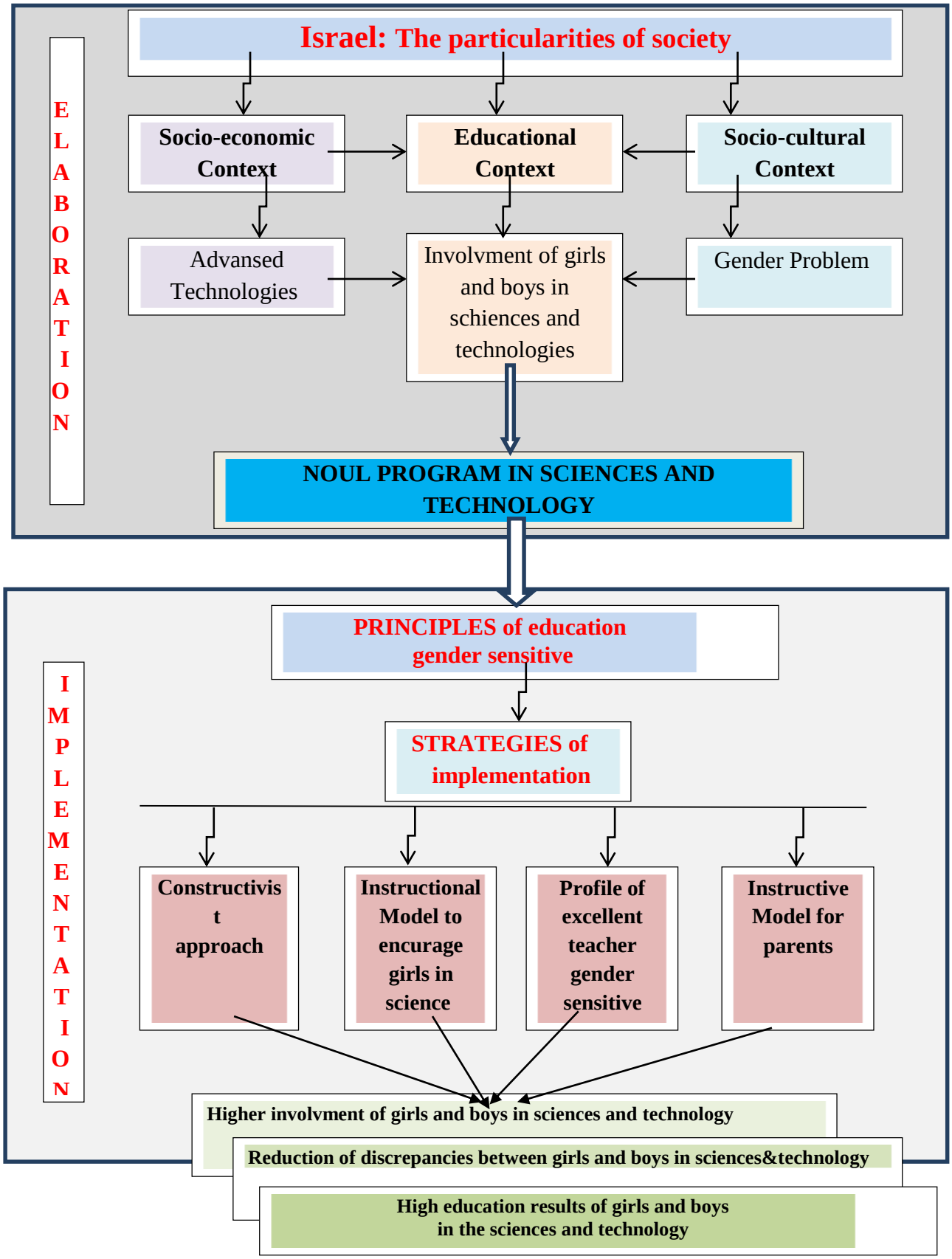


Figure 2.12 Metodology of implementation of the new program in sciences from a gender perspective

implementation: insufficient motivation of students to study science and technology, persistent disparities between girls and boys in motivation and learning, difficulties in teachers' activity for training girls and boys, insufficient motivation of parents in guiding girls to choose science.

One of the questions that have raised in various discussion groups, was how to improve the image of science education and make it more attractive? There are many opportunities: media campaign, integration of teachers with high professional profile, excellence centers, implementing the needs of a modern economy in the study programs, flexibility in study courses, guidance in career development etc. One of the ideas suggested regarding youth is to have dialogues regarding their future with industry entrepreneurs, meeting business owners, as part of personal coaching program [87]. A technological education is to allow for different courses& strategies for different population groups segregated from age, background, education and gender.

In this regard, through various strategies, we have contributed to improving the program achivement, from a gender perspective. We conceptualized gender dimension in implementing the new program in science and technology, focusing on preventing and overcoming the stereotypes and prejudices of gender, related to attitudes and learning of disciplines in science and technology by girls and boys, and ensuring the students success and performance. Some concepts were developed such the gender perspective in science education, gender sensitive career guidance, gender sensitive competences

We elaborated and stated that the Methodology of implementation of the new program in science and technology from a gender perspective is a paradigmatic construct consisting of components / patterns in interaction: theoretical component - constructivist approach; curricular component – gender integration; educational component - strategies to encourage girls students, students activity strategies, students advancement strategies; community component - including the family; psychological component - providing success.

The connection between the "new science program", gender and teaching strategies was established in order to increase learning motivation for girls and boys, reduction of gender stereotypes and prejudices in teaching-learning-assessment in science and technology disciplines, improve the career guidance for girls and boys.

The development of the Methodology of implementation of the new program in science and technology from a gender perspective was conditioned upon: the preparation/special training of teachers, but also the creation of psychological conditions and effective communication in educational institutions.

3. EXPERIMENTAL APPROACH TO IMPROVE THE PERFORMANCE OF BOYS AND GIRLS BASED ON THE NEW PROGRAM IN SCIENCES

3.1. Rationale and characterization of the scientific research

In order to verify the hypothesis that states that the connection between "new program in sciences", gender and teaching strategies is an important factor, namely: learning motivation in science for girls and boys; diminishing gender stereotypes in learning science and technology disciplines; career guidance for girls and boys, developing methodology that will contribute to achieve the highest academic results/ girls and boys advancement in science and technology, the experimental research was conducted.

The finding experiment involved 93 students, and the formative one - 54 students (29 boys, 25 girls) from two high schools in Jerusalem from the 7th, 8th and 9th grades, who were studying in reserve scientific-technological classes, as well as 11 teachers and 5 managers (more details in appendix 8).

As variable on gender exploration, we can refer to:

1) Motivation / interest in learning science of girls and boys;

2) Obtaining higher academic results/ reducing the learning gap in scores between girls and boys;

3) Students decision, especially girls, to advance in future in science/as a result of gender stereotypes decrease in learning sciences and technologies, career guidance for girls and boys.

As important tools, there are: the Constructivist approach to learning, Instructional Model to encourage girls students in science and technology, a Profile of excellent teacher who is gender-sensitive, a Instructive Model for parents, developed by us. We reiterate that those models have been developed and applied within the activities as a teacher, teaching instructor/trainer and supervisor in training courses for teachers. These models, which include concrete work strategies, are complementary instruments to ensure ultimately a more effective implementation of the new program in science and technology.

Meanwhile, during the experiment, periodical meetings were organized, according to the pre-established schedule, with teachers' continuous training, from reserve classes in science and technology, which would subsequently work with students in those classes, to discuss the challenges of teaching and learning science.

Examination of change in the level of knowledge and description of achievements amongst Junior High school pupils in the subject of science, following implementation of the new study program and establishing the scientific technological reserve class. Description of achievements

throughout the years from 7th-9th grades, while conducting a comparison of the grades of boys and girls. Examination of choices of girls and boys in enhanced scientific subjects. Examination of trends of change amongst girls: do more girls choose scientific subjects in High school? Examination of the worthwhileness of investment in the scientific class and the scientific technological reserve class. Examination of the status of a teacher and the subject and relation of teachers, instructors, principals and inspectors to the new program.

Through the questionnaires, opinions of students, teachers and managers (more details in appendixes 2, 3, 4) were identified with reference to several components of the educational process: teachers' characteristics from scientific-technological classes (in the light of teachers, students and managers); the teaching-learning process; the results being used for optimization of the study process.

Based on the questionnaires, key factors were identified that affects the implementation of the new science study program from a gender perspective, namely: insufficient motivation of students, especially girls, to study science and technology; the gap between girls and boys regarding the attitude towards science and technology; low level of professionalization of teachers to guide girls and boys in learning the subjects in question.

Referring to the formative background, in the context of the presentation/achievement of strategies from previously mentioned models, gender awareness of reference groups was used. Among *the topics discussed during the experiment with teachers* were: Gender equality and science/technology; Promoting the importance of secondary education in science and technology; The importance of involving girls and boys in science and technology; Modalities of cooperation between girls and boys in school and social activities; Gender stereotypes in teaching, assessment and teaching material; Defining professional aspirations beyond gender stereotypes; Life and career strategies.

Among *the topics discussed with parents of students of reserve classes in science and technology were*: Cooperation between parents and children; Images of scientists women and men in science/technology; Promoting the importance of secondary education in science and technology; The importance of involving girls and boys in science and technology; Modalities of cooperation between girls and boys in school and social activities; Gender stereotypes and their impact; Gender-sensitive career guidance: Defining professional aspirations beyond gender stereotypes; Life and career strategies.

We note that our research is a component that contributed to the implementation of the new science and technology program. Outcomes of program implementation (real success and

increasing number of students who got a scientific promotion diploma) will be visible in the summer of 2016, the graduation of the first class of graduates.

Meanwhile, based on national statistics it is ascertained the improvement of students' results in science, following the implementation of the new science and technology program in high schools. We note that organizing multiples gender awareness activities for the girls students, teachers and parents contributed to the creation of a unique favourable environment (gender friendly), motivating, especially girls, to study science.

Characteristics of teachers, pupils and senior management in a scientific technological class

Pupils' opinion: teaching in the scientific technological reserve class is done by leading, excelling teachers who are recommended by school management and are required by the pupils. A reference to this is in the professional literature in a model of "excelling teacher" [23; 33], that includes two characteristics: 1) The ability to arouse intellectual excitement amongst learners. 2) The ability to make an interpersonal contact with pupils, exhibiting caring, emotions and support.

In current study, the responding pupils were asked to characterize the behavior of teachers who are suitable for teaching in the designate class. The findings have confirmed the hypothesis and reveal a significant gender variance between preferred boys and preferred girls. Amongst girls, significance was found in a high incidence of good communication skills and in interpersonal relation – clean aesthetic, teaches clearly, life skills, pleasant atmosphere, relates the studied contents to daily life – relation to life. The behavior of loving the profession was found to be in low incidence. Amongst boys, the behaviors found to be significant in high incidence are commitment to teaching and promotion of motivation – controls class management. Significance in low incidence in the behaviors of connection to life and loves the profession. In rest of the item, an equal correlation was found between boys and girls. It is apparent from the results that girls prefer a teacher excelling in interpersonal relations, who is interested accessible, caring, connecting between the studied contents and life. As opposed to boys who prefer a teacher excelling in studying while mastering the studied contents and increasing motivation. Less "active" emotionally. These findings are not definite as there are emotional characteristics indicated by boys and characteristics of contents and control indicated by the girls. It can be deduces out of this that an excelling teacher has his own unique profile. It is of importance that a teacher excels in all the techniques and strategies while adjusting to the class character and the contents [91]. In the question of preference of pupils of the behaviors of a science teacher in designated class, a variance was found between the desire of boys and the desire of girls. However, significance was found with a high and definite incidence in relation to the behavior of a preferred

teacher. According to the results of the study, a teacher who teaches in the designated classed must be able to integrate all the types of behavior together while supplying response to the needs of girls by 100% and the needs of boys by 100% and that is without creating any kind of discrimination. A teacher must be creative and sophisticated, to know how to "jump" between the different behaviors all the time according to the gender approaching hi, without being confused, tires or lose patience and tolerance or creating situation in which pupils would sense this difficulty.

Teachers' opinion: in current study, teachers were asked as to what is required of them in order to teach in a designated class. The hypothesis was that most items would receive significance with a high incidence. The hypothesis was confirmed. The items that have receive a high incidence of 100% have bee – challenging teacher who ,asters the contents and meeting the program targets, improves achievements and brings about a success in tests. The reason lies in seeing the targets of the Ministry in front of their eyes as studying in this class is a measurable and consistent throughout the entire year. Teachers report by statuses each quarter on teaching output. Once a month in May, there is a national designated test and the results of the reexamination are fed into the computer that is delivered directly to the Ministry of Education. Following characteristics were found to be on a high level of incidence of 90% - diversification of ways of teaching, use of strategies, personal attention, reinforcing girls, raising of motivation which are the important factors that assist a teacher in succeeding with the Ministry targets. The more a teacher initiates, creative , has experience, masters the contents and skills, creates good interpersonal relationships with his pupils, the higher are his chance to excel and teach in the designate class.

Opinion of senior management level: in the study, the senior management level was asked as to what is required of and characterizes a teacher who teaches in a designated class. The hypothesis was that most items would receive significance in high incidence except for significance in low intensity on the item relating to reinforcement of girls. The hypothesis was confirmed. The items that received a high incidence of 96% were – creativity, motivation, diverse lesson plans, personal attention and encouragement of choice in High school. With a low incidence of less than 80% the following characteristics were found – leading teacher, reinforcement of girls, improvement of achievements level. There is no compatibility and there is a gap between the significance of incidence of teachers and the senior management level and it is surprising. The reason for the variance of the gap is in self-evaluation of a teacher and between the evaluations of the senior management level. A teacher teaching in the designated class considers himself to be excelling. However, the system does not see all the teaching teachers as leading and excelling. Some managed to teach in the designated class due to absence of skilled professional teachers in

the field (for example, the subject of physics). A situation was created in which teachers skilled in field of knowledge only teach in the designated classes despite a personal lack in many additional attributes required of n excelling teacher. Thus, this variance was created. For correction of this distortion, beginning teachers are to be trained and in the time of training to designate in advance those who are suitable as teachers in technological classes. These teachers would study teaching that embraces interactive strategies that raise the understanding of boys and girls while reducing the gap between them. The items of reinforcing the girls is in a low intensity of incidence with 68% amongst the senior management level that is aware of the fact that not enough is done for reinforcing girls in the field. The more girls are nurtured, by environmental factors (parents, teachers, counselors and senior management level) they would expose them to female empowerment courses, would hold meetings with educated women in the academy and with scientists that would serve a role model for them. They shall study in the classes by teaching that is suitable for reinforcing the girls and boys and thus the teacher would be qualified to teach in the class and be considered a leader and excelling.

In the designated class the excelling teacher must have special teaching skills: mastery of the contents and of innovative technologies, diversification of teaching methods, and development of intellectual curiosity, self-thinking, positive attitudes and interest in the field. Clear learning, integration of experiments related to the contents and to life, giving personal attention and reinforcement of teaching of girls while employing interactive strategies, reduction of gaps between boys and girls, sense of humor and flexibility. In the process of training of beginning teachers, the excelling ones would be “marked” and designate them in their training to teachers in the designate classes.

The correlation between choosing the scientific subjects as enhanced in High school and between the gender assignments with the emphasis of subject of physics.

The study hypotheses

The first research hypothesis was a significant improvement in excelling pupils’ achievements in the science subjects, following the new program in science, in Junior High school. The hypothesis was fully confirmed. There was a significant improvement in the achievements of pupils in international and national tests.

The second research hypothesis was reduction of the gender gap between the achievements of boys and girls. This hypothesis was fully confirmed if one addresses the pupils of designated classes, the gender gap is negligible. If one addresses the entire sector of Hebrew speakers, the

hypothesis was refuted, and there is a gender gap in achievements in favor of boys by 6 points. In the Arabic speaking sector, there is a gender gap in favor of girls of 25 points.

The third research hypothesis was pupils being stressed study-wise. This hypothesis was refuted; pupils are not stressed in the designated scientific class. It might be due to the fact that they do not know of another way of studying and in relation to other subjects studying this subject is not stressful.

The fourth research hypothesis was that the pupils of the designated class are challenged. This hypothesis was refuted. The pupils are not challenged enough as a significant part of teachers who teach in this class are not excelling and suitable for teaching in this type of class. The teachers that teach there master the contents however not in a level of excelling. In order to be an excelling teacher additional characteristics are required which they lack. There is a positive correlation between the third and fourth hypotheses. Pupils are not stressed in studies as they are not challenged.

The fifth research hypothesis was that the reason for choosing studying in the technological class is self-realization. The hypothesis was confirmed. Self-realization occurs as the state has supplied a response to the excelling pupils in establishing a homogeneous designated class, which supplies a response to their needs.

The sixth hypothesis in the study was that the pupils of a designated class are not socially popular due to the burden and investing in studies. The hypothesis was confirmed. The pupils are socially popular in class and the age group and find balance between study and socialization.

The seventh research hypothesis was emotional support of parents while increase of motivation. The hypothesis was confirmed. There is much support of parents for the pupils in the learning processes in the technological class. The bigger is the support the higher is motivation and success in achievements.

The eighth research hypothesis was a gender variance in choosing of enhanced study subjects while addressing the subject of physics. The hypothesis was confirmed. There is a gender variance in choosing of enhanced study subjects. Girls tend to choose subjects like bio-technology, chemistry, as these subjects have more relation to the daily life. There is gender variance in the number of those choosing the physics subject. There is a rising trend in choosing the subject amongst girls however; there is still a gender gap in favor of boys in choosing this subject.

The ninth research hypothesis was none choosing study subjects like physics due to reasons of lack of family support, teachers not good enough in the field and a difficult and not interesting

subject. The hypothesis was confirmed. There is a correlation between family and teachers' support of learning the subject of physics and between lacks of support. The more support there is on the part of family and children, the higher are the chances and motivation in choosing this subject in High school and in life. The more teachers would teach in an interesting manner while relation of the contents to life thus the number of those choosing the field would increase. For now, the situation is not so, and most physics teachers teach the field without arousing much motivation, just as the Ministry of Education that does not do much in resolving this problem.

The tenth research hypothesis was the choosing of science and technology teacher's behavior in designated class in terms of gender. The girls would choose behaviors with emphasis of emotion and personal attention while boys would choose behaviors with emphasis of class management, contents and knowledge. The hypothesis was confirmed. These findings reveal that a science teacher who teaches in this class should know how to deal with the needs of girls and boys. He must act with much sophistication, sensitivity and understanding, be flexible according to the needs, to teach while using teaching strategies that strengthen understanding and reduce gender gaps. Therefore, not each and every teacher with a teaching diploma should be let teaching in this class.

The eleventh research hypothesis was that teachers report illogical overload, stress, non-compatibility to weak pupils and difficulty in implementation of the master document. The hypothesis was confirmed. The multiplicity of study subjects in the program needs to be discussed as well as schedules dictated by the Ministry.

The twelfth research hypothesis was the desire of teachers to teach in the designated class due to the fast speed of learning, learning in small groups, time for enrichment, performing projects and absence of disciplinary problems. The hypothesis was confirmed. Teachers desire to teach in the class due to the convenience in learning. However, alongside with the desire of the teacher it is mandatory to supply a response for the needs of pupils and the system for studying in this class.

The thirteenth research hypothesis was the actions the Ministry of Education takes in terms of gender for increasing the number of those choosing the subject of physics are not sufficient. The hypothesis was confirmed. The more the Ministry of Education improves its attitude regarding this, decides a firm policy, goes on an aggressive campaign, from preschool age and until the university, thus the awareness amongst the population and the number of those studying physics in terms of gender would increase.

3.2 Scientific results implementation

The study has examined whether the new way of science teaching according to the new program, with an emphasis of the scientific technological reserve class, has made a change and opened a small window for the improvement of Israeli pupils' achievement in the subject of science in Junior High school and has created an uptrend in selection of this subject in High school, while creating an equality between genders – boys girls.

The research hypothesis was that the new science study program with an emphasis of the scientific technological reserve class, has created a trend of positive change in a number of aspects – from the study aspect, an increase of the number of girls, an increase in choosing the scientific subjects as enhanced in High school, achievement improvement and demand for studying in this kind of classes.

Analysis of pupil's questionnaire

93 questionnaires from two different Junior High schools; from seventh grade – 8 girls and 15 boys, eighth grade – 11 girls and 10 boys, ninth grade – 24 girls and 25 boys.

First hypothesis – table 3.1 and table 3.2, regarding a considerable improvement in pupils' achievements in the subject of science, following the new science program, in Junior High school was confirmed.

In figure 3.1 a trend of improvement in pupils' achievements in science in the international PISA tests can be seen. An increase of 15 points, from 455 points in the year of 2009, prior to the beginning of the new program, to 470 points in 2012. Hebrew speakers have reached 483 compared to the Arabic speakers who have received 350 points – figure 3.2. A large gap of 133 points between Hebrew speakers and Arabic speakers. Hebrew speakers are only 17 points short in regard to the OECD – 500 [44].

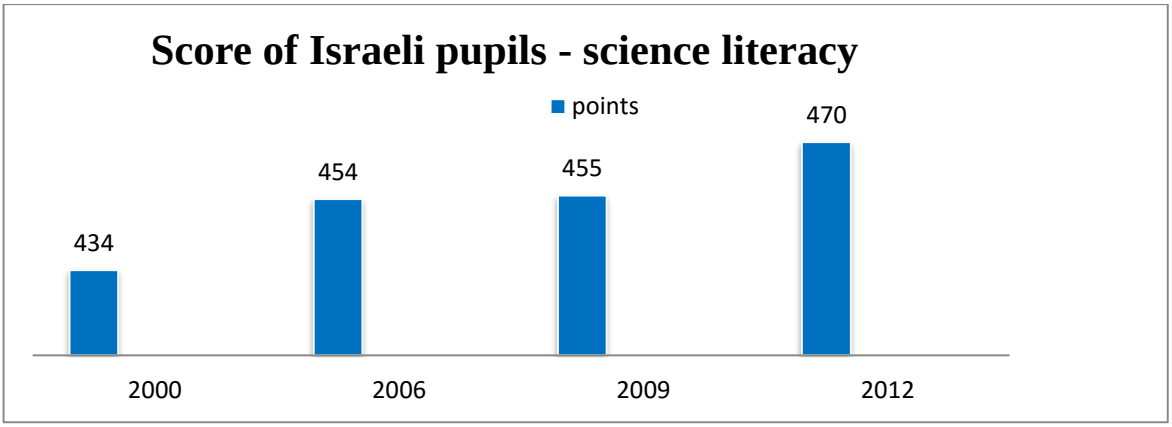


Figure 3.1 Score of Israeli pupils – science literacy (PISA tests)

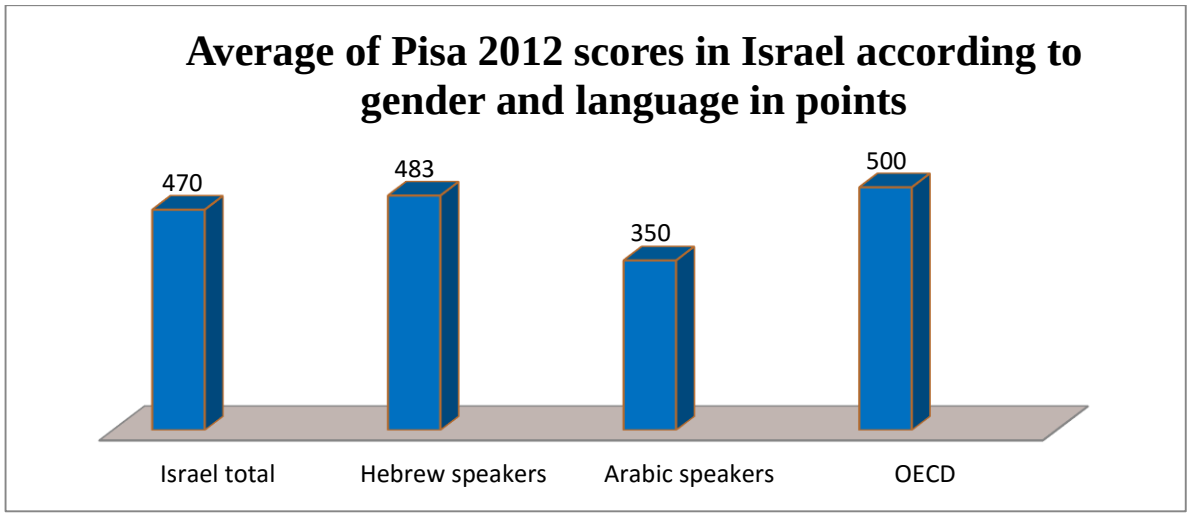


Figure 3.2 Average PISA 2012

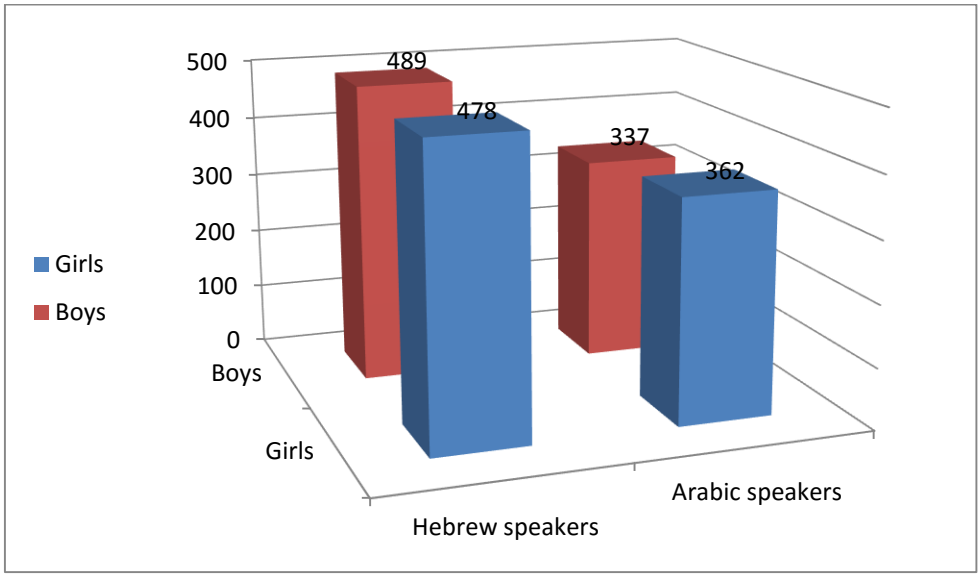


Figure 3.3 Average Israeli score in problem solution according to language sectors and according to gender

Second hypothesis – figure 3.2 and 3.3 – regarding gender. The girls have reduced the gap in achievements in terms of gender as compared to boys. The gap was reduced but there is still a 6 point gap in favor of boys. See table 4. There is a difference in the achievements between Hebrew speaking girls and Arabic speaking girls. From a gender aspect, Hebrew speakers – boys have received 489 points and girls 478, an 11 point gap in favor of boys. In Arabic speakers, girls – 362 points and boys 337, a 25 points gap in favor of girls. [77; 144].

It can be observed that since the program began in 2009, the students' achievements in the discipline of science in Israel increased. The larger is the number of Israeli students in whom the investments are made, the higher is the rate of eminent students. In 2012, the rate of eminent and

excellent students in Israel, 5.6 according to PISA tests, has reached the level of OECD countries of 8%, the gender gap between boys and girls being insignificantly reduced.

Table 3.1 Gradation of countries in PISA 2012 tests, a gap between boys and girls

Grading	Country name	Average score	Gaps distribution (P5-P95)	Girls average	Boys average	Gap (girls-boys)
1	**Singapore**	**562**	**312**	**558**	**567**	**-9**
2	**Korea**	**561**	**292**	**554**	**567**	**-13**
3	**Japan**	**552**	**280**	**542**	**561**	**-19**
7	Canada	526	327	523	528	-5
9	Finland	523	307	526	520	6
10	Great Britain	517	315	514	520	-6
12	France	511	313	509	513	-5
16	Germany	509	324	505	512	-7
17	United states	508	306	506	509	-3
20	Norway	503	337	505	502	3
22	Denmark	497	302	492	502	-10
24	Sweden	491	316	493	489	4
31	Croatia	466	302	459	474	-15
34	**Israel**	**465**	**405**	**451**	**457**	**-6**
	OECD average	500	314	497	503	-7

In 2012, Israel ranked 34th among OECD countries, but with a gender gap lower compared to countries that were in the top of the list. Thus, boys recorded a score of 457 points and the girls - 451, the gender gap being 6 points (Table 3.1) [64; 83].

Third hypothesis to eighth hypothesis – figure 3.4, regarding pupils being stressed by study burden in scientific reserve class. The hypothesis was refuted – only 53.29% have reported on stress, the rest do not feel stressed as was hypothesized – figure 3.4.

Forth hypothesis up to eighth hypothesis – figure 3.4, is regarding students being challenged in their study in the technological reserve class. The hypothesis was refuted. Only 76% of the pupils are challenged and not as was hypothesized, a higher percentage of incidence that approaches 100%.

Fifth hypothesis – regarding pupils studying in the technological reserve class, do not consider the responsibility and commitment for their studies and do not think about their future in this age. The hypothesis regarding their studies shall be significant with a medium incidence. This

hypothesis was refuted. It becomes clear that pupils, in spite of their young ages – 13-15, consider the program as a future guide – 91.34%, take responsibility on their studies 84.9%, are obligated to their success in the program 92.9% - figure 3.4.

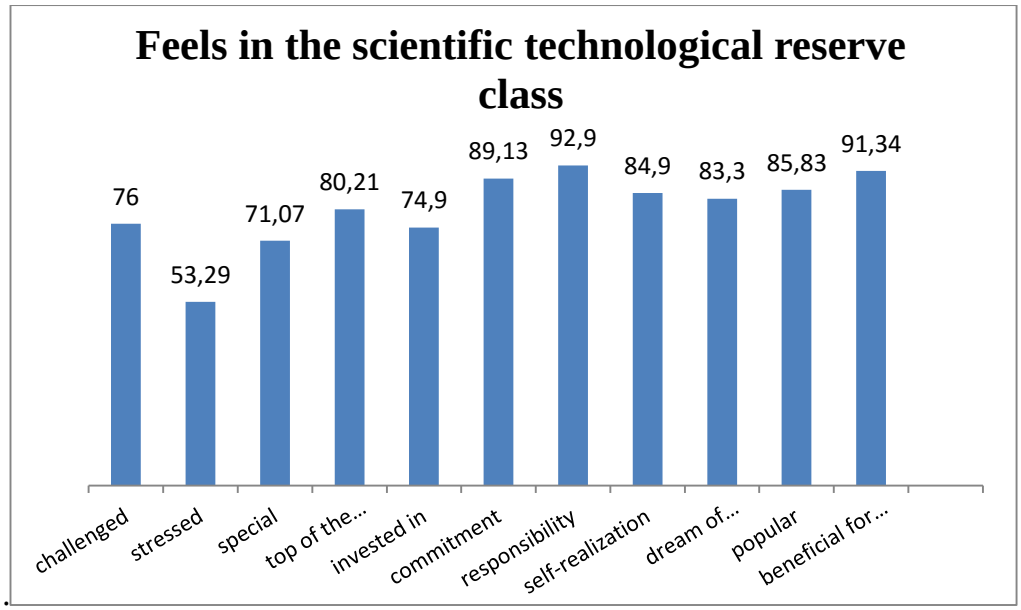


Figure 3.4 Feels in the scientific technological reserve class

Sixth hypothesis - regarding the reason of choosing to study in the technological class is self-realization. The hypothesis was confirmed. 80.21% achieve self-realization in this class. However, an additional datum of another substantial reason is that 83.3% of the pupils have come to study in this class following their parents' realization of a dream figure 3.4.

Seventh hypothesis – regarding popularity. The pupils in this class are less popular from the social aspect since they spend more time studying. This hypothesis has refuted. 85.83% are socially popular. Learning is important but popularity and making connections are extremely important to pupils in adolescence. There is a positive correlation between acceptance and lack of desire to change. Therefore, only 71.07% have reported as special – figure 3.4.

Eighth hypothesis – regarding the fact that technological class pupils are the best in the age group. The hypothesis was confirmed. The surprise was that only 74.9% have pointed out that they see themselves as best in their age group. At the same time, 85.83% have pointed out they are popular. There may be a positive correlation between these data – figure 3.4.

Ninth hypothesis – figure 3.5 is regarding an emotional and study support that enhances motivation. Pupils' families that support their children emotionally and study-wise, at all times

and in a varied ways are doing a lot for the study success in this class. This hypothesis was confirmed. A high significance of incidence in average is apparent for high emotional support of the pupils by the families, of 95.9%. The families are helping and involved in the solutions of problems pupils encounter during studying in the reserve class. 70.86% from the pupils have reported that support talks with family are taking place. Regarding study support, the pupils' families are supporting in the study aspect, are helping greatly to the study success and the acquisition of knowledge. The hypothesis was confirmed.

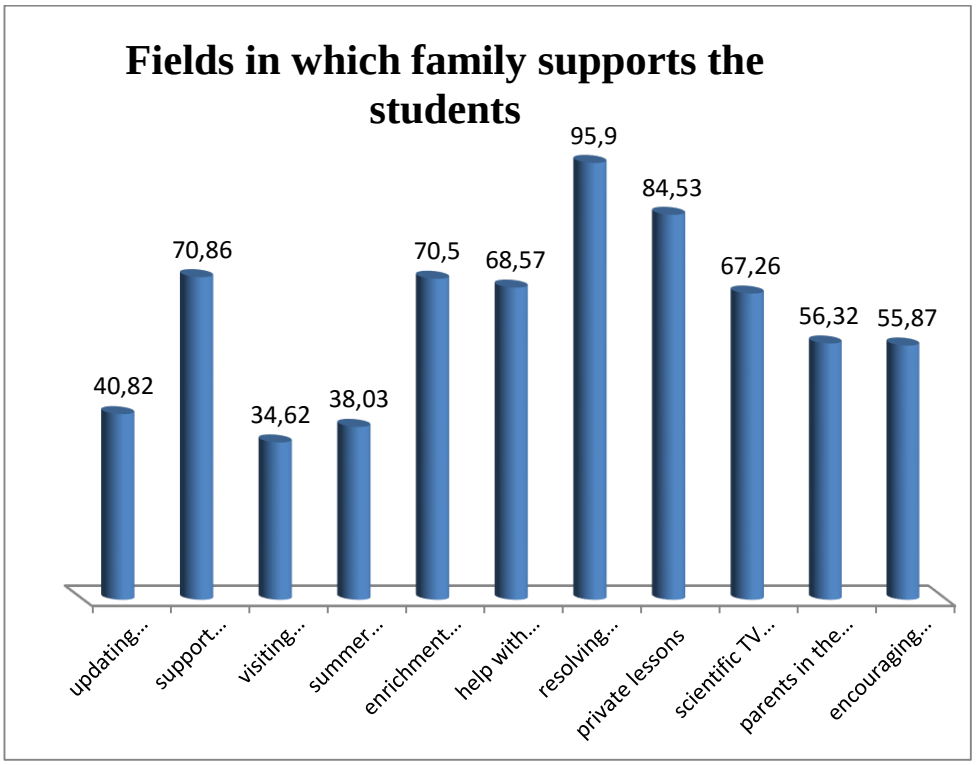


Figure 3.5 Fields in which Family supports the students

84.53% are assisted by private lessons in order to improve the knowledge and the achievements or advanced studies beyond the requirements of the class. 68.57% are getting the family's help in doing homework. 70.5% are studying in enhancement courses in the afternoon beyond what is taught in class. 67.26% watch science programs in different television channels. 40.82% are updated in science up-to-date researches. 38.03% participate in summer camps. 34.62% visit museums.

It was surprising that there is significant medium incidence of many parents, of 56.32%, who are practicing in the field and encourage their children to study in the technological reserve class. Another surprising factor is of average variance of 55.87% of the pupils volunteer and contributes their free time to society. This indicates their will to be connected to society in any way and not to disconnect in order to succeed in their studies. Part of the popularity (table #5 –

popularity 85.83%) indicates the importance of structuration of personality alongside with success in studies and a desire to become a good and contributing citizen of the country. It can be seen that the support from study and emotional aspects is great and diverse which enhances motivation - figure 3.5.

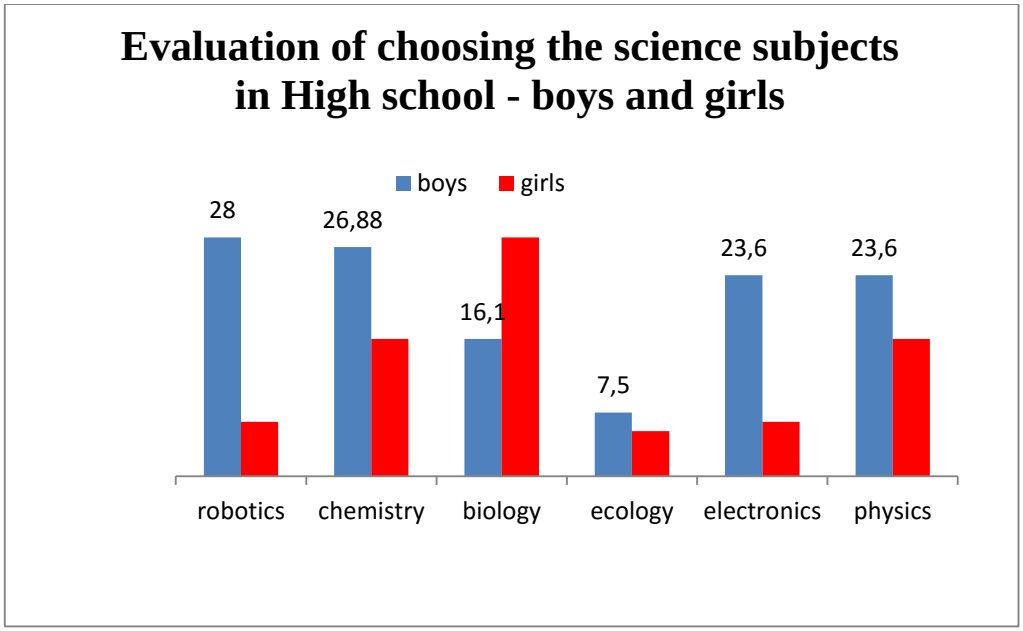


Figure 3.6 Evaluation of choosing the science subjects in High school – boy s and girls

Tenth hypothesis – figure 3.6, is regarding 1) the selection of science study subjects in high school as enhanced. A significant difference shall be found in rates of incidence in terms of gender between boys and girls in the choosing of enhanced subjects in High school. Boys favor with a high incidence the subjects of robotics and chemistry and girls favor biology. 2) The subject of physics is in a low priority in both genders but the gap is positive in favor of boys. The first hypothesis was confirmed and the second was refuted. The subject with high significance of incidence amongst boys is robotics – 28%, than with a small gap of average significance, the subject of chemistry – 26.8%, electronics and physics have identical percentage – 23.65%, biology – 16.1% and ecology is the subject with the lowest average of incidence with 5.3%. In girls, a significance in high average of incidence was found for the subject is biology with 28%. With incidence in equal percentage are chemistry and physics with 16.1%. The subject of physics was accelerated amongst girls and was definitely a surprise in the study. With a low average of incidence like in boys there is the subject of ecology – 7.5%. Robotics and electronics were chosen with in a low average of incidence – only 6.4%. Surprisingly, there was an increase in the number of boys and girls who have chosen enhanced physics. However there is still a gender gap in the

choosing of the subject of 7.5% in favor of boys. In both genders, the number of average incidence amongst those choosing physics as an enhanced subject is low – fig. 3.6.

Eleventh hypothesis – figure 3.7, regarding the reasons for choosing of the favored enhanced subjects in High school. The subjects that have significance for high incidence as being enhanced in High school by boys and girls are affected by interest in the field, profitability of

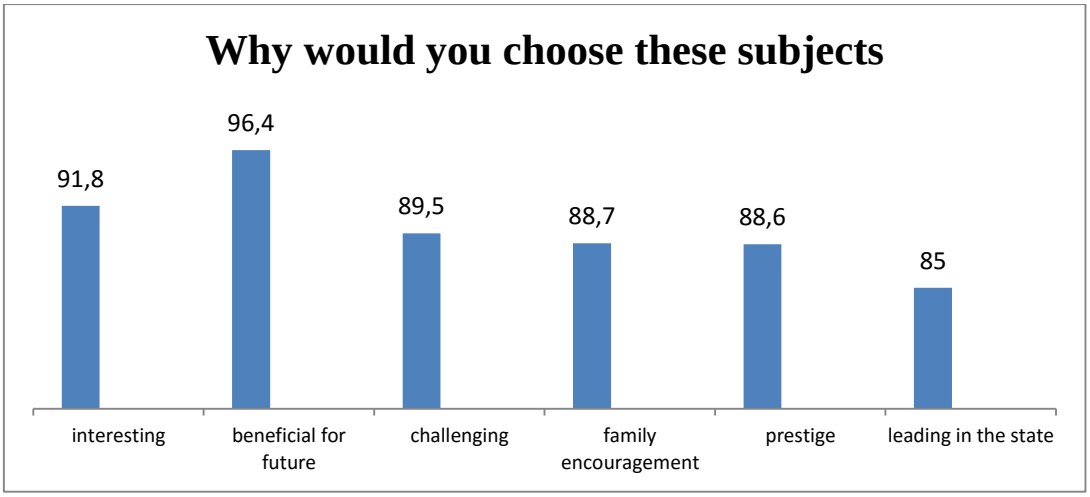


Figure 3.7 Why would you choose these subjects?

investment in the subject future-wise – livelihood and occupation, prestige and the family's encouragement regarding the field. The hypothesis was confirmed. 91.8% have reported choosing a subject according to interest, 96.4% have reported with a high incidence on choosing a subject out of thinking and future care for their lives. 88.6% have reported on high incidence of support and influence of family in choosing the enhanced subject in High school, 88.7% have reported on the importance of the subject regarding its prestige. (There is a positive correlation between the family's support study and emotion-wise – table #6). There is a positive correlation between table #8 and table #5 in which pupils feel invested by the country by about 90%, obligated to the country by about 92.9% and that studying is beneficial for their professional future by 91.34 – figure 3.7.

Twelfth hypothesis – fig. 3.8, is regarding the reasons for not choosing other subjects. The reasons for not choosing certain science subjects as enhanced in High school, as physics stem from family's influence, from difficult and not interesting contents. The hypothesis was confirmed. 73.8% have indicated with high average incidence, that family does not encourage them in choosing of the scientific subjects that have not been chosen as enhanced in High school.

All along the way, a high trend of influence of the family, emotionally and study-wise can be seen (positive correlation between tables 6 and 8). 91.8% have answered with significant high incidence on lack of interest in choosing of the scientific subjects as enhanced in High school.

56.7% have reported on a difficult material. Surprisingly, 41% have indicated that not choosing the subjects stems from not understanding the studied contents.

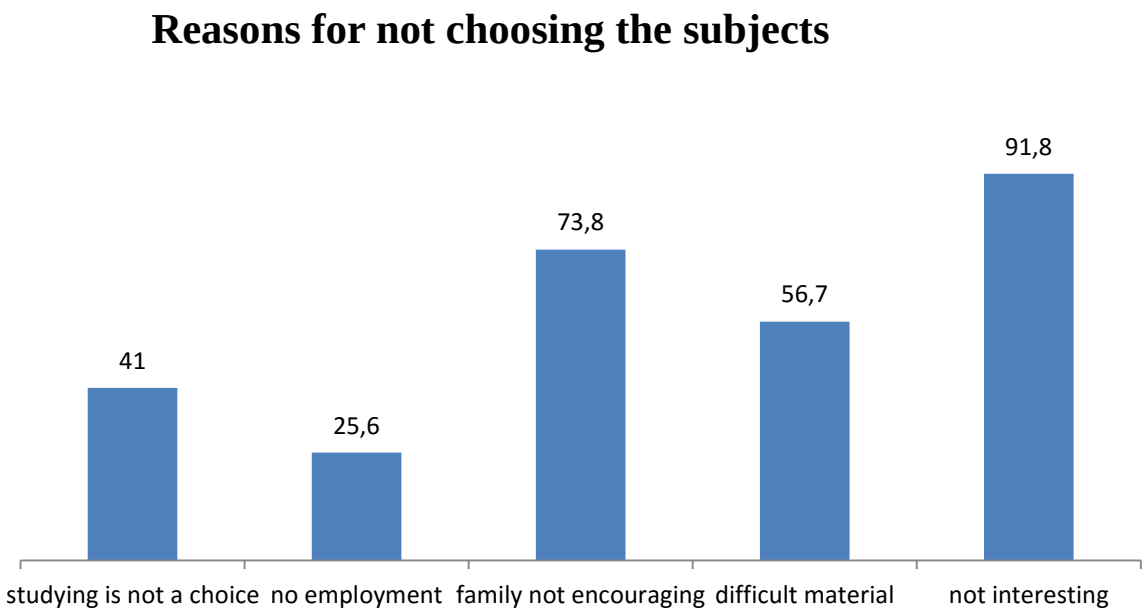


Figure 3.8. Reasons for not choosing the subjects

Thirteenth hypothesis – figure 3.9, regarding the rise in those choosing the physics subject as enhanced in High school. Pupils would choose physics as enhanced in High school and study with a significant teacher, who varies teaching methods, connects subjects to life, combines experiences in indoor and outdoor learning, and takes his pupils to tours. The hypothesis was confirmed. 91.6% wants a significant teacher who varies his teaching methods, 100% of the pupils are interested in performing experiments in outdoor and indoor learning, 98% have reported a desire to take study tours that combine scientific experiences (there is a correlation between all of these parameters) – figure 3.9.

Fourteenth hypothesis – figure 3.10, is regarding the behavior types amongst science teachers when an option to choose is available for him. The hypothesis is that a significant gender variance with a high average of incidence shall exist in the characteristic selection. Amongst girls, characteristics related with emotion, connecting contents to life and clear explanations shall be prominent. Amongst boys, characteristics that show the proficiency of a teacher in the contents and the running of a class would be prominent; the emotional aspect would be less prominent. There would be some characteristics equal between the two genders. The hypothesis was confirmed.

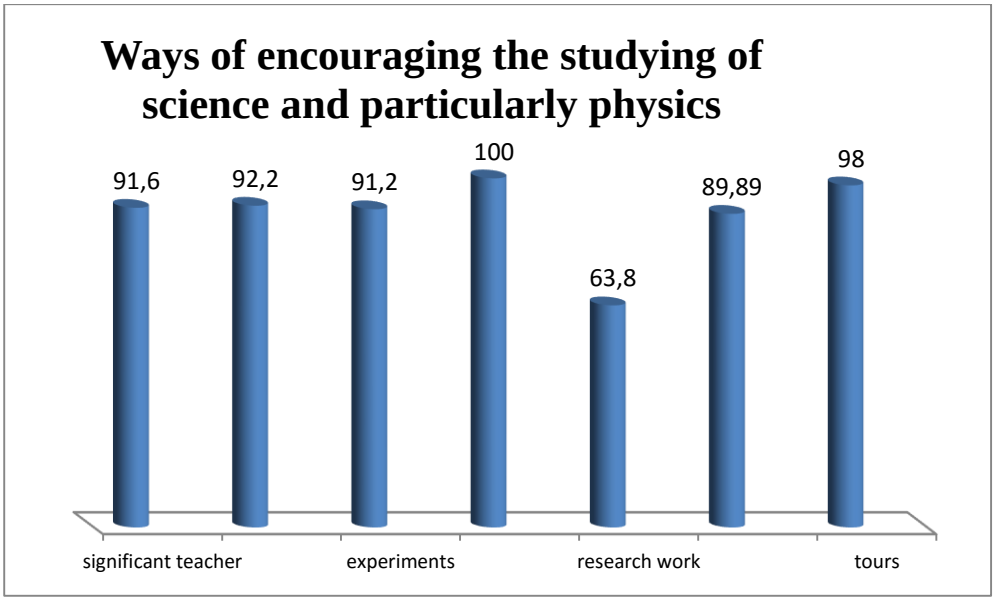


Figure 3.9 Ways of encouraging the studying of science and particularly physics

According to figure 3.10, obvious gaps are revealed in significance of high incidence between the will of girls and boys in choosing a science teacher. However, there are some characteristics that are equal amongst boys and girls. The items are: listens to problems – about 52%, likes the teaching profession – about 47%, and gives study tools – about 54%, proficient in contents – about 58%. Amongst girls, a high incidence of emotional preference is apparent regarding a teacher study-wise. 77.9% have pointed out the importance of a clean esthetic teacher, 69.67% of a teacher that creates a pleasant and unstressed study environment, 52.9% of one stimulating teaching, 56.6% of one connecting the contents to daily life and who loves his pupils 55.1%. Amongst boys, characteristics connected to managing a class are prominent – 67.6% that is not emotional – figure 3.10.

We note that the visions of girls and boys have served as a basis for the Profile of excellence teacher gender sensitive. It was initially discussed with students, then teachers and it has been adjusted along the way. We indicate that the profile served in fact, as a tool and support for teachers in teaching activity. Increased interest aroused gender specificity, namely the meaning of "gender sensitive". The major challenge aimed the ability to include gender in teacher's work. These issues were also discussed during the training activities, being determined as: the ability to apply alternative strategies to patriarchal stereotypes, to encourage girls and boys in learning, teach them to identify their practical and strategic needs, guide them in designing career related to science and technology by giving them real opportunities to develop interests and potential etc.

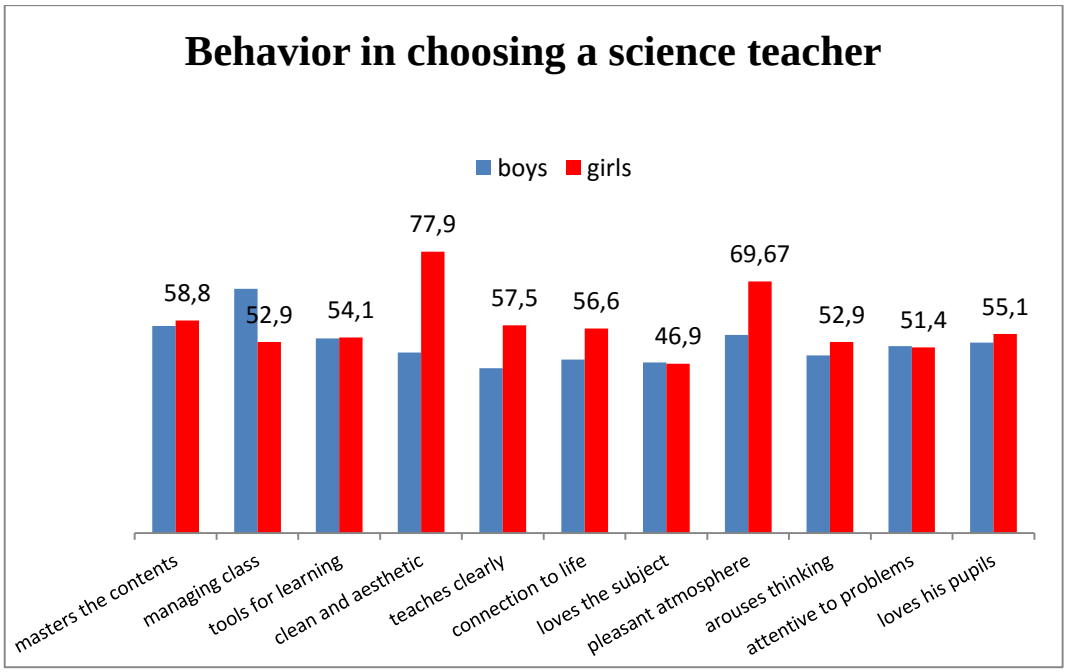


Figure 3.10 Criteria for choosing science teacher

Fifteenth hypothesis – figure 3.11 – regarding the reasons for choosing studying in the technological scientific reserve class. In this hypothesis there are several reasons that have affected the choice of studying in this class. Serious pupils with a high study motivation that are challenged with science, excellent teachers, recommendation of friends graduated from these classes, parents recommendation, prestige, promoting of life and contributing socially. The hypothesis was confirmed. There is a high average of incidence of effect of parents upon choosing the studying in the class – 87.3% (correlation between tables 5,6,8,9), recommendation of a friend 81%, serious pupils, prestige 83.8% (a correlation with table 8 prestige 88.6%).

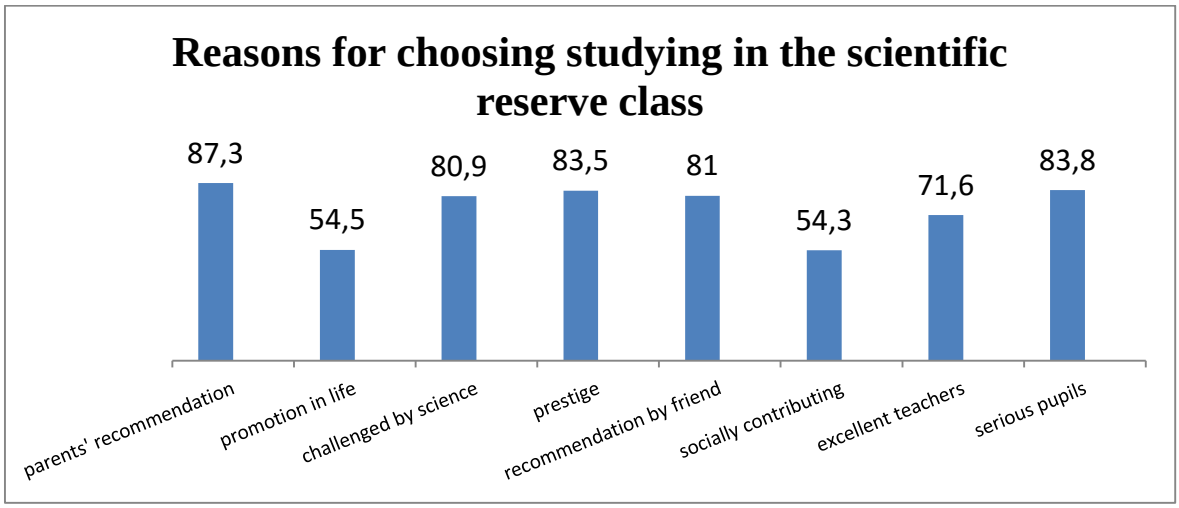


Figure 3.11 Reasons for choosing studying in the scientific reserve class

Challenged by science is only 80.9%. Since the subject of discussion is the scientific technological class, a higher percentage was expected. Only 54.3% have chosen the class for a social reason although according to table #5, 85.83% have reported about themselves that they are popular in their age group. Thus it can be learned that the strong desire to be accepted to the class overcomes the desire to be with a good friend. Excellent teachers have received 71.6%, a low average score for teachers in excelling classes – figure 3.11.

Sixteenth hypothesis – figure 3.12 regarding gender choosing of future occupation. There is a variance in occupations between the genders. Amongst boys, the leading future occupations are chemistry, computers and robotics, while amongst girls the leading occupations are chemistry, bio-technology and biology. The hypothesis was partially and surprisingly confirmed. Gender-wise speaking, there is a variance in the selection of future occupation. Amongst the boys the occupations of chemistry – 49.4% and computers – 43.5% stand out. Surprisingly, robotics occupation – 36.1% was pushed aside for the occupation of bio-technology – 36.2%. Physics was pushed down in the choosing of occupation as fifth – 33.2%. (In difference from table #7 – robotics – 28%, chemistry – 26.8%, electronics and physics – 23.6%). Amongst girls, with significant high average of incidence is occupation of biology – 42.6%, then chemistry – 39.7%. (In table #7, girls have chosen biology with 28%, physics and chemistry with 16.1% in a substantial gap from biology). An interesting thing is that in table #13, the occupations of biology – 27.9%, physics – 27.7%, robotics – 27.6%, ecology – 28.3% and computers – 28.7% were found to be in average in a similar incidence of about 28%.

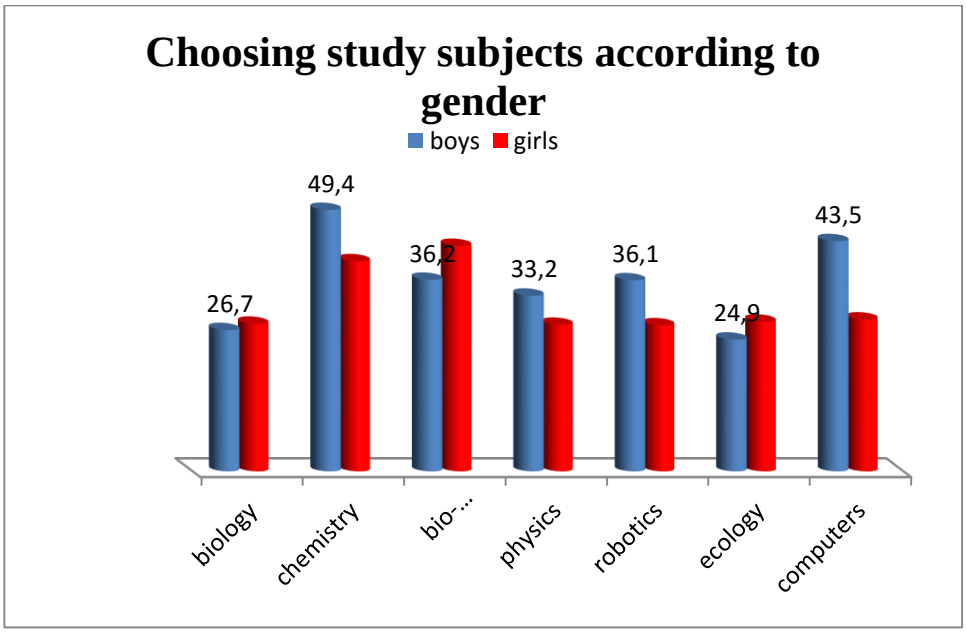


Figure 3.12 Choosing study subjects according to gender

Teacher questionnaire analysis (11 teachers – 4 males, 7 females).

Seventeenth hypothesis is regarding a teacher's attitude towards the new science program.

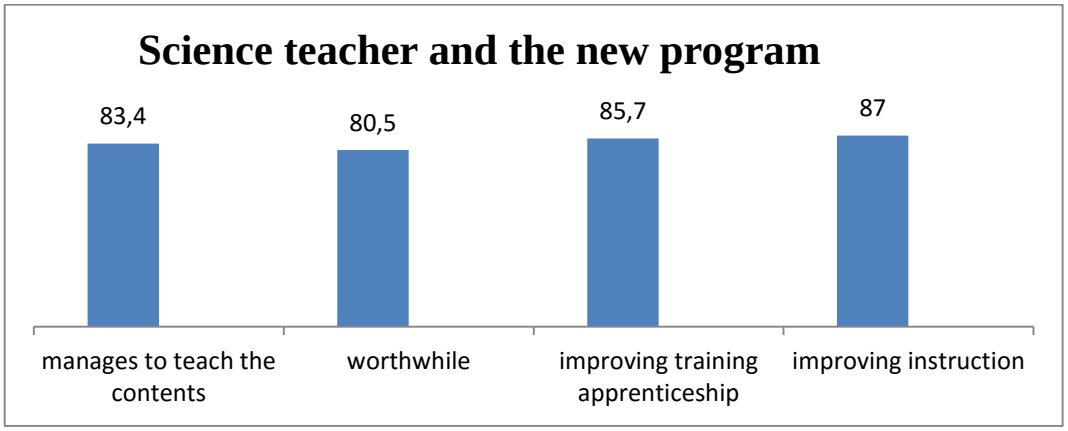


Figure 3.13 Science teachers and the new program

The hypothesis was that a teacher would indicate not meeting the quotas and not succeeding in teaching all the required subjects on time, participating in courses, being helped by instruction and training apprenticeships that improve learning. The hypothesis was confirmed. With average significance for high incidence, 83.4% of the teachers have reported that they do not manage to teach all the required subjects on time according to the new program. Only 17% of the teachers manage to succeed to teaching the entire new program on time. 80.5% undergo training apprenticeships and not more as hypothesized by the researcher, the instruction – 87% and the training apprenticeships – 85.7% are helping and improving learning. The surprise factor is that only 80.5% undergo training apprenticeships, however in the study improvement training apprenticeships; there is a higher percentage of teachers – 85.7%, figure 3.13

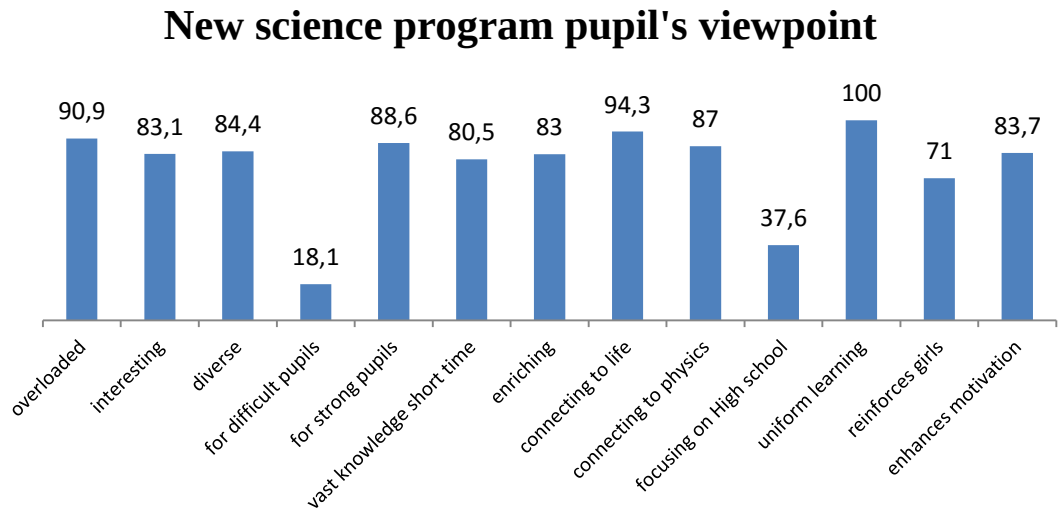


Figure 3.14 New science program pupils' viewpoint

Eighteenth hypothesis – fig. 3.14, regarding a pupil's viewpoint at the new science program. The hypothesis is divided into two: 1) the program is overloaded, interesting, enriching and diverse, suitable, connects the subject of physics and enhances motivation amongst strong pupils. It is not suitable for weak pupils. A lot of knowledge is learned in a sort's time and it is connected to life. 2) The program is superficial and is not focused on High school well enough, enhances girls but still not enough, connecting to the field of physics, is not suitable for pupils with difficulties. The hypotheses were confirmed. The program is studied with significant high incidence, uniformly in schools in which the sequences of the contents are thought according to the master document. 90.9% have reported with significance of high incidence on an overloaded program, 83.1% – interesting, 83% – enriching, 84.4% – diverse, 94.3% –connecting and relating to life (what is interesting in table #11, is a pupil points out that only 56.6% of the teachers connects the subject to life whereas according to table #10, in the subject of physics, the connection of the subject to life is high – 89.89%, there is a negative correlation). Learning is connected to the subject of physics in 87%, enhances motivation in 83.7%, however, a low average incidence of reinforcing girls only of only 71%, which is not enough, 80.5% teaches a lot of knowledge in a short time, focusing on High school only in 37.6%. Suitable for pupils with difficulties only with 18.1%, fig. 3.14.

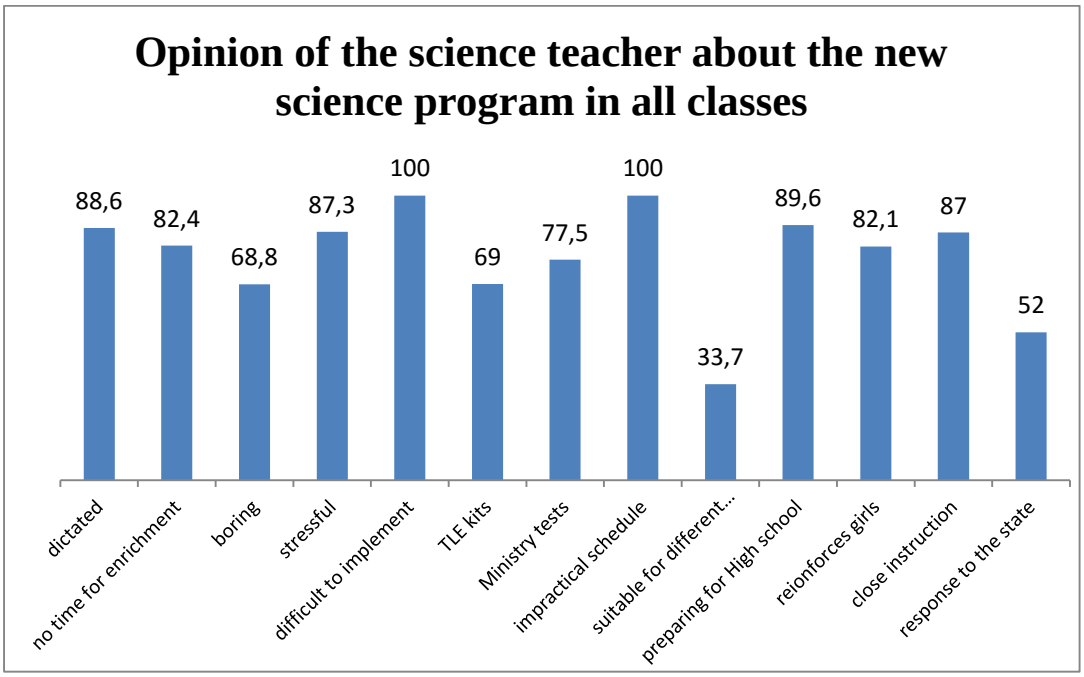


Figure 3.15 Opinion of the science teacher about the new science program in all classes

Nineteenth hypothesis – fig. 3.15, is regarding a science teacher's opinion regarding the new program. The hypothesis was that the program is dictated, stressing, hard to be implemented

– impractical time table, no time for enrichment studies, enables close guidance, enhances girls, does not fit different study levels, Ministry of Education tests and Estimation-Learning-Teaching kits help a teacher greatly and their use is extensive, is not boring and it is attempting to supply a response to the country. The hypothesis was confirmed in some items and in some was refuted. 88.6% of dictated, 87.3% of stressing, 82.45% of not leaving time for enrichment, 100% of impractical and difficult to be implemented time tables, 89.6% of preparing for High school, and 82.1% of enhancing girls. Enables close guidance of 87%, only 33.7% of the program being suitable for different study levels. The hypotheses of the researcher regarding the Estimation-Learning-Teaching kits were refuted since there use is only by 69%. In the Ministry's tests – 77.5%. 68.8% have indicated that there is accordance to table #15 – dictated, uniform, is not suitable to pupils with difficulties, enhances girls in the field. On the other hand, there are items that are not in accordance – interesting, preparing to high school, fig. 3.15.

Twentieth hypothesis – fig. 3.16, regarding a science teacher's coping with the new program. 1) The teacher undergoes training apprenticeships during the year. There are summer training apprenticeships in order to free time during the school year therefore he takes advantage of them. He prepares in advance various lesson plans, he is helped by guidance regularly, he is accustomed to receive the help of colleagues, and he invests a lot and challenges himself.

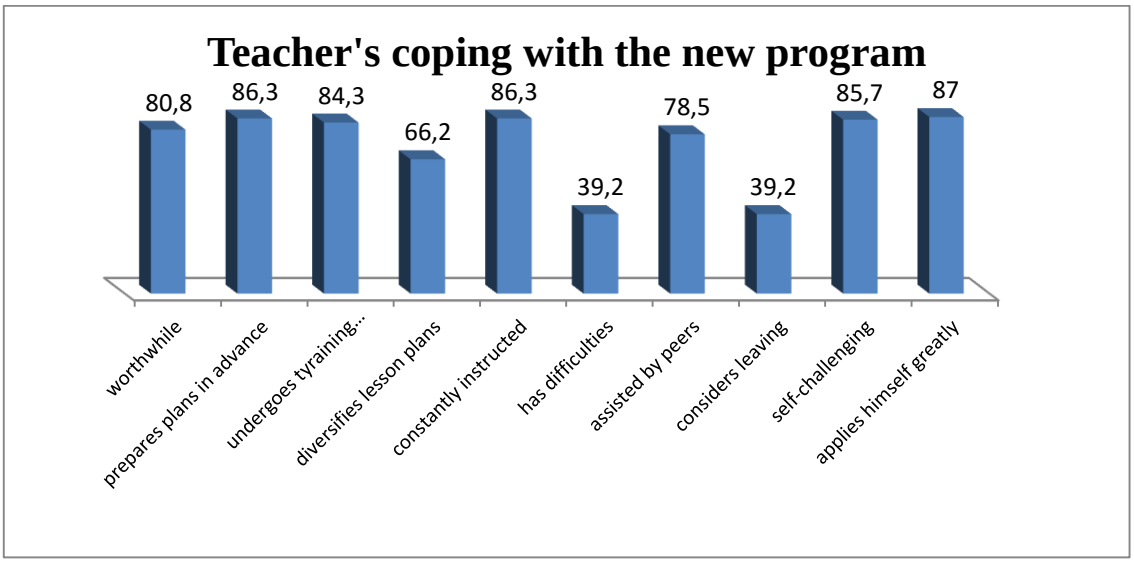


Figure 3.16 Teacher's coping with the new program

2) The teacher has diverse help, is dealing and coping, does not conceder leaving the profession or a career change to another field. The first part of the hypothesis was confirmed and the second part of the hypothesis was refuted. The teacher undergoes training apprenticeships by 80.8%, during the year (there is a correlation with table #14 pointing out teachers training apprenticeships

of 80.5%). 84.3% would rather take summer training apprenticeships in order to free time for work during the year, 86.3% are preparing lesson plans in advance, surprisingly, only 66.2% prepare diverse plans. 86.3% are being helped and supported by constant instruction (there is a correlation with 87% improving instruction in table #14). 78.5% are being helped by colleagues. Only 85.7% have reported self-challenge, 87% have reported on a lot of investment in their work. The hypothesis was refuted with 39.2% of the teachers having difficulties despite of the training apprenticeships, the instruction, the help of colleagues. 39.2% are considering leaving working in the field, fig. 3.16.

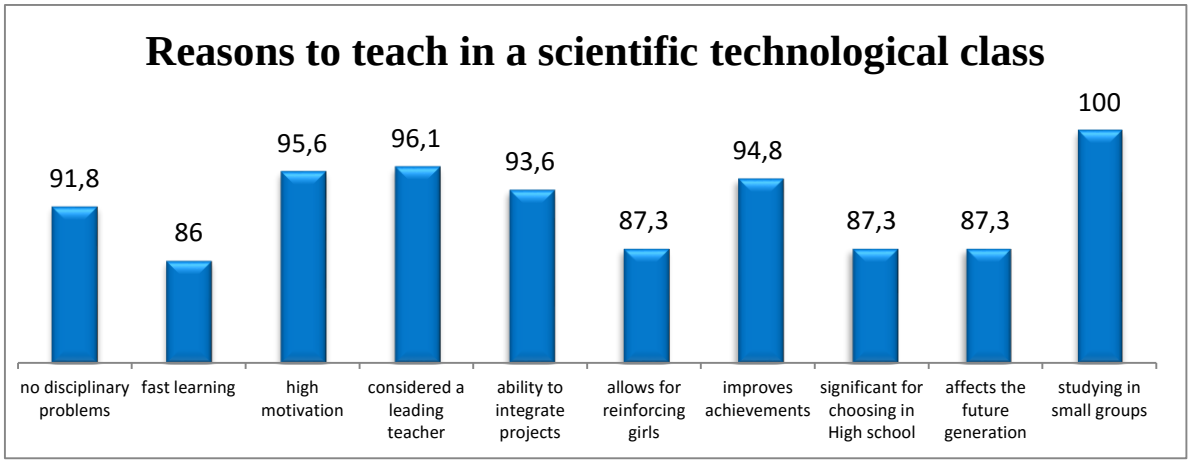


Figure 3.17 Reasons to teach in a scientific technological class

Twenty first hypotheses – figure 3.17, regarding the reasons of science teachers' desire to teach in the scientific technological reserve class. Learning in small groups that enables a good personal familiarity with all the pupils, teaching by means of projects, learning in a fast speed while reinforcing the girls. Improves pupils' achievements due to the high motivation for learning, there are no discipline problems. The teacher is considered to be leading and excelling in the educational system. The teacher is impacting the future generation and he is significant in the choosing of enhanced orientation in High school. The hypothesis was confirmed. The science teacher teaches in a class with a reduced number of pupils, thus a significance in high incidence for teaching in small study groups. The personal attitude enables learning of 93.6% by projects (no correlation to fig. 3.15 in which is indicated that in regular classes 82.4% report that there is no time for enrichment), 86% study in a faster speed (there is a positive correlation to fig. 3.14 in which 88.6% have indicated the program is adjusted to strong pupils). Teachers report a decrease of 91.8% in discipline problems in class (correlation to fig. 3.11, pupils' choosing the technological reserve class, with 83.8% of serious pupils). A report of 94.8% of achievement improvement, while 87.3% in reinforcing of girls (in table #16 – science teacher in the new program, with 82%

enhancement of girls). 96% have pointed out that the teacher is considered to a leader (correlation to fig. 3.9 in which it was reported on about 92% of ways of encouraging the studying of physics by a significant teacher, however, surprisingly, in fig. 3.11, pupils have pointed out the reasons for choosing the technological reserve class of only 71.6% for excellent teachers). 87.3% the teacher influences the future generation (there is correlation to table #8 – choosing of study subjects, with 96.4% useful to the future and in fig. 3.4, 91.3% considers the technological reserve class as beneficial to the future), 87.3% is identical in the choosing of the enhanced orientation in High school as well, fig. 3.17.

Senior management level questionnaire (5 questionnaires – 5 women).

Twenty second hypotheses – fig. 3.18, regarding the characteristics of a teacher who wants to teach in the technological reserve class. The teacher must be proficient in the contents, must meet the quotas according to the muster document and to meet the Ministry targets while diversifying teaching methods, must focus learning, challenge the pupils and increase motivation while giving a personal attitude with an emphasis on reinforcing girls. The hypothesis was confirmed. 100% of the teachers are obligated to master the contents and meet quotas according to the muster document and the Ministry targets (according to fig. 3.13, science teacher and the new program, only 83.4% succeed in teaching the program on time according to the muster document), while a 100% of challenge (there is a correlation to fig. 3.11, reason for choosing the technological reserve class by pupils, 80.9% of the challenge of science). 89.6% –rising of motivation amongst pupils.

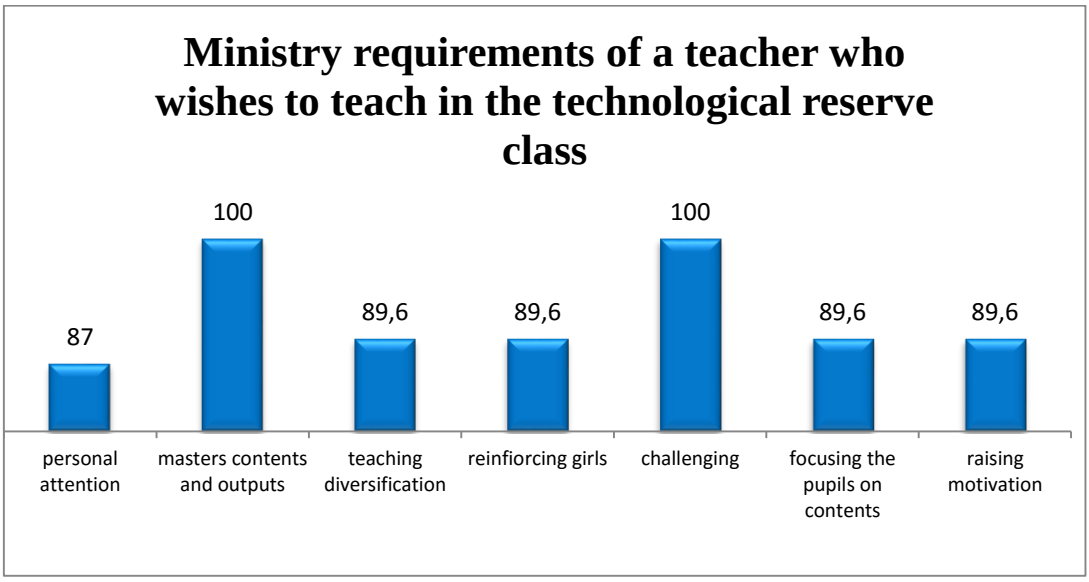


Figure 3.18 Ministry requirements of a teacher who wishes to teach in the technological reserve class

The teachers are obligated with 89.6% to diversify teaching methods and to focus learning on the contents while integration of 87% of giving personal attention and 89.6% of reinforcing girls. (There is a correlation to table #18 – the reason for a teacher's desire to teach in the science technological reserve class while reinforcing girls with 87.3% and enhancing motivation with 95.6%), fig. 3.18.

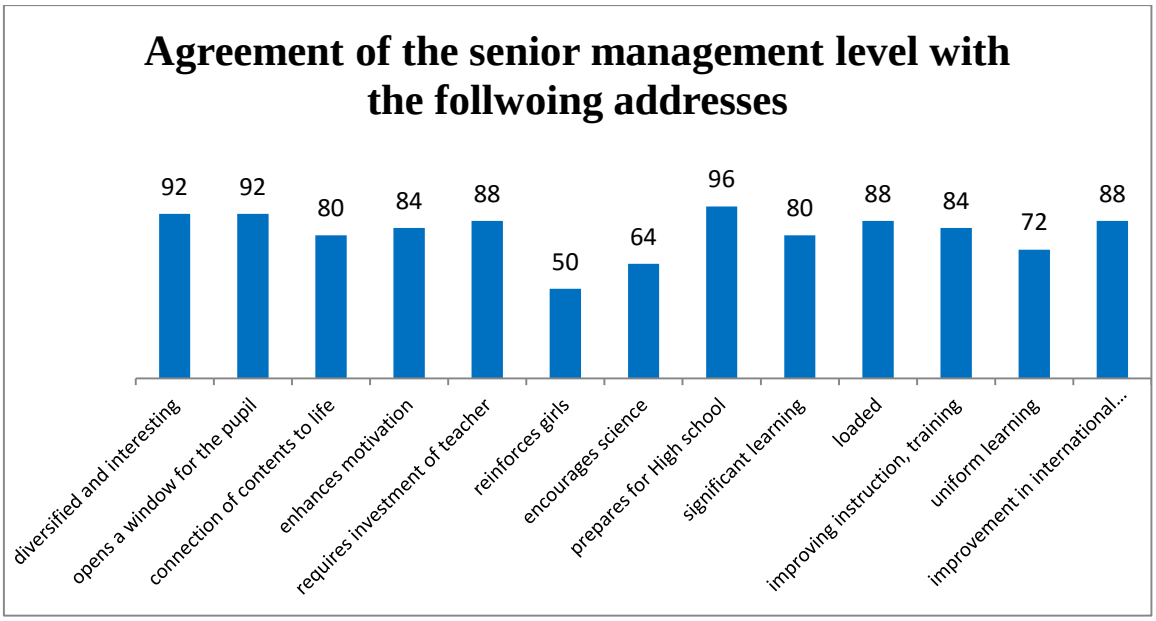


Figure 3.19 Agreement of the senior management level with the following addresses

Twenty third hypotheses – figure 3.19, regarding the consent of the senior management level to different attitudes relating to the new science program. The program is diverse, enriches and opens a window to the pupil's world; however it is overloaded, enhances motivation amongst pupils and reinforces girls. It encourages the pupils and bringing them closer to learning the science field, and improves exams achievements. The instruction improves learning. The program connects the contents to life and prepares for High school. Studying in schools in Israel is uniform. The hypothesis was confirmed, in most of the items with high percentage and the hypotheses regarding reinforcement of girls and the uniform studying were refuted.

According to the senior management level, the program is with 92% diverse and interesting (indicating that there is no correlation between them and teachers who consider in table #16 that the program is boring with 68.8%, and from a pupil's viewpoint, as considered by the teachers, interesting only with 83.1% in fig. 3.14). With 92%, the programs open a window to the learner's world due to its being diverse. 88% of the senior management level thinks the program is overloaded, 84% think it enhances motivation amongst pupils (a pupil's viewpoint according to the teachers' report in fig. 3.14, is intensifying motivation with 83.7%). In the subject of reinforcing

the girls, the hypothesis was refuted, only 50% of the senior management level thinks the program reinforces the girls (no accordance with table #19, reinforcement of girls by the Ministry of Education, with 89.6%, in fig. 3.15, where teachers have indicated their opinion of the new programs as reinforcing the girls with 82.1% and in fig. 3.14, pupil's viewpoint, where he considers the reinforcement of girls with 71% only). The program encourages the pupils and brings them closer to the field of science with only 62%. Improves pupils' achievements with 88% (there is a correlation with fig. 3.1, improvement in the international PISA tests results). 84% have reported of instruction and training apprenticeships as improving learning. (There is a correlation for this in fig. 3.16, a teacher is coping with the new program and being helped with 86.3% in instruction and with 80.8% in training apprenticeships. In table #16, a teacher's opinion of the new program, 87% from close instruction, and from table #14, the science teacher and the new program, 87% of guidance improving learning and with 85.7% training apprenticeships improving learning and 80.5% undergo training apprenticeships.). 80% – the program connects to life (there is no correlation with fig. 3.14, the new science program from a pupil's viewpoint, who considers with 94.3% a connection to life and in fig. 3.9, ways to encourage studying of physics, 89.89% have indicated a connection of the contents to life. There is a gap between these tables and the senior management level). Uniform subjects learning in the muster document – 72%, fig. 3.19.

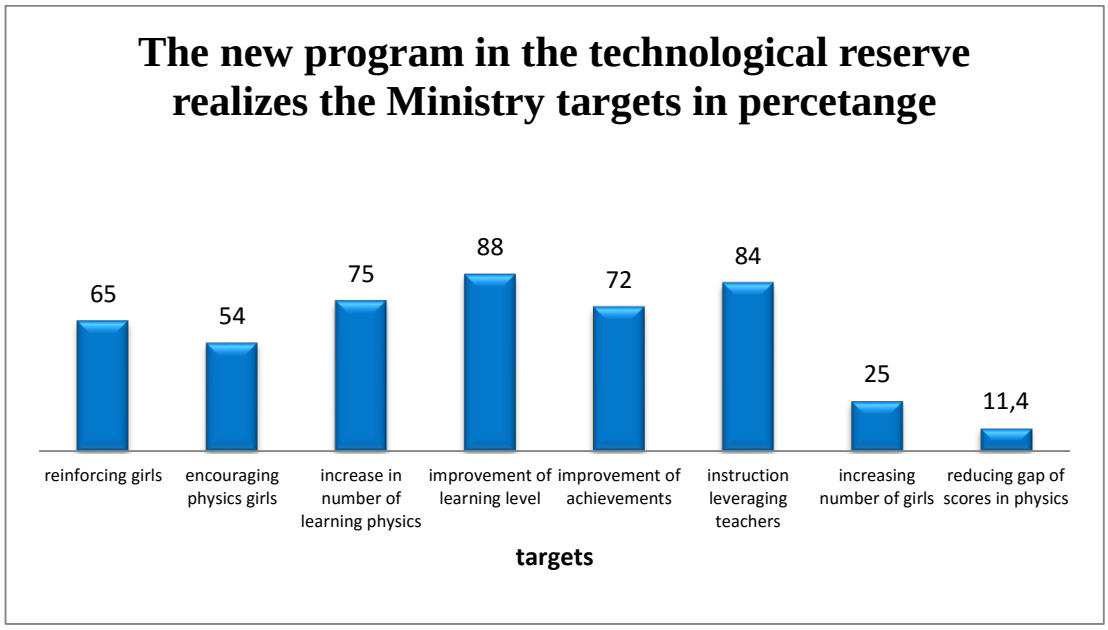


Figure 3.20 The new program in the technological reserve realizes the Ministry targets in percentages

Twenty fourth hypotheses – figure 3.20, regarding the new program in the scientific technological class as realizing the targets of the Ministry of Education. 1) The science program in the technological scientific reserve class has a trend of a positive improvement in level of

achievements, in the learning level while increasing the number of pupils studying science, and reinforcement of girls in those fields, all relatively to the beginning of the way. As a result, the gender gap of the scores of girls in the subject of physics has reduced. The instruction is leveraging the teachers. 2) The number of girls who study in the technological scientific reserve class is low and must be improved. The first and second hypotheses were confirmed.

As a result of the program, an 88% improvement has occurred in the level of learning in the technological scientific reserve classes and a 72% improvement in the level of achievements while increasing the number of the science pupils with 75% and increasing the reinforcement of girls with 65%. The gender gap of scores in the subject of physics was reduced to 11.4%. Instruction leverages teachers with 84%. The number of girls learning in the technological scientific reserve class is still low with 25% only, fig. 3.20.

Twenty fifth hypotheses – fig. 3.21, regarding the perception of the subject of physics in the technological reserve class by girls. There was a trend of improvement and change in the acceptance of the subject of physics gender-wise speaking, in the girls' world. However, the number of girls studying physics is very limited. Girls perceive the subject of physics as difficult, belonging to men's world, they have difficulties in understanding the contents, they can't see a future in it, some are starting to see a future in it, and there is a lack of parents' encouragement regarding this subject.

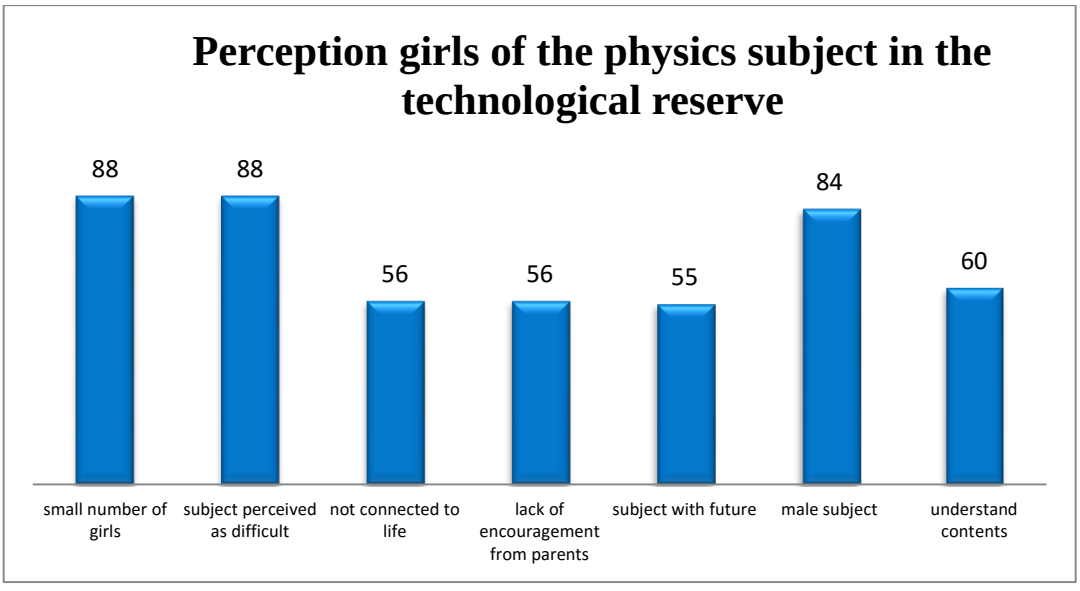


Figure 3.21 Perception girls of the physics subject in the technological reserve

The girls do not see the subject as connected with life therefore the number of girls studying the subject is small and it has grown a little. The hypothesis was confirmed. The subject of physics

is perceived as difficult with significance in high incidence of 88%. Only 10% consider the subject as not difficult and are willing to study physics. 56% consider this subject as not connected to life. 55% consider the subject as ability with a future (with a small trend of improvement in the relation), 44% do not see the subject as ability with a future. 56% report on lack of support and encouragement from home (according to table #8, 88% encouragement of the family for the choosing of the subject). The number of girls studying physics is 12%. 88% do not choose to study physics – figure 3.21.

At the same time, following the activities undertaken by teachers and parental involvement (trained in program) the situation has changed significantly (Figure 3.22). Thus, the perception that physics is little required by girls dropped from 88 to 38, that it is a difficult subject - decreased from 88 to 28, that it is not connected to life - decreased from 78 to 56, that it belongs to the world of men - decreased from 80 to 35, that it is a difficult discipline - decreased from 60 to 16. We note that the positive perception of physics increased, and with the increase of parents' involvement from 56 to 90, increased the connection with life from 55 to 88.

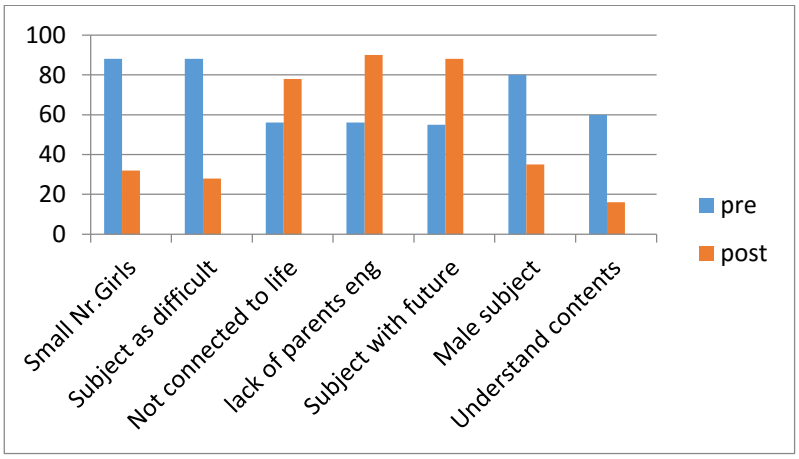


Figure 3.22. Perception girls of the physics subject in the technological reserve class

Twenty sixth hypotheses – figure 3.23, regarding the measures the Ministry of Education takes to increase the number of physics learners in the gender aspect, boys and girls. The hypothesis is that the Ministry of Education has increased activity for increasing the number of those choosing the subject of physics amongst boys and girls but the actions are still not enough.

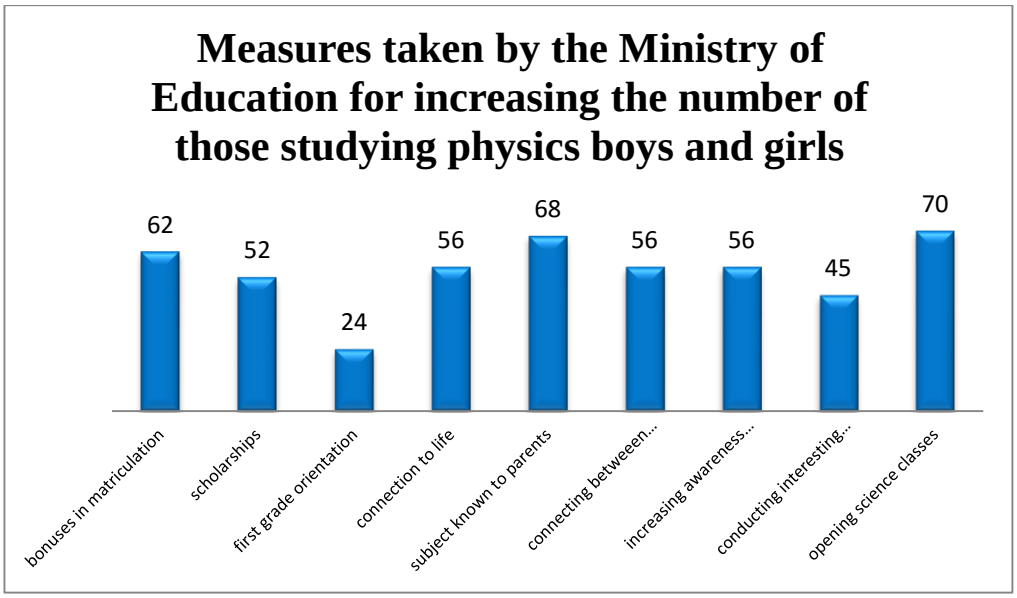


Figure 3.23 Measures taken by the Ministry of Education for increasing the number of those studying physics boys and girls

The hypothesis was confirmed. The measures that the Ministry of Education takes have received low percentage. Bonuses in the matriculation exams to substantially encourage studying this subject have received only 62%, university and High school scholarships have received only 52%. 56% see a connection between the taught contents to life. 44% do not see a connection between this subject and life. 45% claims the experiments taught are interesting, 55% which is the majority, claim the experiments are not interesting at all. Only 56% advertise information in the different media. Only 68% of the parents are aware of the programs. Only 56% of the schools are in a direct contact with industry. Only 24% invest in the orientation of parents to this subject from the first grade. 70% of schools in Israel have opened a scientific technological reserve class. This is a high percentage relatively to the parameters indicated in this table, fig. 3.23.

Scientific results implementation focused on pupils

Following the research findings an intervention program was formulated. Referring to the formative background, in the context of the presentation/achievement of strategies from previously mentioned models, gender awareness of reference groups was used. Amongst *the topics addressed during the students training* were: Promoting the importance of secondary education in science and technology; the importance of involving girls and boys in science and technology; Modalities of cooperation between girls and boys in school and social activities; Gender stereotypes; developing self-efficacy; Defining professional aspirations beyond gender stereotypes; Life and career strategies. The discussion of topics was combined with study visits to various research institutions in science and technology, meetings and debates with scientists. We note that,

regarding girls, special attention was paid to the topic of self-confidence, self-assessment and strategies to strengthen them.

The conclusion following the research findings is that there is a problem in number of pupils who choose the subject of physics as enhanced in terms of gender, boys with emphasis of girls. In current study it was found that there is a trend of slight rise in choosing the subject in two genders, however in terms of gender there is still a prominent advantage in favor of boys. Presently there are more women practicing science but they are still a minority in comparison to the male scientists. The reasons for this are: social – lack of family support and stereotype effect of the society at the age of adolescence. Girls who apply to science at the age of adolescence are considered less feminine and less popular. Boys at an age of adolescence who succeed in the field of science are considered "geeks". There is a historical background to these stereotypes in this field. In the past, there was a need of physical strength in the subject of science. Therefore, this subject has become a male subject which caused the exclusion of women from practicing it. Stereotypes have come into being which appeared and still appear in the media in movies and books. The existence of women in science throughout history is affected by gender stereotypes that prevail in society. This experiment attempts to present a trend of change in the stereotypes that boys and girls face particularly those who wish to practice the world of science after studying for three years in the scientific technological reserve class.

54 pupils were tested in the experiment from the Teddy Kolek Junior High school in Jerusalem, who studies in a scientific technological reserve class; the distribution is as follows: 29 boys, 25 girls. The experiment was performed twice, in 7^{th} grade, first year Junior High school in the scientific reserve class, and at the end of 9^{th} grade, at the end of studies in Junior High school, after three years of studying in the scientific technological reserve class.

The pupils received an empty white page, felt pens and pencils of different colors. They were asked to draw a scientist on one side of the page and on the other side to describe a daily schedule in a life of a scientist. The task is anonymous. No explanations were given.

After three years, a comparison was made between the results. The results were explained in three conventions. In instructor convention in teaching of science in the Pisga center in Jerusalem, in an annual convention of Teddy Kolek Junior High school in Jerusalem and in a convention of teachers' teachers of the Ministry of Education in Jerusalem District.

Out of 54 boys and girls in the 7^{th} grade age group, who have drawn a scientist, only one pupil used colors and a pen. Rests of pupils have drawn with pencil only. All the class pupils have

drawn scientists. There is no attention given to female scientists in the drawings. The scientist appeared as a monstrous man who received an electric shock, with a square body, wearing glasses, a white lab robe, if there is hair then it is wild, standing up as spikes, working as a chemist, with materials and tools, working alone, not smiling. A day in a scientist life is most boring. The scientist gets up at 7 in the working, eats and drinks, does experiments, eats again does experiments eats again and returns home. 5 girls stated that he brushes his teeth and puts on cloths and takes a shower. It was not mentioned that a scientist works in a team. From what is written he is lonely most of the time, alone and disconnected from society. 3 girls stated that a scientist has a family. One pupil stated that a scientist watches the science channel on TV.

In 9th grade, 25 girls (all of them) have drawn female scientists. 22 pupils made use of colors. The scientists are smiling and less square-like in their body structure. The female scientists are meticulous in their attire and hair, adorned with jewelries. The robe is placed on the body and emphasizes femininity. The hair of boys is not in order in most cases. Boys' and girls' scientists appear with a robe and lab equipment. Scientists appear as weird. The scientist gets up in the morning goes to the lab and conducts experiments over there all day alone and with no friends, and in the evening returns home and goes to sleep as he has no family or children. The innovation amongst pupils from 9th grade is a scientist going to Weizmann Institute in Rehovot for the purpose of conducting experiments in order to win prices, does experiments in society. Female scientists have family and children. During the day and the experiments, they tend to talk to the husband and children, finish the work day at 16:00, go shopping, to the gym and go out to have fun.

Intervention program – The experiment examines gender difference and stereotypical society. Order interventions-

- Painting diagnosis of 7th.
- Meetings with scientists at the Weizmann Institute in Rehovot and Bloomfield Science Museum.
- Feedback from meetings with scientists male and female.
- Teacher guidance as science instructor. Trainings on gender issues. Transmission of information through holding lectures to teachers.
- Another diagnostic drawing to equalize the process.

In the experiment participated 54 students from Junior High Schools. The target group was: Teddy kolk in Jerusalem and Dekel Vilnei in Male -Adomim from scientific and technology

reserve classes- 25 girls and 29 boys. The experiment was performed twice at schools in the classrooms lasted 45 minutes. The mission was to draw a scientist on an empty white page. On the other side describe daily schedule in a life scientist. The task is anonymous. No explanations. Analysis of drawings was by Criteria. The research tools – *Drawing scientist* customer psychology strategy- called psycho-diagnostic. Analysis projective is a drawing according to psychology teaches us the following points: Both sexes at any age group and statuses tend to draw their own kind first and only then the opposite sex if they asked to. Diagnostic students painting the image, perception and conceptual perspective of students pretest and after the posttest intervention. It is a tool dropped. This students research in the 7th the boys draw more scientists (Male) than scientists (Female). A phenomenon that emphasizes the highlights issue of gender and stereotypes (Hammer 1980).

A tend of change can be seen between the results in tasks in 7th grade and in 9th grade. In 9th grade female scientists were drawn as opposed to 7th grade that have drawn only male scientists. In the description of day in the life of a scientist, a trend of change is apparent. The scientist works in Weizmann Institute with a team. Regarding female scientists the change is essential. Thus we learn that studying in the scientific technological reserve class, has changed thinking for part of the pupils mainly the 22 girls, and part of the stereotypes and that is due to a multiplicity of drives to Weizmann Institute and meeting young male and female scientists. Still the scientist looks weird, detached from environment, his life are neglected and boring and alienated from environment, focused on the activity and in the desire to invent tools and cures in order to be beneficial for humanity and receive awards. However, female scientists dress orderly, with a robe and around them is equipment from the field of chemistry. They communicate with the children, the family and society. They end their work at 16:00.

From these results, we learn that the stereotypes regarding boys and girls, men and women in science, continue despite technological changes, the desire to study in the scientific technological classes and succeed in life. Pupils who study in the scientific technological reserve class and designated to be the future scientists of the country have difficulties in releasing the existing stereotypes and are strongly affected by them. These stereotypes stem mainly from watching the media. The pupils, boys and girls, who since childhood are interested in science, watch multiple TV programs and are constantly exposed to an absent-minded scientist who wear glasses, wears a white robe and has hair that stands on its end, conducting experiments, behaves in a weird manner and is detached from environment. Therefore, it is difficult for pupils despite their studying in the scientific classes to detach from stereotypes that are so deeply rooted in

society. Solutions for this, as early as from the age of kindergarten and until High school, are to persist and get the boys and girls to meet male and female scientists from various fields who will tell about their life and activities. They will be part of the enhancement in kindergartens and schools. Meetings will include visits to buildings in which male and female scientists work, thus understanding that the work is done in a team rather than alone, will see that the buildings are innovative and advanced, filled with aesthetic people and in terms of technology, they meet the standards of 21st century. Additionally, the conduct of a scientist is to be immediately changed as appears in literature and children programs on TV and the media. Should the condition not be changed, the stereotypes will continue and it will encumber the educational system to draw pupils in to science with an emphasis on the subject of physics and turn it into a wanted and prestigious subject. The results achieved are better than those achieved during the diagnosis and therefore, highly positive change between the results in tasks in 7th grade and in 9th grade. The experiment proved is successful and valid.

Results

54 pupils were tested in the experiment from the Teddy Kolek Junior High school in Jerusalem, who studies in a scientific technological reserve class; the distribution is as follows: 29 boys, 25 girls. The experiment was performed twice, in 7th grade, first year Junior High school in the scientific reserve class, and at the end of 9th grade, at the end of studies in Junior High school, after three years of studying in the scientific technological reserve class.

In 7th grade the pupils have often drawn with pencil. All the class pupils have drawn scientists (male). There is no attention given to female scientists in the drawings. The scientist appeared as a monstrous man who received an electric shock, with a square body, wearing glasses, a white lab robe, if there is hair then it is wild, standing up as spikes, working as a chemist, with materials and tools, working alone, not smiling.

In 9th grade, 22 girls drawn female scientists. 31 pupils (boys' and girls') have drawn female scientists. 32 pupils made use of colors. The scientists are smiling and less square-like in their body structure. The female scientists are meticulous in their attire and hair, adorned with jewelries. The robe is placed on the body and emphasizes femininity.

A tend of change can be seen between the results in tasks in 7th grade and in 9th grade. In 9th grade female scientists were drawn as opposed to 7th grade that have drawn only male scientists. Thus we learn that studying in the scientific technological reserve class, has changed thinking for part of the pupils mainly the 22 girls, and part of the stereotypes and that is due to a multiplicity

of drives to Weizmann Institute and meeting young male and female scientists. Still the scientist looks weird, detached from environment, his life are neglected and boring**.**

The results achieved are better than those achieved during the diagnosis and therefore, proposed mode**.** From these results, we learn that the stereotypes regarding boys and girls, men and women in science, continue despite technological changes, the desire to study in the scientific technological classes and succeed in life. Pupils who study in the scientific technological reserve class and designated to be the future scientists of the country have difficulties in releasing the existing stereotypes and are strongly affected by them. More details are in the appendix 9.

Criteria for analyzing the painting

The following table presents an analysis painting of students' science technologic reserve class students in 7th and in the 9th. The paintings are analyzed by age, gender and years. The analysis was done according to clear and structured criteria. In the painting dropped we you can see the self-esteem of boys and girls**.** This study examined the consequences painting self-image to the scientist. Tested gender dimension, and quantified the body. The painting of the students, boys and girls, diagnoses how the image perception before at the pretest and after at the posttest. The table illustrates the steps of the research interventions**.** The drawing consequences of students attached appendices**.**

Table 3.2 Distribution criteria according to scientists' paintings grades, gender and year

April-2012-Class 9th		December -2009-Class 7th		Criteria
girls	**boys**	**girls**	**boys**	
25	29	25	29	Students number-54
21	22	18	20	Wearing a robe
1	7	2	7	Mustache
7	5	6	8	Wearing glasses
21	21	10	17	protective glasses
22	10	0	1	Painting colors
4	8	9	15	Strange hair
F-23	**M**-31	**F**-10 ,**M**-14	**M**-30	Scientist

				Male/ **F**emale
12	5	6	3	Smile
Dress fashionably , team work , taking with her children' go to kindergarten in the morning and in the afternoon , talks with husband and children on the phone , going shopping , meeting friends , spending time and goes to the gym.	Works with a team, take a showered and dressed, spending time with family sometimes works until 20-21.	Wake up in the morning, brushing his teeth taking a shower, getting dressed. Sometimes goes to the gym.	Boring life scientist work at 7p.m, traveling to laboratory make an experiments all day returns Home and sleep.	***life*** span

The following table shows the formative stage of the research with pupils. Shows the activities an experiment held in science technology reserve classes for three years in junior high school. A canceled performance is active, rational, interpretation of the results and conclusions of these operators**.** This table illustrates the steps by period. The target groups which carried out the intervention**.** The intervention was carried through - tools, rationale and results**.**

Table 3.3 Depicts, rationale&interpretation of pupils' results of activities (2009-2012)

SUB-STAGES	CLASS/ AGE OF PUPILS	ACTION	RATIONAL	INTERPRETATION Of RESULTS
DIAGNOSTIC	7-th age 13; Dec-2009	Projective picture of scientist	Understand Perception Of scientist's role	Drown image- Superficial male/odd ,stereotypical; no emotional expression. Painting of the species
FORMATIVE	8-th; Age 14 Feb-2011	Meet female &male scientists at work at Weitzman Institute	Familiarize with real modelling figures; Change stereotypical perceptions	Pupils surprised to discover scientists are emotional human beings: excited ,professionally proud, like to study, some do have relatives or own family; dressed according to fashion, tattoos, and earrings
EVALUATIVE	9-th; Age15 April-2012	Projective picture of scientist	Use the same tool which had been used at the diagnostic sub-stage to estimate perceptional change	Trend of change, drawing female scientists, Reference to the work environment, Sexual tight clothing
CONCLUSIONS	Nov-2011	Meet young female scientists At Science Museum	Familiarize with real modelling figures; Change stereotypical perceptions	Breaking stereotypes The scientists study , conduct research , enjoy life high salaries Relationships and children.

Table 3.4 Description Construction formative experiment at various times through different target groups-2009-2015

Target groups	Time/Age	Steps of intervention	Tools	Rational	Evaluation of findings
Pupils	Class 7th. Age-13, Sep 2009 *Pretest*	Establishment of a Sciences group of students indicated. Medium starting point.	Based on certificate and receipt groupings in English and mathematics, actual scores.	Providing the opportunity for strong students who were not accepted scientific reserve classroom	Create a class with excellent students. Graduated with honors, increased the number of high school students who choose science with an emphasis gender.
	Class 7th. Age-13, Dec 2009	Diagnostic, Guidance on task white page part , without more explanation	Drawing projective image (HAMMER 1996).	Drawing projective image.	Most of the girls painted male scientist shows stereotypes. The scientist looks weird with glasses.
	Class 7th Age 13, Dec 2009	Diagnostic, describe life Schedule of a scientist in one day	Perception of a scientist schedule	Perception agenda , lived life and prioritize of a scientist	Profession takes up all day with no social life.
	Class 8th Age 14, Oct 2010	Opening a special course for the empowerment of women in the sciences, technology and especially robotics	Course Only for Girls (Blonder 2011).	Increasing the number of girls in science and increase the number of girls in high school	48 girls from 50 girls chose to continue study science in high school including robotics. Great success.
	class 9th Age-15, April 2012 *Posttest*	Transfer the same data as class 7th Diagnostic, Guidance on task white page part, without more explanation.	Comparative Tool what happened following the intervention. Drawing projective image (Hammer 1996)	Drawing projective image.	More figures are correct gender.Boys and multi girls painted female scientist. The scientists cultivated, maintain a feminine look, robe close and highlights the body lines. The self-concept , realistic and gender change Accurate gender identification allows professional security and the continued promotion of the profession.
	class 9th Age-15,	Diagnostic, describe life Schedule of a	Perception	Perception agenda , lived life and	Changing the perception scientists

	April 2012	scientist in one day	of a scientist schedule	prioritize of a scientists	for girls with families and social life, and life of a scientist male.
Pupils and parents	class 9th Age-15, Feb 2012	Meeting girls mothers and male scientists	Meeting (coffee and cake) girls and mothers with young male scientists	Breaking stereotype, Encouraging girls and family choosing science and meeting with scientists explaining why they chose the profession? To see they are happy with friends and own family.	The girls were amazed by young scientist and already Doctor who wear modern clothes, Look good, highly salaries. Some of them started a family. Breaking stereotypes to girls and mothers.
	class 8th Age-14, Feb 2013	Joint intervention Parents- students. Day dedicated to the subject of inquiry.	Lectures, learning by inquiry - Presentation + building model Illustrative	Parents take part writing subject of inquiry.	Every parent enjoys watching his son / daughters explain his works. The parents and children were proud and ask for about meeting every end of period.
Parents	class 7th Age-14, Sep 2015	Evening parents opening the academic year	Presentation	Explanation goals and strategies at work in this class take part in the responsibility for success, translate satisfactory action. Finding time needs gender assistance - individual private lessons, plans on T.V , reading articles, museums Parents in the area understand the importance and can encourage. Can be used for modeling. Parents Lecturers or lectures and creating a shared sense of belonging. A need basic for that age	High attendance parents. Parents asked to show presentation also to students. Enthusiasm, ability to assess the skills of students in gender, willingness to cooperate, involvement in the success of the program.

Teachers	class 9th Age-14-15 Sep -May 2012	Moving feedback , Transfer of appropriate strategies for teaching gender	Observation lessons in the classroom	Encouraging girls, learning according differentiated instruction. Learning styles and use different gender strategies. Especially multi-intelligence (Gardner 2011)	Strengthening girls, improving teaching methods of differential gender l Building models - strengthening girls and profile sensitive gender teacher. Lecture demand common to all teachers at the training center.
	Center teachers May 2013	Teachers lecture in the Jerusalem district, some of them were guided, and I built models following the observations in class. Exposing these models and use in classrooms.	Exposing well-attended lecture models. Using results intelligentsia strategy - Helping to build a program adapted to the genders needs. (Klein 2014).	Recommendations to encourage and strengthen girls in science. With program objectives and linkages sciences.	Highlight teachers, consent, and application for the use of models and decision the presentation. Reference to the gender dimension.

The main scientific results: Among significant results from the mentioned interventions, we note the increased interest in science of boys and girls. Thus, if before applying the strategies only 65.72% of boys (1st place) and 60% of girls (2nd place) from reserve class have shown interest in science, after carrying out the activities - the score grew to 100% of boys and 92% of the girls which showed interest in science (Figure 3.24).

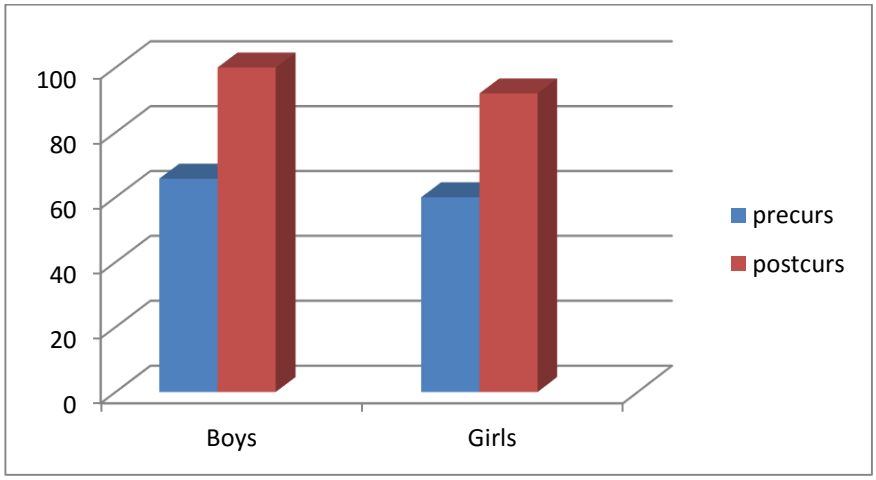


Figure 3.24 Interest in science of students (by sex), %

As a result of the activities, the students' attitude towards the advancement of science in future changed. Thus, if before training activities only 55% of boys (1st place) and 48% of girls (2nd place) from reserve class have confirmed ***the decision of students' advancement in science in future***, after carrying out the activities - the score increased of 93% for boys and 88% for girls that have indicated the decision of students' advancement in science in future (Figure 3.25).

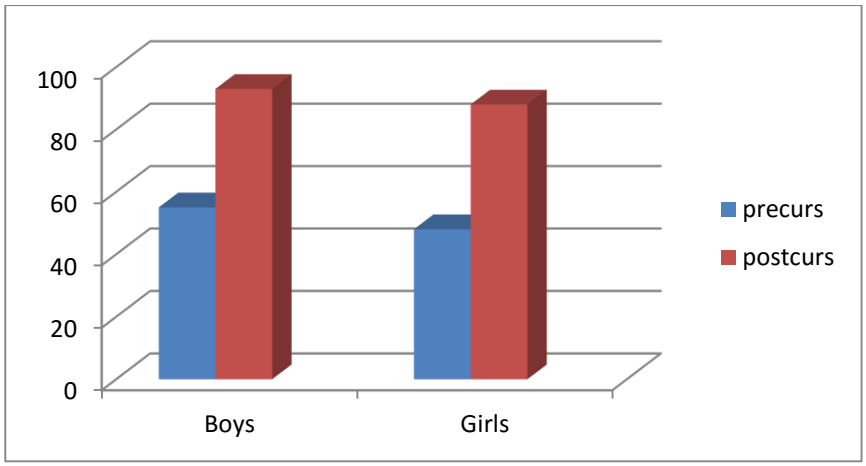


Figure 3.25. The decision of students' advancement in science in future

Some example of figures that was changed following the formative experiment:

1) **Yael-**In seventh grade, Yael's scores were mediocre even though she had invested in her studies. Following reinforcement and higher teacher assessment of Yael's achievements have been improved. After three years of science education and enrichment activities Yael chose to study 5 unit's chemistry in high school.

2) **Sahar-** Excellent student in all subjects. Due to the activities and the strengthening of learning strategies she chose to study in High school 15 units Biotechnology.

Percent of the high school students **who reported interest**, and **agree or strongly that they like science** by gender- boys -93.1%, girls-88%.

Points of emphasis

- The formative experiment closed the gap between ideal and reality**.**
- The experiment included three phases- diagnosis, formative and evaluation.
- The model validated through experiments significantly in three target groups.
- The intervention has demonstrated through written strategies following the experiment as part of both companies use and can build a model and programs for future, encouraging excellence in gender, with an emphasis on girls.
- Increased capacities of teachers highly motivated, will teach classes to invest in each student individually according to his needs while strengthening boys and girls according those needs.

- The program can be built and based on the paradigm of results intelligence. The results intelligentsia helps build the appropriate program gender needs. Following formative experiment shows continuity and progress step by step. [120]

* The final goal:

  - Pupils- to build a gender perception, increased self-confidence and realistic.
  - Parents- maximum cooperation and support gender according to needs pupils.
  - Teacher - taught according to the strategies and responding needs.

3.3. Conclusions of third chapter

*The intervention has demonstrated through written strategies following the experiment as part of both companies use and can build a model and programs for future, encouraging excellence in gender, with an emphasis on girls. * According results intelligence the goal professions as girls choose scientific and technological with cooperation and support from teachers and parents. It is important the students will have an accurate perception of the scientist that gives them gender confidence. [120].

***** Girls and boy's attitude are friendlier to the sciences subjects and thinking of continuing studies and practice in the field of the future. Girls with more motivation for choose learning 5 points physics in high school. Improving Boys and Girls achievements, the achievements higher. The gap between boy's and girl's negligible.

* Highly parent's motivation gives to the pupils support and success in achievements. Highly positive change between the results in tasks in 7^{th} grade and in 9^{th} grade. The experiment proved-successful and valid.

What has changed from the beginning this research till now the end?

- Till now, there is no class structure model of technological scientific reserve class. The model that I wroth exclusive and innovative, is a very high light's now and the ministry of education can us it. It's clearer to explain the structure and the model of the class for people who do not come from the school system. The time that I build the model give options to made the class structure clear to me and to the schools that I was instructor of theme.
- There are not absolute criteria for acceptance of students to those classes. Each school decides on his own and what he wants to found the best pupils to those classes. They based on the report card grades, interest in science, special tests and personal interview.
- Personally as a teacher and instructor I'm increasing the number of students, boys and girls, who choose scientific subjects in high school. At the same time I'm strengthened the pupils, boy's and girl's in the sciences by diversifying and improving methods of teaching, innovation, attitude and personal encouragement, an experiments, meetings with scientists men and women,

lectures, tours of the Weizmann Institute and to the Science museums. (As instructor I'm promoting all my teachers how to reinforce all students in those classes).

- As a manager's science and as instructor 6 years (in the past), I built a work plan model - strategies to encourage students' boys and girls in science and technology. Recommendation – *persistent modelling*: from the age of kindergarten get boys and girls to meet male and female scientists. Stop projecting movies on TV with Strange scientists it affects youth**.**
- Contribution: Following the formative experiment we have built a strategies model to teachers, parents and pupils which gender focused the new program in science and technology. Recommendation – *persistent modelling*: from the age of kindergarten get boys and girls to meet male and female scientists. Stop projecting movies on TV with Strange scientists it affects youth**.**

Result analysis of students' drawings has revealed tendency of changing of students' vision of the image of women and men scientists. If the 9th grade students drew a woman scientist, students from the 7th grade drew only male scientist. Referring to descriptions of women and men scientists, describing a day from the life / work of a scientists, visible changing trends are noticeable through separation from stereotypical patterns, especially in representations of girls. Thus, we can conclude that studies in the reserve class in science and technology have helped changing the way of thinking for a part of the students, especially of 25 girls. Changing stereotypes is due largely to training session and especially to multiple visits to Weitzman Institute and meetings with young men and women scientists.

GENERAL CONCLUSIONS AND RECOMMENDATIONS

The new study program in science and technology from 2009 has provided new opportunities to study for eminent students interested in learning, in Israel, by creating reserve classes in science and technology. Introducing the program was conditional upon external factors as well as internal. External factors target the necessity to maintain and advance the state of Israel on the international arena, on the background of scientific-technical progress, but also the contemporary socio-economic trends/challenges. The internal factors include state needs to correct previous mistakes in the education system, when science classes have been reduced, and schools that study technology have been closed, which led to lower interest and lower scores in science and technology education.

The Technicon has recognized the importance of the program and would award an increased bonus to its graduates. The Ministry of Education is interested in increasing the number of pupils who study for an enhanced scientific technological matriculation certificate from about 6.5% presently, to 14% in the next three years. For promoting this issue, the Ministry would invest about 200 million NIS and Intel an additional 20 million NIS.

The program has begun its operation in 2011 and was implemented in about 30 schools around the country. Presently (2014), the program is operated at 130 schools all around the country. These schools encourage pupils to choose and persist in the scientific technological subjects, while using social media, clips and virtual games all of which are meant to supply inspiration to pupils. The pupils are exposed, as part of the program, to a high-tech environment through visits in the manufacturing facility of Intel. The cooperation between Intel and the Science and Technology Administration in the Ministry of Education, includes the supplying of technological and methodological consulting by company personnel for the definition of standards, policy and strategy as part of "adjusting the educational system to the 21st century", while designing and implementing a model for cooperation between the high-tech industry in Israel and scientific-technological excelling classes, and taking part of the training if excelling pupils in the field of computer sciences [99, 109].

The new study program in science, focused on the reserve class in science and technology, has created a trend of positive change in many aspects - from the study matter, to increasing advanced scientific disciplines choices in school, improving results and requesting to study in this class. However, the implementation of the program identified a number of problems: insufficient motivation of students to study science and technology, persistent discrepancies between girls and boys in motivation and in learning, difficulties in the teachers' work activities with girls and boys,

insufficient motivation from parents in favour of technological program. Those conclusions served as a benchmark for the decision to include gender in the implementation activities of the new program in the context of the education system in Israel.

In the present research, key concepts/terms to the relevant field were developed: gender in science and technology education; gender-sensitive skills; gender-sensitive career guidance; gender friendly/sensitive school. The conceptualization of gender in reference to the exploration of the new program in science and technology, focusing on prevention and overcoming gender stereotypes in attitudes and learning disciplines in science and technology by girls and boys, and ensuring students' success and achievement, have provided the theoretical foundations for the researched subject.

The research results have confirmed that motivating girls and boys for sciences and technologies discipline can be achieved through gender sensitive strategies that are effective, paradigmatically addressed from a pedagogical and social perspective and based on the interdependence of educational activities focused on students and gender awareness of teachers, and also parents.

At the same time, only excellent and known teachers must be admitted to teach in special classes. Science teachers must know how to integrate the two strategies for both genders, because according to this study, girls and boys want to study together. When choosing advanced subjects in high school, often there is a significant difference between boys and girls. Usually, the boys choose such disciplines as computer, chemistry, robotics, chemistry and biology, and girls are choosing subjects related to life. Thus, through applied strategies, the teacher must combine the mentioned aspects, appropriate to the strategic and practical gender needs. In order to increase tests motivation and success, beginner teachers who teach in college should be identified during the studies and trained in advance to be nominated/selected to teach in special classes. Studies should include strategies suitable for teaching boys and girls, thus appears the problem of the exploration of their gender sensitive skills development experience.

In conclusion, achieving the methodology of implementation of the new program in science from a gender perspective is conditional upon the preparation/special training of teachers, but also upon the creation of psychological and communicable conditions in educational institutions.

Significant results were obtained in this study regarding the parental involvement and the major impact on the choice of the type of class over the transition of juniors from primary to secondary school cycle. The study has confirmed the idea that students, especially girls, whose families offer support, including emotional, demonstrate increased interest and achieve greater

success in school. We can see the development of a gender-sensitive school-family-student (especially girls) partnership.

We noted that the new science study program has improved students' results. Among them, following the indicated interventions, we see as significant: the increased interest in science of boys and girls, especially girls, and the students changing attitudes in favour of science advancement in future. From the gender perspective, there is an obvious tendency to choose science and technology disciplines as advanced subjects. There is also a growing trend toward the decision to choose physics as subject, but nevertheless there is still much to be done in the field.

As a result, there was an improvement of achievements at national and international level and ranking on top of the positions after Switzerland and Sweden. In these classes, the difference between boys' and girls' scores is insignificant.

This study has confirmed the correlation between the new science study program, gender and improving achievements in the reserve classes. We note that the connection between "new program in sciences", gender and teaching strategies is an important factor of motivating girls and boys to learn, of diminishing gender stereotypes and prejudices in learning science and technology disciplines, education and career guidance for girls and boys, obtaining higher academic results/ diminishing the differences in scores of boys and girls in learning.

The survey shows that the introduction of the gender dimension in the "new program in sciences", expressed through gender-sensitive methods and techniques, is an important condition in order to improve academic performance in high school.

We acknowledge that the gender dimension in science and technology education is a formative-educational approach targeting a series of actions, which are based on considering influences specifics on the formation of boys and girls from the educational instructive process context, oriented to prevent and overcome gender stereotypes, attracting girls and boys in science and technology by encouraging and exploring their potential.

As a result of the research, it was developed and validated the methodology of implementation of the new science study program from a gender perspective, which represents a paradigmatic structure consisting of components/patterns in interaction: theoretical component - constructivist approach; curricular component - gender; teaching component - strategies to encourage female students, students' working strategies, strategies of students' improvement; community component - including the family; psychological component - providing success. Finally, this methodology included: the Constructivist approach to learning, a Profile of excellent teacher who is gender-sensitive, Instructional Model to encourage girls students in science and technology, a Instructive Model for parents.

In the context of the above mentioned, we conclude that the **solution of scientific research problem** lies in the theoretical and praxiological methodology of implementation of the new study program in sciences from a gender perspective, ensuring the reduction of gender stereotypes and prejudices with reference to the relevant disciplines, and the students' performance efficiency.

At the same time, we are aware that beyond the positive achieved results; there are still numerous challenges that require continuous interventions with joint effort of all educational actors.

Based on the results obtained in the research, we propose the following **recommendations**:

At decision-makers level:

- Develop the educational policies through gender mainstreaming
- Extend the possibilities of gender sensitive training for teachers in the initial phase of students training in higher education institutions by introducing in the curriculum the Course "Gender equality in education".
- Introduce the instructive Model of the methodological training of teachers to encourage girls students in science and technology.
- Conduct gender analysis of the textbooks and teaching materials in the field of science and technology studies.
- Organize/coordinate, on an educational system level, information and awareness campaigns regarding gender equality in education, focusing on science and technology education.
- Create opportunities for motivating teachers, due to the effort to increase the numbers of students studying sciences and technologies (rewarding, appreciations, credits etc).
- Develop of methodological guides, theoretical and applicative supports referring to activities concerning gender sensitive training in the educational institutions.
- Collect and disseminate positive practices on gender education, on gender mainstreaming in the educational system.

At the educational institutions level:

- Implement the gender-sensitive strategies at the educational institutions level. Pay particular attention to girls, especially from the reserve classes in sciences, choosing physics, by diversifying the working methods focusing on content and praxiologic aspects connected to daily life.
- Create the gender sensitive/friendly environment in educational institutions (physical, informational, relational conditions).
- Develop partnerships between schools and research institutions in order to explore the

patterns of women and men scientists in science and technology (meetings of students with scientists, study visits, joint projects), ensuring gender balanced approach.

- Develop partnerships between school and students, focusing on gender awareness, for the purposes to guide efficiently children in the process of career design and training (beyond stereotypes and prejudices).
- Provide opportunities, for parents, of gender-sensitive training / assistance in overcoming stereotypes related to study and advancement in science and technology.
- Encourage, through various methods, boys and girls studying physics since pre-school during afternoon lessons, starting with awards to university scholarships.

At family level:

- Parents should maintain and develop a continuous dialogue with girls and boys, offering them support in favour of choosing and supporting education in science and technology.
- Apply strategies to encourage girls' self-esteem, strengthen their self-confidence, and their motivation to study in science and technology.
- Develop partnerships between school-family-students, focusing on gender sensitive aspect, in order to guide efficiently children in learning and career in science and technology.
- Orient girls and boys towards cooperation during lessons within community social activities.

SUGGESTIONS FOR FURTHER RESEARCH

In current study, the correlation between the new science program in the scientific designated technological class was examined, while examining the improvements of the level of achievements and the choosing of enhanced science subjects in High school, with an emphasis on the subject of physics, in terms of gender and in addressing the needs of pupils, teachers, senior management level and parents.

As current study is first one in the field and was examined in the process, and in order to find the points of strength and weakness of the program of perception of six-year orientations, a further study is to be conducted and to examine the "correlation between the number of those receiving a quality scientific technological matriculation certificate in terms of gender and between the new science program in the designated classes".

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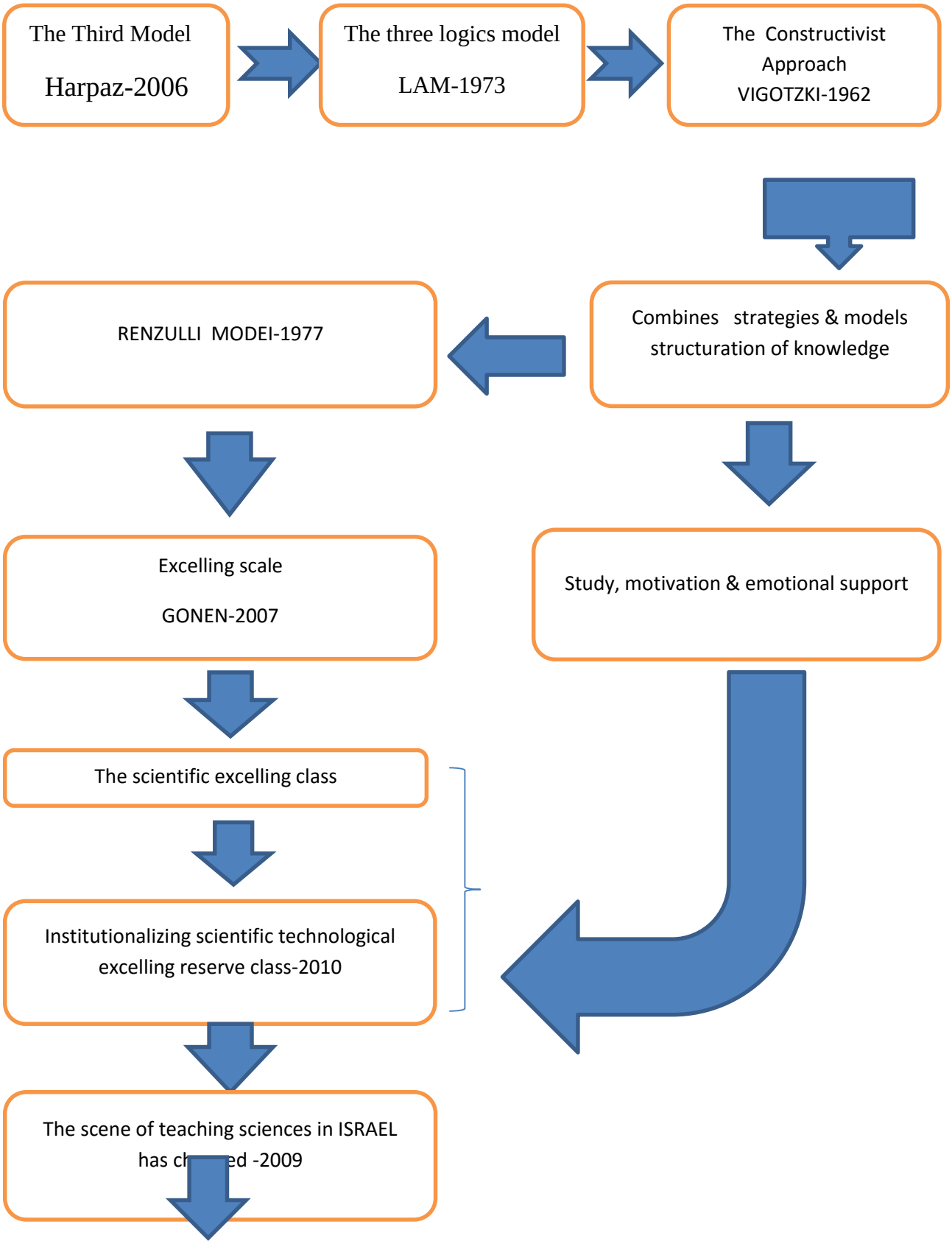
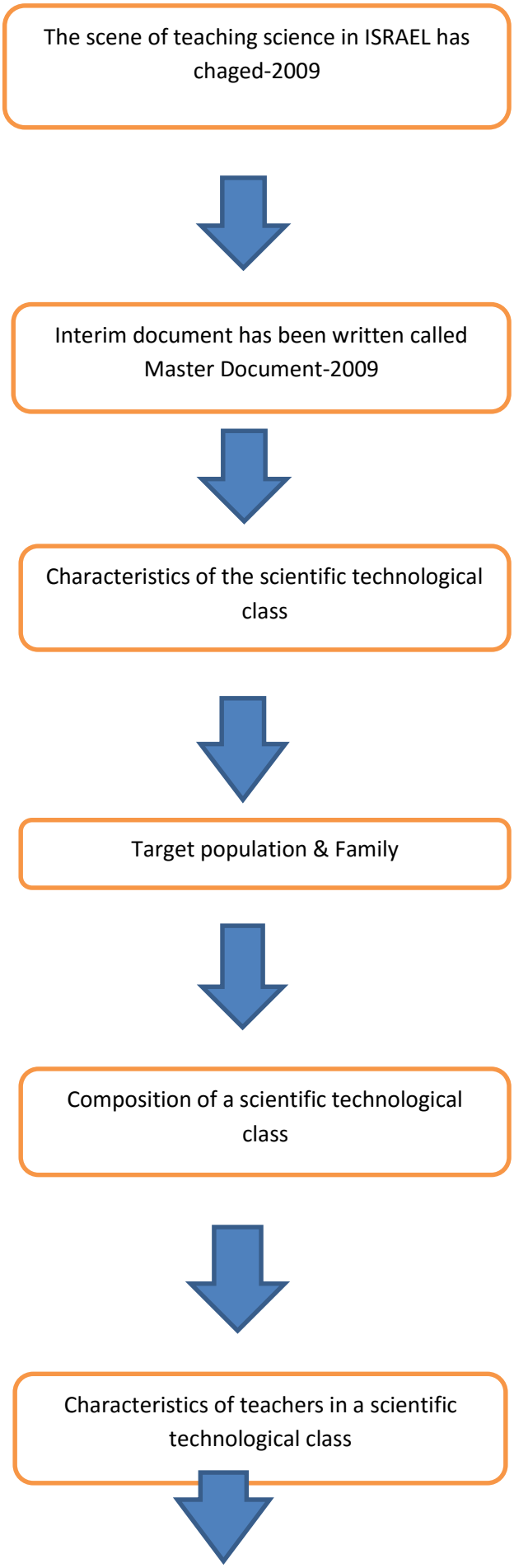
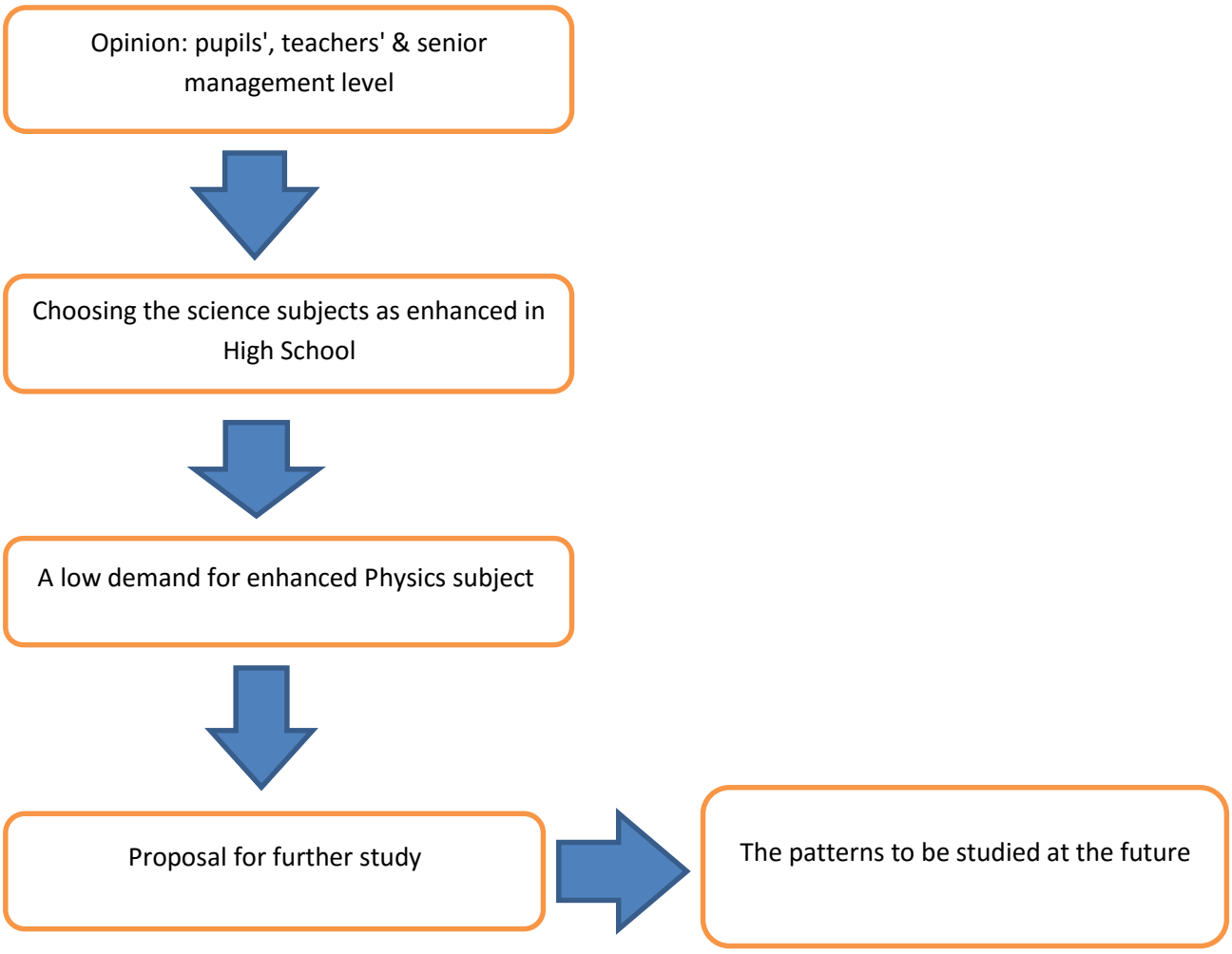
APPENDIXES

APPENDIX NO . 1. ALL MODELS AND THEORIES THAT APPEAR IN THIS RESEARCH- Flow Diagram-




The scene of teaching science in ISRAEL has chaged-2009
Interim document has been written called Master Document-2009
Characteristics of the scientific technological class
Target population & Family
Composition of a scientific technological class
Characteristics of teachers in a scientific technological class


Opinion: pupils', teachers' & senior management level
Choosing the science subjects as enhanced in High School
A low demand for enhanced Physics subject
Proposal for further study
The patterns to be studied at the future

APPENDIX NO. 2 Questionnaire #1- Student questionnaire

1. How do you feel in the technology reserve classroom?

	1 not at all	**2 Slightly**	**3 Moderately**	**4 To a large extent**	**5 Greatly**
1. Challenged	1	2	3	4	5
2. Stressed	1	2	3	4	5
3. Special at school	1	2	3	4	5
4. Top of the age group	1	2	3	4	5
5. Invested in	1	2	3	4	5
6. Commitment to success	1	2	3	4	5
7. Responsibility a student takes	1	2	3	4	5
8. Self-realization	1	2	3	4	5
9. Dream of parents	1	2	3	4	5
10. Popular	1	2	3	4	5
11. Helpful in future	1	2	3	4	5
	1	2	3	4	5

2. How do you think should be the composition of the class?

1. Only boys	
2. Only girls	
3. Boys & girls- mixed	

3. Which enrichment activities do you participate in? (Please check all that apply)

1.PCs - computers	
2. Robotics - FLL	
3. Medicine &health enhancement *www.prefua.org.il/about.aspx*	
4."Atidim" Targeting students excel in science and technology the military, industry and academia http://atidim.org/program/pre	
5"Michael" - Extraction personal skills excellence. Technological learning and personal empowerment. www.michael.org.il	

4. Which scientific subjects in High school will you choose in your opinion?

1. Chemistry	
2. Biology	
3. Ecology	
4. Electronics	
5. Physics	
6. Robotics	

5. Why did you choose subjects that you have checked in the previous question?

	1 not at all	2 Slightly	3 Moderately	4 To a large extent	5 Greatly
1. Interesting	1	2	3	4	5
2. Useful in the future	1	2	3	4	5
3. Challenge	1	2	3	4	5
4. Promotion of family	1	2	3	4	5
5. Prestige	1	2	3	4	5
6. Leading in Israel	1	2	3	4	5
7.Other reasons	1	2	3	4	5

6.Why don't you choose subjects you have not marked ?

	1 not at all	2 Slightly	3 Moderately	4 To a large extent	5 Greatly
1. Study material is hard to understand	1	2	3	4	5
2. Uninteresting	1	2	3	4	5
3. Subjects are taught not clear	1	2	3	4	5
4. Has no employment in	1	2	3	4	5
5. Discouragements from family	1	2	3	4	5

7. To what extent do you see yourself engaged in any of the science subjects listed in the table below?

	1 not at all	2 Slightly	3 Moderately	4 To a large extent	5 Greatly
Biology	1	2	3	4	5
Chemistry	1	2	3	4	5
Biotechnology	1	2	3	4	5
Physics	1	2	3	4	5
Robotics	1	2	3	4	5
Ecology	1	2	3	4	5
PCs	1	2	3	4	5

8. What is the encouraging motivation in choosing what scientific subjects in general and physics in particular?

	1 not at all	2 Slightly	3 Moderately	4 To a large extent	5 Greatly

A good teacher	1	2	3	4	5
Diversity of teaching methods	1	2	3	4	5
Many trials - experiences	1	2	3	4	5
Learning of classroom - Belmonte Laboratories	1	2	3	4	5
Exploration work group	1	2	3	4	5
Link to daily life	1	2	3	4	5
Tours	1	2	3	4	5

9. Upon ability to choose a science teacher, to what extent do you think any of following behaviors should he be characterized by?

	1 not at all	**2 Slightly**	**3 Moderately**	**4 To a large extent**	**5 Greatly**
Controls contents	1	2	3	4	5
Controls the management class	1	2	3	4	5
Encourages and leads the promotion of students	1	2	3	4	5
Provides learning tools	1	2	3	4	5
cleanly organized & aesthetically pleasing	1	2	3	4	5
Teaches very clearly	1	2	3	4	5
Links to learning content	1	2	3	4	5
Transmitting love	1	2	3	4	5
Creating good atmosphere	1	2	3	4	5
Thinking	1	2	3	4	5
Paid heed to personal problems	1	2	3	4	5
Likes his students	1	2	3	4	5
Other	1	2	3	4	5

10. To what extent family supports and encourages learn science?

	1 not at all	**2 Slightly**	**3 Moderately**	**4 To a large extent**	**5 Greatly**
Family support & encouragement					

11. How is this support expressed?

	1 not at all	**2 Slightly**	**3 Moderately**	**4 To a large extent**	**5 Greatly**
New research update	1	2	3	4	5
Calls, support	1	2	3	4	5
Visiting sciences museum	1	2	3	4	5

Summer camps	1	2	3	4	5
Enrichment	1	2	3	4	5
Help with homework and projects	1	2	3	4	5
Solving difficult problems	1	2	3	4	5
Private lessons	1	2	3	4	5
Watching TV channels relevant	1	2	3	4	5
Parents work's in sciences fields	1	2	3	4	5
Volunteer - zoo, etc.	1	2	3	4	5

12. Why did you choose to study in the science technology class?

	1 not at all	**2 Slightly**	**3 Moderately**	**4 To a large extent**	**5 Greatly**
1. Parents recommendation	1	2	3	4	5
2.Helpful - Promoting life	1	2	3	4	5
3.Challenged by scientific professions	1	2	3	4	5
4. Prestige	1	2	3	4	5
5. Recommendation by friend	1	2	3	4	5
6. Socially contributing .	1	2	3	4	5
7. Excellent teachers	1	2	3	4	5
8. Serious students	1	2	3	4	5
9. No discipline problems	1	2	3	4	5
10. Other	1	2	3	4	5

13. To what extent will you recommend to friends / family to choose studying in the technological reserve class?

	1 not at all	**2 Slightly**	**3 Moderately**	**4 To a large extent**	**5 Greatly**

APPENDIX NO. 3 Questionnaire #2 –science teachers' questionnaire

1. Teacher and information regarding the new program in science

	1 not at all	**2 Slightly**	**3 Moderately**	**4 To a large extent**	**5 Greatly**
1. Teach all subjects	1	2	3	4	5
2. Teachers' training	1	2	3	4	5
3. improving training apprenticeship	1	2	3	4	5
4. Improving instruction	1	2	3	4	5

2. How is the new program from a student perspective?

	1 not at all	**2 Slightly**	**3 Moderately**	**4 To a large extent**	**5 Greatly**
1. Overloaded	1	2	3	4	5
2. Interesting	1	2	3	4	5
3. Diverse	1	2	3	4	5
4. For difficult students	1	2	3	4	5
5. For strong students	1	2	3	4	5
6. Shows great knowledge in short time	1	2	3	4	5
7. Enriching the learner	1	2	3	4	5
8. Connects to life.	1	2	3	4	5
9. Connects the physics.	1	2	3	4	5
10. Focusing on high school	1	2	3	4	5
11. Uniformly throughout the country	1	2	3	4	5
12. Reinforces girls	1	2	3	4	5
13. Enhances motivation	1	2	3	4	5
13. Other					

3. What do you think about the new program from the perspective of the teacher?

	1 not at all	**2 Slightly**	**3 Moderately**	**4 To a large extent**	**5 Greatly**
1. dictated	1	2	3	4	5
2. No time for enrichment	1	2	3	4	5
3. Boring	1	2	3	4	5
4. Stressful	1	2	3	4	5
5. Difficult to implement	1	2	3	4	5
6. TLE kits	1	2	3	4	5

7. Ministry tests	1	2	3	4	5
8. Impractical schedule	1	2	3	4	5
9. suitable for different levels	1	2	3	4	5
10. Prepares students well for high school	1	2	3	4	5
11. Strengthens girls	1	2	3	4	5
12. Learning Targets close instruction	1	2	3	4	5
13. Response to the state	1	2	3	4	5
14. Other					

4. How does a teacher cope with the new program?

	1 not at all	**2 Slightly**	**3 Moderately**	**4 To a large extent**	**5 Greatly**
1. Worthwhile	1	2	3	4	5
2. Prepares plans in advance	1	2	3	4	5
3. Prepares plans during the summer	1	2	3	4	5
4. Diversifies lesson plans	1	2	3	4	5
5. Constantly instructed	1	2	3	4	5
6. Has difficulties	1	2	3	4	5
7. Assisted by peers	1	2	3	4	5
8. Considers leaving	1	2	3	4	5
9. Self-challenging	1	2	3	4	5
10. Applies himself greatly	1	2	3	4	5
11. Other					

5. Did you want to teach in the scientific technological reserve class? A. yes b. No

If your answer is yes, please answer the following question:

6. To which extent each of the following reasons makes you want to teach in a scientific technological reserve class?

	1 not at all	**2 Slightly**	**3 Moderately**	**4 To a large extent**	**5 Greatly**
1. No disciplinary problems	1	2	3	4	5
2. Fast learning	1	2	3	4	5
3. High motivation	1	2	3	4	5
4. Considered a leading teacher	1	2	3	4	5
5. Ability of integration projects	1	2	3	4	5
6. Reinforcing girls	1	2	3	4	5
7. Improves higher achievement	1	2	3	4	5
8. Significant for choosing in high school	1	2	3	4	5
9. Effects the future generation	1	2	3	4	5
10. Studying in small groups	1	2	3	4	5

7. What is required from a teacher who teaches in a scientific technological reserve class?

	1 not at all	**2 Slightly**	**3 Moderately**	**4 To a large extent**	**5 Greatly**
1. Personal attention	1	2	3	4	5
2. Masters contents & controlling	1	2	3	4	5
3. Teaching diversification of methods	1	2	3	4	5
4. Reinforcing girls	1	2	3	4	5
challenging	1	2	3	4	5
5. Focusing the students plan's objectives	1	2	3	4	5
6. Raising motivation	1	2	3	4	5
7. Other					

APPENDIX NO. 4 Questionnaire 3 - Questionnaire for senior position holders

For each of the following questions, please circle out the answer that best reflect your attitude about it.

1. Listed below are the various references regarding the new curriculum in science. To what extent do you agree with any of them?

	1 not at all	**2 Slightly**	**3 Moderately**	**4 To a large extent**	**5 Greatly**
1. Diversified &Interesting	1	2	3	4	5
Opens a window for students	1	2	3	4	5
2. Connection of contents to life	1	2	3	4	5
3. Enhances motivation	1	2	3	4	5
4. Requires investment of teacher	1	2	3	4	5
5. Reinforces girls	1	2	3	4	5
6. Encourages teaching science	1	2	3	4	5
7. Prepares for high school choice	1	2	3	4	5
8. Significant learning	1	2	3	4	5
9. Loaded	1	2	3	4	5
10. Improving instruction, training	1	2	3	4	5
11. Uniform learning	1	2	3	4	5
12. Improvement in international tests	1	2	3	4	5
13. Other					

2. To what extent does the new program in the technological reserve class realize the Ministry targets?

	1 not at all	**2 Slightly**	**3 Moderately**	**4 To a large extent**	**5 Greatly**
1. Reinforcing girls	1	2	3	4	5
2. Encouraging physics girls	1	2	3	4	5
3. Increase in number of students learning physics	1	2	3	4	5
4. Improvement of learning level	1	2	3	4	5
5. Improvement of achievements	1	2	3	4	5

6. Instruction leveraging teachers	1	2	3	4	5
7. Increasing number of girls	1	2	3	4	5
8. Reducing gap of scores in physics	1	2	3	4	5
9. Other					

3. The attributes of a teacher who teaches in a scientific technological class.

	1 not at all	**2 Slightly**	**3 Moderately**	**4 To a large extent**	**5 Greatly**
1. Leading teacher in school	1	2	3	4	5
2. Creative thinker	1	2	3	4	5
3. Open to new ideas	1	2	3	4	5
4. Motivated	1	2	3	4	5
5. Pleasure & motivation among students	1	2	3	4	5
6. Invests in preparing lessens	1	2	3	4	5
7. Reinforces girls	1	2	3	4	5
8. Enhances achievement level	1	2	3	4	5
9. Encourages choosing sciences in high school	1	2	3	4	5
10. Other					

4. How do you think girls choose the subject of physics in the scientific technological reserve class?

	1 not at all	**2 Slightly**	**3 Moderately**	**4 To a large extent**	**5 Greatly**
1. Small number of girls	1	2	3	4	5
2. Subject perceived as difficult	1	2	3	4	5
3. Not connected to life	1	2	3	4	5
4. Lack of support & encouragement from parents	1	2	3	4	5
5. Subject with future	1	2	3	4	5
6. Male subject	1	2	3	4	5
7. Understand contents	1	2	3	4	5
8.Other					

5. To what extent do you think the Ministry of Education has adopted each of the actions listed in following table to increase the number of those studying physics, girls and boy?

	1 not at all	**2 Slightly**	**3 Moderately**	**4 To a large extent**	**5 Greatly**
1. Matriculation bonuses	1	2	3	4	5
2. Scholarships	1	2	3	4	5
3. First grade orientation	1	2	3	4	5
4. Connection to life	1	2	3	4	5
5. Subject known to parents	1	2	3	4	5
6. Connecting between industry & school	1	2	3	4	5
7. Increasing awareness advertisement	1	2	3	4	5
8. Conducting interesting experiments	1	2	3	4	5
9. Opening science classes	1	2	3	4	5
10. Other					

APPENDIX NO. 5 Science curriculum in Israel

Science curriculum – Seventh grade till ninth grade.

ISRAEL

Master document - Proposed annual deployment of subjects in science and technology classes 7, 2013

Mid-January 12 (4 × 3) hours	December 12 (4 × 3) hours	November 16 (4 × 4) hours	October 10 (4 × 2.5)hours	August to September 16 (4 × 4) hours	Months And teaching hours	
Subject 2: Energy 10hours	**Subject 1: Materials Technology 50hours + 9 hours subject of energy**					
Content	**Structuring research skills**	**Content**	**Structuring research skills**	**Content**		
- -Types of Energy - -Conversion of energy - -Energy Conversion -The conservation of energy	- Reading Graph Platform - Making a comparative view - Making measurements, recording observation results in tables prepared A. Performing a controlled experiment B. Making measurements, recording experimental results tables ready C. Work Report Writing	Material change processes - Physical change - macro - Conservation of mass Structure of matter: particle model Explainer particle model symptoms and physical changes - Side gases	- Asking questions about the phenomenon A. Identification of factors that can affect the phenomenon In. Identifying factors that vary on the question of the study - Reading the findings presented in the text and table representation - Reading a pie chart	- Relationships: Science - Technology - Maintain laboratory safety rules Materials, properties and uses - Characterization of Materials - General - Uses materials - General	**Half 1**	**Seventh grade** **By: 4WH Student / the** **120 hours per year**

Mid-January 12 (4 × 3) hours	December 12 (4 × 3) hours	November 16 (4 × 4) hours	October 10 (4 × 2.5)hours	August to September 16 (4 × 4) hours	Months And teaching hours	
	- Isolation and identification variables constant factor A. Making measurements and recording of results tables ready *	- Side fluids -Physical change - Micro -Changes of state - Micro -Conservation of mass - Micro -Energy transfer from body to body -Thermal energy - heat and temperature	- Read simple data table	Design process - Gases: properties and uses Materials: benefits and environmental price -Effect of use of materials on quality of life -Distinction between body and material Mass and volume of bodies -Volume -Essay -Characterization of Materials - Density		

*Another option explicit teaching of study skills

JUNE Hours3)× (4 12	May (4 × 4) 16 hours	APRIL HOURS3)× (4 12	March (2 × 4) 8 hours	February (3.5 × 4) 14 hours	Mid-January (2 × 4) 8 hours	Months And teaching hours

Subject 3: systems and processes in living organisms - Transportation 30)hours(		Subject 2- : Variety of organisms 8)hours(	Subject 1-cells 10 hours			
Content	**Structuring research skills**	**Content**	**Structuring research skills**	**Content**		
A. Information production graph pie *	Water bodies of living creatures - The importance of transportation systems multicellular organisms	-Sorting things sharp - celled and multi - cellular - Classification of living things kingdoms -No flowers and plants with flowers - Classification of animals and invertebrates to vertebrates	- Making an observation According to comparative	- Characteristics of Life	**Half 2**	Seventh grade By: 4 WH Student / the 120 hours per year בטל עריכות
In. Converting findings represent a bar graph table *	- Water Features - The importance of water for creatures Transport in plants			- Cell structure and function unit basic - The existence of basic needs of living things - Levels of organization		

JUNE Hours3)× (4 12	May (4 × 4) 16 hours	APRIL HOURS3)× (4 12	March (2 × 4) 8 hours	February (3.5 × 4) 14 hours	Mid-January (2 × 4) 8 hours	Months And teaching hours
- Reading Graph Platform - Registration results tables ready - Generate different representations information: text,	- The importance of phloem and advice systems Plant water balance - Emission of water, water absorption, water balance The human body as a system of - Health and circulatory system Water balance in man and animals - Proper water balance Heat balance of the human body and the relationship with the water balance Human health - Keeping water and heat balance of normal				- Cell structure and function	

*Another option explicit teaching of study skills **Master document - Proposed annual deployment of subjects in science and technology classes 8, 2013**

January 20 (5 × 4)hours	December 15 (5 × 3) hours		November 20 (5 × 4)hours	October (5 × 2.5) 12.5hours	The end of August-September 20 (5 × 4) hours	Months And teaching hours	
Subject 3: Forces and Motion 20hours	**Subject 2: Energy 16 hours**		**Subject 1: Materials 45 hours**				
Content	**Structuring research skills**	**Content**	**Structuring research skills**	**Content**			
Forces and change **-Presence describing the interaction between** **Bodies** **-Powers: Properties and Measurement** **-Forces as factors change** **-The law of action and reaction** **-Balance between the two forces acting on** **The same body that neutralize each other** **Friction** **-Friction force between two** **Bodies in contact** **Gravity** **-The gravitational force of**	A. Formulation based research hypothesis controlled experiment B. Sort results identify the relationship between the variables A. Read and Description findings from tables or graphs B. Graph representation of data from a table column - Research design (controlled experiment) *	Electrical energy - When an electric current flow circuit Electrical energy consumed - The conservation of energy - The circuit components And Codes - Electrical conductivity - Electric current as the movement Circuit charges - Measurement of the flow - Factors affecting the current	A. Formulation of research purpose and research question In. The question of research quality assessment A. Basic work skill acquisition in a spreadsheet - B. Processing raw results using summary table Calculating the difference C. Continuous graph representation results - Averaging repetitions of measurements - A. Experimental design, including a control group and rehearsals	Structure of matter: particle types - Different types of particles Foundations and Atomic Structure - Element composed of identical atoms - Atomic Structure Table of elements - Arrange the elements table elements - Symbol elements in the language of chemists Compounds - Compound as a combination of atomic elements related	**Half 1**	**Eighth grade** **By: 5WH Student / the** **150 hours per year**

January 20 (5 × 4)hours	December 15 (5 × 3) hours		November 20 (5 × 4)hours	October (5 × 2.5) 12.5hours	The end of August-September 20 (5 × 4) hours	Months And teaching hours
attraction between two bodies **-Weight vs. mass** **Magnetic force** **-Electric power and magnetic force** **Power and Energy** **-Differences between Power Energy** **-The relationship between energy power** **-Pressure force acting on the unit area** **Lever and inclined plane that increases power** **-Lever** **-Incline** **Motion** **-Movement characterized by the size** **Speed and direction**		- Connecting resistors in circles Electric - Electricity and Magnetism - Safety in energy use Tram - Ways for electrical energy - The environmental cost of using Materials (power generation)	B. Description of the study results table and graph Platform C. Drawing conclusions from the results table or graph Platform	Each other Changes in the material - The chemical process - Conservation of mass - Chemical processes Energy Conversion Materials: benefits and environmental price - The effect of using quality materials Life Ionic compounds - Compounds built sorting and Noshaotihn Types of compounds - Acids and bases Mixtures - Mixtures as not pure		

*Another option explicit teaching of study skills

June 15 (5 × 3) hours	May 20 (5 × 4)hours	April 15 (5 × 3)hours	March 10 (5 × 2)hours	February 17.5 (5 × 3.5) hours	Months And teaching hours	
Subject 3: Reproduction and development, cell communication 41hours		**Subject 2: Ecosystems 20hours**		**Subject 1: Systems Technologies 10hours**		
Structuring research skills	**Content**	**Structuring research skills**	**Content**	**Content**		
-Reading and Description findings From tables or Graphs* -Table conclusions Data*	Characteristics and basic needs of life - Cell unit of structure and function of basic Living things - The importance of reproduction to continue the species Cell - Cell origin from - The genetic material cells of living things, Functioning and organization of chromosomes in the nucleus Cell processes - Cell division - Cell differentiation	A. Controlled trial design includes a control group design and rehearsals In. Build a table based on the results of measurement and registration table A. Identify and investigate the research hypothesis research text describes a comparative view B. Identifying comparative observational study components C. Hypothesis formulation based surveillance study of comparative	Levels of organization - Production, population, habitat - Characteristics of living organisms living together - Basic needs for living things Interactions creatures - Environment - An environment that provides basic needs For -The effect of a - the biotic factors Biotic -Effect of biotic factors on the factors A - biotic -Biodiversity	**Technological systems: structure and action** **-Technological system as a collection of** **Manmade elements, workers** **Coordinated response to and achieving** **Target** **-Technological system operation** **Characterized by input, process and output** **The impact of technology on society and the environment** **-Development of technological systems**	**Half 2**	**Eighth grade** **By: 5WH Student / the** **150 hours per year**

June 15 (5 × 3) hours	May 20 (5 × 4)hours	April 15 (5 × 3)hours	March 10 (5 × 2)hours	February 17.5 (5 × 3.5) hours	Months And teaching hours	
- Representation of data from a table * Continuous Chart	- Match the cell structure functioning Reproduction and development - Various forms of reproduction in living organisms Communication - Communication with the environment as one of the characteristics Life in the context of reproduction - The importance of communication Human reproduction - Human reproductive system structure and function - Human reproduction - Importance of the relationship between the body systems - Health and Reproduction Human involvement in the process of reproduction and development: the impact on the	D. istinction between research methods: observation versus comparative controlled trial E. The. Comparative Observation Planning - Reading and a verbal description of the quantitative and qualitative findings presented in graphs * - Drawing conclusions from the results presented in graphs * - A verbal description of the findings presented in the graph continuously * - Draw conclusions based on the results shown in the graph *	-Matching plants and animals to their environment -Interactions between organisms Conversions and conversion of energy -Conversion and conversion of energy into the fabric of Food And Food Pyramid -Factors affecting population size Human involvement in the environment and its components -Human impact on the relationship between Organisms in the environment and coping with Implications -Materials, effectiveness and environmental price (in the context Energy / Materials / Ecology(	**-Changes in technology generator** **Global society** **-Changes in wake of developments** **Technological** **-Advantages and disadvantages of using** **Technology by reference** **Environmental aspects, social,** **Economic and ethical**		

June 15 (5 × 3) hours	May 20 (5 × 4)hours	April 15 (5 × 3)hours	March 10 (5 × 2)hours	February 17.5 (5 × 3.5) hours	Months And teaching hours	
	individual, society and the environment Reproduction in plants - Reproductive system structure and function in plants - The process of sexual reproduction in plants Reproduction and Development (continued) - Development of man and animals: an embryo to adult - Development of plants: a life cycle - from seed Seed					

*Another option explicit teaching of study skills

Mid-January 15 (5 × 3) hours	December 15 (5 × 3) hours	November hours 20 (5 × 4)	October hours 12.5 (5 × 2.5)	August to September 20 (5 × 4) hours	Months And teaching hours	
Subject 3: Cell and Heredity (15 out of 30 (hours		(Subject 2: Cell and feed (20 hours		Subject 1: Materials (25 (hours		
Structuring research skills	Content	Structuring research skills	Content	Structuring research skills	Content	
-Identify components of the study And the relationship between them In the text Research: a question Hypothesis, properties Experiment, Conclusion *	Genetic material - Levels of organization - Structure and organization - The genetic material - DNA - Function of the genetic material DNA - Organelles and their function in cell processes: the ribosome - Processes in the cell: assembly proteins - Changes in the genetic material (mutations) and effects on the	A. Formulation of research question (with three variables(B. Examination of the research question using the properties	Characteristics of Life (Back) - Characteristics of common life in living organisms - Cell structure and function unit of the underlying Cell structure and function Materials of the cells and their function Feed and energy production - Basic needs for living things - The importance of the input process - Organelles and their function in cell processes: Membrane - Cell processes: cellular respiration Feed plants - Organelles and their function in cell processes: chloroplast - Cell processes: photosynthesis - Mineral feed	Build a table to collect data Study (3 (variables	Chemical bond energy and chemical process - Forces of attraction and electrical repulsion forces - Types of chemical bonds - Chemical energy Element carbon and its compounds - Unique carbon - Carbon compounds - Food ingredients - Food and energy in the body Impact of substance use The individual,	Half 1	Ninth grade :By WH 5 Student / the 150 hours per year

Mid-January 15 (5 × 3) hours	December 15 (5 × 3) hours	November hours 20 (5 × 4)	October hours 12.5 (5 × 2.5)	August to September 20 (5 × 4) hours	Months And teaching hours
Subject 3: Cell and Heredity (15 out of 30 (hours		**(Subject 2: Cell and feed (20 hours**	**Subject 1: Materials (25 (hours**		
	individual and biodiversity - Avoiding damage in DNA		Feed people or animals - Feed Htrotrofit - The importance of digestion - Components of the human digestive system - Adjust the digestive system functioning person Body as a system of - Importance of the relationship between the body systems Health Food and Nutrition - Health and NutritionCell structure and function Materials of the cells and their function Feed and energy production - Basic needs for living things - The importance of the input process - Organelles and their function in cell processes: Membrane - Cell processes: cellular respiration Feed plants - Organelles and their function in cell processes: chloroplast		society and the environment - The effect of the use on quality of life - The environmental cost of materials - Existing approach possible solutions to reduce environmental damage	

Mid-January 15 (5 × 3) hours	December 15 (5 × 3) hours	November hours 20 (5 × 4)	October hours 12.5 (5 × 2.5)		August to September 20 (5 × 4) hours	Months And teaching hours
Subject 3: Cell and Heredity (15 out of 30 (hours		(Subject 2: Cell and feed (20 hours		Subject 1: Materials (25 (hours		
			- Cell processes: photosynthesis - Mineral feed Feed people or animals - Feed Htrotrofit - The importance of digestion - Components of the human digestive system - Adjust the digestive system functioning person Body as a system of - Importance of the relationship between the body systems Health Food and Nutrition - Health and Nutrition			
		- Examination of research hypothesis (With 3-2 variables) with characteristics - Identify components and the relationship between research Research text:				

Mid-January 15 (5 × 3) hours	December 15 (5 × 3) hours	November hours 20 (5 × 4)	October hours 12.5 (5 × 2.5)	August to September 20 (5 × 4) hours	Months And teaching hours
Subject 3: Cell and Heredity (15 out of 30 (hours		**(Subject 2: Cell and feed (20 hours**		**Subject 1: Materials (25 (hours**	
		Research question, hypothesis and conclusion * A. Build a table to collect research data (3 variables) In. Conclusion formulation reasoned argument *			
				A. Graph description and analysis of trends, outliers and the relationship between variables B. Conclusion formulation reasoned argument, debate the meaning of the conclusion regarding the hypothesis and scientific background	
Whole process of scientific inquiry and problem solving (15 hours) the content of the curriculum - chemistry, ecology, cell, nutrition, heredity, energy and technology systems					

Mid-January 15 (5 × 3) hours	December 15 (5 × 3) hours	November hours 20 (5 × 4)	October hours 12.5 (5 × 2.5)	August to September 20 (5 × 4) hours	Months And teaching hours
Subject 3: Cell and Heredity (15 out of 30 (hours	(Subject 2: Cell and feed (20 hours	Subject 1: Materials (25 (hours			
Selected construction skills while research process: choosing an appropriate way of exploration, processing and representation of data in tables and graphs, presenting research results of scientific poster					

*Another option explicit teaching of study skills

June (5 × 3) 15 hours	May (5 × 4) hours 20	April (5 × 3) hours 15	March 10 (5 × 2) hours	February hours 17.5 (5 × 3.5)	Mid-January hours 10 (5 × 2)	Months And teaching hours
(Subject 4: Energy and Technology Systems (60 hours				Subject 3: Cell and Heredity - (continued (15 of 30 hours		
Structuring research skills	Content			Structuring research skills	Content	
A. Build a table to collect research data (3 variables) *	Conservation of energy (back) Technologies for and to life - Energy technology systems, conversions and transitions Energy level and uses it			Formulation of a conclusion * Reasoned argument	**Heredity** **Heredity - and Environment** **Principles of - heredity** **Genetic - diversity** **Human interference in the process of inheritance** **Deliberate - inbreeding**	**Half 2** **Ninth grade** **:By 5 hours per week Student / the 150 hours per year**
B. Data processing: calculating the difference						
C. Conclusion formulation reasoned argument and debate the meaning of the hypothesis and conclusion together scientific background *						

June (5 × 3) 15 hours	May (5 × 4) hours 20	April (5 × 3) hours 15	March 10 (5 × 2) hours	February hours 17.5 (5 × 3.5)		Mid-January hours 10 (5 × 2)	Months And teaching hours	
- Graph description and analysis of trends, outliers And the relationship between variables * A. Conclusion formulation reasoned argument and debate the meaning of the hypothesis and conclusion together scientific background * B. Complex tables of data representation using mathematical skills: sum, difference, percent, screening, detection range						**Genetic - Engineering** **Ethical issues -** **Health and Heredity** **Hereditary - diseases**		
		- The relationship between the height and the energy body weight and body height height - The unit of measurement of energy: Jewel - Converting the energy level of the body into kinetic energy and vice versa - Use energy level human needs Energy of motion						

June (5 × 3) 15 hours	May (5 × 4) hours 20	April (5 × 3) hours 15	March 10 (5 × 2) hours	February hours 17.5 (5 × 3.5)	Mid-January hours 10 (5 × 2)	Months And teaching hours	
		- The relationship between energy and the movement of bodies and valve speed - Use motion energy of human needs - Energy transport Movement; energy road traffic Thermal energy - Specific heat - Units of measurement of energy and proportions, including: Jewel and Calorie - Latent heat - Thermal energy systems, energy conversion technologies Energy electric systems - Conversion and electrical systems, energy breaks - Sizes circuit: current intensity (I), voltage (V), resistance (R), Ohm's law - Circuit energy calculations - Supplier of electrical energy; efficiency - producing usable energy efficiency Radiant energy and uses it - Types of electromagnetic radiation, properties of radiation - Radiant energy in energy conversion technologies - Natural phenomena related to heat by radiation - Energy of radiation as related to the various processes in living organisms Electromagnetic radiation - Uses, price and Solutions - Technological applications and uses				

June (5 × 3) 15 hours	May (5 × 4) hours 20	April (5 × 3) hours 15	March 10 (5 × 2) hours	February hours 17.5 (5 × 3.5)	Mid-January hours 10 (5 × 2)	Months And teaching hours	
		- The price of health - Possible solutions - Health and electromagnetic energy - Nuclear energy and converting systems - Chemical energy					

APPENDIX NO. 6:GLOSSARY

1) **GENDER**-Gender is an acquired identity, refers to the socially given attributes, roles, activities, responsibilities and needs connected to being men (masculine) and women (feminine) in a given society at a given time. Gender refers to both, women and men, and the relations between them. Women and men's gender identity determines how they are perceived and how they are expected to think and act as men and women. Gender determines what is expected, allowed and valued in a woman or a man in a given context. In most societies there are differences and inequalities between women and men in responsibilities assigned, activities undertaken, access to and control over resources, as well as decision-making opportunities. Gender and Stereotypes goes together because of set and characteristics attributed to a specific ethnic, national, cultural or racial group which gives rise to false expectations that individual members of the group will conform to these traits. For an example women are perceived in society is affiliated with a private space (home, children, family) and men with the public sphere (work, politics, commerce).

2) **IEA**- the International Organization for Assessment of Educational Achievements IEA has operated from the end of the 50's. It is characterized by execution of assessment actions with respect to the official curricula in the various states. As the curricula are different from state to state, there is a need for development of a joint curricular framework for all the countries participating in the study. The framework defines what students at a certain class level are supposed to know and be capable of doing serves as infrastructure with respect to which they develop examination questions. The teaching curricular framework can change. Thus it happened in fact also in the international study in sciences – TIMSS.

3) **LOST DECADE**- In which science teaching hours have been reduced and technological schools have been closed. A period of a decade in which science education in schools. Studied in a limited fashion in teachers' accordance. Students' test scores declined in the last places also the numbers of international studies were decreased.

4) MEIZAV- School principals' effectiveness and growth indexes. A set of tests and surveys conducted in elementary schools and junior high schools in Israel subjects: science and technology, language (Hebrew or Arabic), mathematics and English. RAMA conducts tests (National Authority for Measurement and Evaluation in Education), a national professional authority and independent branch. The research goal is to provide school principals pedagogical objective information about the school, used by managers to build programs that work to improve teaching and school climate.

5) PISA- Program for International Student Assessment. A test conducted as part of an international study in the field of education, which is held every three years since 2000,2003 ,2006,2009,2012. The study was conducted by the director of education of the Organization for Economic Co-operation and Development (OECD). The study examined schoolchildren aged 15-16 tested a number of issues learning (reading literacy, mathematics literacy, scientific literacy, etc.), and collected information about their background, educational environment and attitudes and perceptions about topics of study examined in the study. In addition, school administrators asked about school policy and school climate, number of hours. The research goal of PISA is to assess and compare the level of educational achievement of the 15 countries around the world, the goal of improving educational methods and educational achievement in schools and education systems. PISA testing comparing the products of the different education systems in the world. The study seeks to examine the extent to which students coming to the end of compulsory education stage, ready for integration and contribute to society as young adults in society and the modern, developed economy. The tests therefore examine the extent to which the students acquired general thinking skills and understanding of issues test subjects so they function, contribute to grapple good and efficient in their future. The tests examine practical approach applied knowledge, adult -world knowledge

crucial "life skills and the ability to solve real-world problems that require a combination of different areas. Controlled trials do not focus on specific content or curriculum issues of one kind or another, but require the application of knowledge and issues gained.

6) TIMSS- These tests take place every 4 years – 1999, 2003, 2007 and 2011, 2015. They examine the abilities of 8th grade pupils in science and math, around the world. The TIMSS examines the success of pupils according to the study program. The tests are designed on the basis of study programs while attempting to create a wide common denominator amongst the participating countries. In 2011, 240 thousand pupils from 42 countries were tested. 151 schools were randomly sampled. In Israel, 4,698 pupils have participated. In these tests the Israeli pupils have reached the highest achievement since Israel joined the international tests in the late90's in all subjects. "…The average of the achievements of Israel is significantly higher than the average of the participating countries. Israeli pupils have made the largest leap amongst the group of countries with high achievements. A steep rise was registered in the rate of high-achievement pupils. An improvement of dozens of points has taken place in the achievements of pupils as well as a dramatic improvement in comparative data. The improvement included all layers of the population and is mutual to the Jewish and the Arab sectors: Hebrew speakers – 530, Arabic speakers – 481, international average – 477. The TIMSS tests scale was designed in 1995: 625 and above – excelling, 550 and above – high, 475 and above – mediocre, 400 and above – low, below 400 – below threshold.

7) STRC-Science and technology reserve class- In 2009, Gideon Saar was elected to be the Minister of Education. One of his targets was increasing the number of pupils that study for an enhanced scientific technological matriculation certificate, from 6.5% in 2009 to 14% in 2016 and to 20% in 2020. The initiator of the idea is Dr. Ofer Rimon, Head of Science and Technology Administration in the Ministry of Education. Intel Company and the Ministry of Education declared on mutual action programs for the advancement of technological education in Israel. Classes were established in 2009. At the beginning joins to the pilot 30 schools. Currently, there are these classrooms in 130 schools .For new members' schools the program is freeze. The program included 6 years from junior high school to high schools. Pupils who study the scientific subjects in an enhanced level, have studies of math – 7 weekly hours, sciences – 5 weekly hours, physics – 2 weekly hours and robotics – 2 weekly hours. Additionally, there is a high level is various fields of knowledge. Learning speed is fast and profound. The pupils cannot get a grade lower than 75. The program purpose is increasing the target of rate of excelling pupils in the fields of science and technology in a significant manner in scope and quality of graduates who finish High School with an enhanced scientific technological matriculation certificate, while instilling of tools for the realization of this target and a gender emphasis in relation to girls. For the first time a "quality scientific technological matriculation certificate" was defined. The purpose is to create an excelling six-year course, from Junior High school up to High school, that leads to a quality matriculation certificate in the fields of science and technology that includes: 5 study points in mathematics, 5 study points in nature sciences (physics, biology chemistry), 5 study points in technologies (software engineering, electronics engineering, mechanical engineering, biotechnology or scientific-technological) or an additional subject from nature sciences of 5 study points.

8) Science and technology sector including the subjects- Biology, chemistry, physics, Ecology, Computer science, Cyber, Robotics, Biotechnology.

APPENDIX NO. 7

International tests and setting of standards

*The 20th century was characterized by standards' policy. They have spread from Eastern Asia to the European countries the United Kingdom, the United State and Israel.

*The purpose is to create a unified level of standards and awarding equal opportunity to all pupils. The creation of standards has led to a multiplicity of evaluation tests, internal and external, such as the Meizav (school effectiveness and growth indexes – in Hebrew acronym) and international tests such as Pisa (Program for International Student Assignment). The standards have not led the educational system to high achievements, but to mediocrity amongst pupils with high abilities.

*The low achievements, reflected from international tests, have reinforced the idea that there is a need for standards in the core subjects: science, language and math. The race for scores has brought studying to the traditional methods based on memorization, unification, overload of teachers; pupils not necessarily have improved their achievements. On the other hand the unity in study program, the focus on study subjects, the repeating memorization and drilling have improved the achievement in scores of Israel and the United Kingdom.

*The tests are delivered in fixed periodicity once every three years and allows for an observation of trends over time. The tests are delivered in every country in a representative sample. The scores are reported on a national level. Israel has participated in the international tests of Pisa and TIMSS (Trends in International Mathematics & Science Study).

Pisa tests (Program for International Student Assessment)

Out of all tests, the Pisa test is the most relevant. This test is conducted by the OECD. For 20 years, Israel was approaching the organization and was in negotiations and in October 7, 2010 became a full member. The study has begun in 2000 and is conducted every three years.

* The purpose of the study is to examine the extent to which 15 years old adolescents "are ready for adult life" – meaning, have acquired general tools of thinking and understanding in a way that makes possible for a better and more effective coping with their environment. The study examines knowledge and cognitive skills in three fields of knowledge – scientific literature, mathematical literacy and reading literacy.

Scientific literacy includes – ability to recognize questions, to acquire new knowledge, to explain scientific phenomena, to reach conclusions based on empiric proofs, to distinguish what characterizes science, to be aware of the way science and technology design the environment and aspire to deal with scientific matters with a critical eye. In the Pisa study in Israel, 470,000 pupils have participated at the age of 15 who were part of 64 participating countries [210].

*In March of 2013, a new government was elected in Israel and a new Minister of Education was appointed – Rabbi Shai Piron. The Minister presently studies the system and attempts to formulate changes:

1. limitation of the Meizav tests (school effectiveness and growth indexes), which are delivered annually, since 2007 in the core subjects of science, math, mother's tongue and English, in thousands of classes;

2. Change in matriculation exams and decreasing their number.

*The previous Minister of Education, Gideon Saar, supported measurement and evaluation of pupils' achievements and succeeded in it.

* The new Minister of Education, Shai Piron, wishes to strengthen the factor of education in schools: "the message is less testing and more learning. According to a principal of a Junior High school in Northern Israel, "the Meizav is an important tool, but the hysteria around it has gone out of proportion. We stopped educating pupils as we are busy all the time in measurement, which has become a goal in its own"… the teachers on the ground hope for a decrease in pressure of tests and encouragement of investigatory assignments. These changes can bring about a reduction of the array of training apprenticeships of teachers and instructions in Israel (teachers would be happy about it), a cancellation or reduction of the duties of instructors on the ground which is a loss of investment in professional growth which has accumulated in the last four years (principals and teachers would be happy with it). This would entail a change and a decrease in pupils' achievements, a reduction of income sources of instructors and professional promotion in the educational system [105, 125].

*2012 was the fourth year of studying sciences according to the new program. Teachers teach according to the program, and use the TLE (Teaching, Learning and Evaluation) kits, and most of them undergo specialist trainings and have better mastery of the contents. However, the subject has become extremely demanding.

*The teacher must master the four subjects: biology, chemistry, physics and technology. It is required of him, to assume responsibility to study and invest great efforts to prepare his lesson plans. Still, there are difficulties mainly in the studying of physics (not enough mastering of the contents).

*Teachers' doubts and reservations regarding the program: many study topics are being studied in a set time by a superficial manner, whereas in the national and international tests the requirement is more profound. There is no time for experiential learning. High rate of studying, covering material requirements and time limits, teachers and pupils being measured at all times.

* The teacher is under stress and the burnout is high. There are still many teachers missing in the field who are able to teach sciences, have a good mastery of the material and make the pupils enjoy and be motivated and improve their achievements. The laboratories are outdated.

*Advantages: a uniform studying nationwide – spiral from primary to High school, team spirit, diverse quality specialist trainings, improvement of mastering the material, uniform exams; a subject that occupies the attention of the country and is being mentioned in the media .

*Despite the dramatic change in the studying of sciences, the state leaders are concerned with the future generation who do not choose these important subjects. In 2011 only 6,400 pupils took matriculation exams in the science subjects, which is a decrease of 13% in the last 5 years

[206]. The problem stems from an unsatisfying teachers' level, the system not being adapted for the 21st century, outdated laboratories, studying occasionally without experiments.

* One of the solutions is the establishment of 15 lab centers nationwide – "Hemda" (Hebrew for – "education for science"). The first one was opened this year, 2012, in Tel-Aviv. These labs are modern and upgraded, and meet the requirements of 70-100 schools for experiments with advanced equipment for each pair of pupils from sunrise to sunset. The project cost is 50 million NIS [119].

* From 2009, when the program has begun, there was an improvement in achievements according to the annual scale. A new scale from 2007, allows for a comparison of achievements in the "Meizav" tests (SEGT –School Efficiency and Growth Tests), throughout the years in the same subject and class grade [62] **.**

The following table shows an improvement in achievement of national tests – MEIZAV, students of Israel in 2007-2011**.**

Table 1. The achievements and improvement in Meizav tests results, 8th grade of Junior High school, between 2007-2011 [63]

Year	Jewish sector	Arab sector
2007	513	466
2009	525	459
2010	534	494
2011	547	525

The graph shows the improving student achievement in National test- MEIZAV now in data graph display for the table columns. Years 2007-2011.

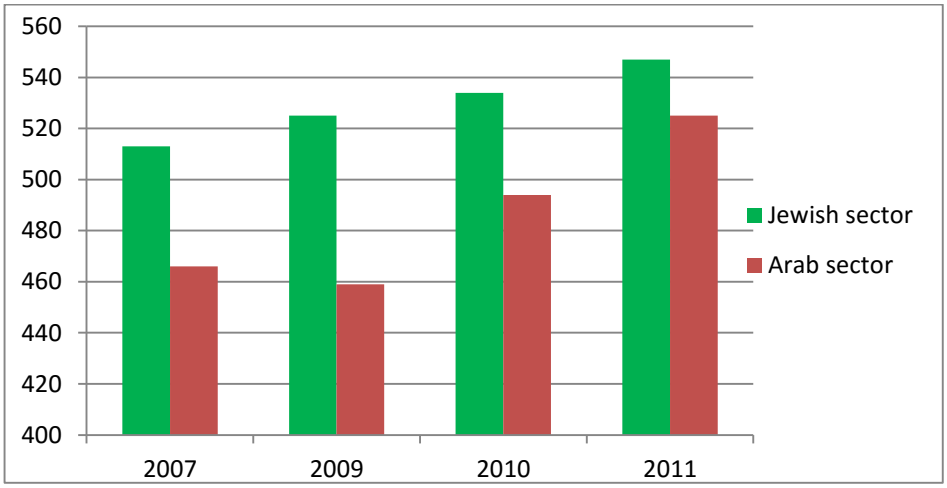


Fig. 1. The achievements and improvement in Meizav tests results (national tests), 8th grade of Junior High school, between 2007-2011 [63]

*The study program applies to the secular Jewish sector, religious and orthodox sectors, and Arab, Druze, Circassia and Bedouin sectors. In above table the gaps in achievements between the Jewish and Arab sectors can be observed.

*Dr. Ofer Rimon, the manager of Science and Technology Administration in the Ministry of Education approaches also the Arab, Druze and Bedouin sectors and encourages the studying of the subject. The slogan is "science and technology studies are the language of the next generation!" Choosing these study orientations allows for the understanding of the scientific technological world that surrounds us. This choice is interesting, sets forth challenges and paves the way to integration in Israeli industry and research.

* Since the founding of the state of Israel and till present time the Israeli export has increased by more than 13,000 ; from around 6 million US$ in 1948 to over 80 billion US$ in 2011. In the early years of the state we based on citrus fruit, diamonds and some industry.

*In the last decades, Israel has turned into a state which principal ingredient of its export is the branches of technology, electronics, software and computerized systems, communication and medical devices.

* There is a evolved activity of R and D in Israel with discoveries that have received world acclaim, amongst which are: the development of Copaxone, the disc on key, early detection of Parkinson's, the tiniest camera in the world, the laser printer, ICQ, sun-heated water tank, cherry tomato, drip irrigation system, colon test pill and missiles interception system [152].

*In 2009, teaching according to the new program has begun. The change began in a Junior High school. For this purpose, a master paper was written which obligated teachers, in all sectors, to teach according to it, to meet the schedules, and undergo training apprenticeships during the study year.

*There was an improvement in national and international tests in the achievements of pupils. *Teachers complain about heavy pressure and burden, not meeting the requirements of the study program, teaching for exams and claim that studying is superficial. There is no time for personal and profound work as it was in the past. Every year there are light changes in the master paper according to teachers' suggestions.

*Pupils, on the other hand, prefer a variety of subjects and the vast variance. The multiplicity of subjects diversifies studying and allows for studying in small units. A pupil who does not relate to a certain part of the subject can relate to another and continue loving the subject. In parallel, the state encourages and reinforces physics studies which in recent years have nearly gone extinct.

*Israel has begun adjusting itself to studying according the requirements of the 21st century. It still needs to invest greatly in the subject – computerization of classes, integrative boards and more.

*The educational system in the United Kingdom has also changed the science study program and raised the level of pupils' achievements in national and international tests. The situation has brought about a motivation to continue with higher education. Despite the changes, the level of involvement of government is high in the field of education. It has difficulties in finding a balance

between centralization of government and decentralization of authorities and awarding autonomy to teachers.

*Teachers feel committed to focusing on the program and to teaching for exams. This leads to superficial studying, a limited short term assimilation of the acquired knowledge. In the United Kingdom the subject of telecommunication and the use of computer technology have begun being integrated as required according to the needs of the 21st century.

*Teachers are the country's source of pride, they excel and have Master's degree in education; they are appreciated by principals, pupils and parents. They are autonomous in their work, teach without exams or homework. The teachers have a central role in the evaluation of pupils. Since the reform, the country leads in the first place worldwide in pupils' achievements in the subject of science.

* Pupils study 6 hours of science that include technology and industry. There is no doubt that the country deserves an admiration in its formulation of reform and the excelling and leading accomplishments in the world. This is definitely enviable!

*There are national and international standards that dictate unity in requirements from pupils. However, the standards arouse objections – it emphasizes gaps and weak populations, teachers feel threatened by being measured by exams and scores. Schools devote the majority of their time to teaching the subjects in which pupils are expected to be examined.

* Exams become the goal of education – one study program that fits all, although the economy in the 21st century sets requirements to diverse workforce with a wide array of abilities. The current requirement of accountability has caused the neglect of the formative evaluation duty. Production of general knowledge has taken its place, which summarizes the study achievements, allows for local, national and international comparisons and the forsaking of the individual studier and the local system.

The world believes today in the importance of education and aspires to supply a good education. The question is in what way? For achieving the purpose, a significant change is required rather than another temporary solution. This type of change might reduce the number of matriculation exams and the number of studied subjects, and on the other hand, inclusion of humanistic, scientific and artistic subjects. Such teaching emphasizes – the structuration of knowledge by the studier under supervision and control, a combination between personal and mutual learning, alternative evaluation that emphasizes the inclusion of a pupil in in the various stages of the process and includes his self-evaluation and the evaluation of his peers in class. This type of changes is under process around the world as well as in 110 experimental schools throughout Israel which examine various models of studying according to the needs of the 21st century [210].

APPENDIX NO. 8

Methodology of pedagogical experiment (description)

Research questions

1. What are the changes in description of achievements of scientific technological reserve pupils?
2. How have studying according to the new program, affected boys and girls in choosing of scientific subjects as enhanced subjects in High school?
3. How has introduction of the new program in the study system as part of the scientific technological reserve, affected the status of the science subject in a school and the relation of teachers, instructors, principals and inspectors to it?

Research population

Examined population – pupils of the scientific technological reserve classes in Teddy Kollek in Jerusalem, and Dekel Vilna'i in the city of Ma'ale Edomim, Junior High schools. The examination is in Junior High school, 7th, 8th and 9th grade. This is pupils who have been accepted in the 7th grade to the reserve classes, after many selections, in the years 2011, 2012, 2013. The population is diverse and heterogeneous, from all layers of population. What is common here is motivation and very high achievements, pupils who have excelled in primary schools, who have a good scientific and mathematical thinking, who live in the neighborhood of Pisgat-Zeev and its surroundings. A diverse socio-economic layer that includes also pupils with special needs, with impaired vision and more. In Ma'ale-Edomim, it is pupils of the 9th grade who have begun studying in Junior High school in 2011 as a scientific class and in 8th grade they have become a scientific technological class. They constitute the first year of students that have been integrated in the project in this Junior High school.

The pupils of 2011 in Teddy- Kolek studies in 9th grade, the 2012 pupils study in 8th grade and the pupils of 2013 study in 7th grade.

At the beginning of the year of 2011, 7th and 8th grade pupils studied in two classes as part of the scientific reserve (regular rather than technological). In one class, there were 38 and in the other, 16 pupils. Towards 9th grade, those with highest grades from the two classes in math, science and physics, have joined into a class of 25 pupils (boys and girls). This class was the scientific technological reserve class. Pupils of 2012 and 2013 have begun studying in the scientific technological reserve class right from 7th grade.

In the scientific technological reserve class, physics, science and technological subjects are studied in an enhanced manner. The reserve comprises 25 pupils. Rest of the study subjects are studied with the rest of the core scientific class, in which they have begun studying from 7th grade and that exists in rest of the age groups. In the study of pupils of the scientific technologic reserve class, the researcher shall examine the following issues: desire of pupils, emotions, changes in social-emotional terms, understanding of contents, and connection to type of class. Types of teachers suitable for teaching in such a class. Does investing in this class achieve its purposes? What is the direction in choosing of orientations in High school? Does the family support and helps in the learning process? How, has there been a prior background before arriving to this class? While a comparison between the years between girls and boys.

Teachers would answer the questionnaire generally, in relation to the new program and studying in the scientific technological class. Instructors, inspectors and principals would answer the questionnaire generally in relation to the new program in the scientific technological class and the changes which have or have not taken place during the 4 years that this program exists.

Research tools

The study was conducted at longitudinal section, in the year of 2014. It was conducted in parallel in three age groups 7th, 8th and 9th grades in the scientific technological reserve classes in the Teddy Kolek Junior High school in Jerusalem. In parallel, this questionnaire was delivered in the 9th grade in the Dekel-Vilna'i Junior High school in the city of Ma'ale-Edomim (presently only one class exists). It was based on filling 3 different questionnaires: questionnaire for science teachers, questionnaire for reserve pupils, and questionnaire for the senior ranks of the Ministry of Education.

Questionnaire for science teachers

A teacher was asked to his opinion regarding the new science program. Does he have time to teach all the study subjects? What does the teacher think, from a pupil's viewpoint, regarding the science study program? How does the teacher cope with the new program? Why is he interested in teaching in the scientific technological reserve class and what is required of a teacher to teach in this class?

From the answers of teachers, the researcher would be able to understand what is their opinion of the new program, is it acceptable to them, do they connect to it, are there any difficulties coming up? Do the training apprenticeships and instructions promote and improve learning and achievements? How does a teacher perceive the new program from the viewpoint of a pupil? What do teachers do in order to cope with difficulties, should they exist, and improve effectiveness from year to year? In case there is a need, how can the teachers be facilitated? Are there any emphases missing in the new program, what is missing and what can be improved?

Questionnaire for a pupil

In this questionnaire we learned how a pupil feels in the scientific technological reserve class. What are the motives to sign up for this class? Does the class constitute a challenge in study or social terms? Are there any difficulties coming up? Do pupils feel special in the age group? If so, why? Should boys and girls be integrated in the scientific technological class? Do pupils have a prior scientific background? Do parents and families support the learning and promotion processes and how? Which subjects do they intend to choose in High school? Is there a relation between a science teacher and the choosing of the subject of science in High school? Do you see in your life a future in the subject of science? Why do many pupils not choose physics? Why do so few girls choose this subject? What would encourage motivation of choosing the scientific subjects in general and physics in particular? Would you recommend to friends/family studying in this class?

From this questionnaire, we learned about the characteristics of this class. How do pupils feel in this class? Are they really unique and special? Is there congruence between perception of a teacher and perception of a pupil of studying in this class? What does encourage pupils to arrive to this class? Do they need support from home in order to arrive to this class? Does a teacher have significant impact on pupils' choosing the study subjects in High school? Is there a change in the inclination of choosing the subject of physics amongst boys and girls? Is there improvement in achievements, in choosing the subjects and in rise in the number of pupils choosing scientific subjects in Highs school, after opening the scientific technological class? Which subjects are preferred by boys and girls in the field of science? Is there a need for change, improvement and what is to be done about it? Has the choosing of the character of pupils in 7^{th} grade been right and good?

Questionnaire for senior position holders in the Ministry of education

This questionnaire would be given to the head inspector in science in the country, Mrs. Shoshi Cohen, the inspectors of scientific technological reserve classes and the school principals of current study (Teddy Kolek and Dekel Vilna'i) [71].

The first question is general, regarding the new study program. It details various relations to the new study program and the extent of agreement of respondents to the relation. The second question relates to the targets of the scientific technological reserve class. Are they being achieved? What are the required characteristics of a teacher for this class? How do girls perceive the studying of the subject of physics in this class? What does the Ministry of Education continue to do in order to increase the number of boys and girls who choose physics?

From these answers we examined the satisfaction of the senior ranks with the new program in science, in the scientific technological reserve class; the increase of number of boys and girls who choose physics. What does the Ministry of Education continue to do to improve the program and make it more effective? What are the difficulties that still exist? Does the way of teaching in this class encourage and strengthen girls? Is the number of girls in these classes is according to the set targets?

Research proceeding

The tool in current study is a questionnaire. There are 3 different questionnaires by Likert scale – for science teachers, for pupils and for senior ranks in the educational system related to science and the scientific technological reserve classes. We examined the answers of pupils and understand trends. As well, we described the trends of the grades of pupils in the scientific technological reserve class, in 7th, 8th and 9th grades who finish their studies in the Junior Highs School, in June 2014 and the first year of pupils in the 9th grade age group who finish in the city of Ma'ale-Edomim.

The sample represents pupils of the scientific technological reserve classes, in Junior High school of Pisgat-Ze'ev in Jerusalem, in the years 2011-2013. The Teddy Kollek junior High school has 20 years of experiences in leading studying in scientific classes. The structure of the scientific technological reserve class is relatively new and this is its fourth year in the school. In relation to other schools in the country, it is considered as veteran. We compared the data of the first scientific technological reserve class in the Junior High school of Dekel Vilna'i, in the city of Ma'ale-Edomim. Presently, there are 130 scientific technological reserve classes in Israel. Most have been opened in the last couple of years. We examined trends between the various age groups – 7th, 8th and 9th grades, changes in school as a result of this class, advantages, shortcomings of this class, actions that need to be improved accordingly, and writing of recommendations accordingly.

Research limitations

*Difficulties in skill of reading the research questionnaire:

The pupils have shown seriousness regarding the questionnaire but due to the lack of the presence of the researcher at the time of writing down the answers there were items which understanding was not as required. For example, the use of words challenge, self-realization. There were answers written in a negative form and the pupils have had difficulties in answering those questions. For examine – the family does not encourage although they have meant in their answer that the family does encourage. The teachers that were present in classes assisted with this problem.

*Variance in the designated reserve classes

The designated classes are uniform in purpose and targets however there is difference between them. As they grow every year, new insights are being learned that cause an addition of ideas, performance and contents. This affects the variance in the pupils' answers.

*Information on the designated classes

These classes operate in the system since 2010. The implementation of the program is by gradient and therefore the program exists for 4 years inly in 30 schools in the country. In many schools the programs exist for one year. Therefore, there is a difficulty in a comparative research between these classes and there is not much information. The information current study is based on was taken from the work of the researcher in the field as a designated class teacher in the past and as a science instructor in the Jerusalem district.

*Difficulty in receiving the questionnaires from the senior management level

Due to the overload at work of the senior management level a difficulty in receiving the questionnaires on time was created. There were items which have not been responded to, which could be due to political reasons. The answers of the science chief instructor Mrs. Shoshi Cohen [71], were done by coordination on the telephone in advance. There were items she hasn't answered due to lack of exact data: for example, teachers' burnout, to each answer in this interview was added an extensive explanation which altered the structure of the questionnaire that was given to all.

*Teachers questionnaire -Due to a limited number of these classes, the number of teachers that were asked was low. *Type of defined population.- The questionnaires were filled out by pupils of the scientific technological reserve class in the Teddy Kollec Junior High school in Jerusalem in three grades of 7th, 8th and 9th grade. In the Dekel Vilna'ei Junior High school in Ma'ale-Adumim in 9th grade only (first year of the program) – 93 respondents. An attempt was made to reach the designated classes in Ort Ironi Dalet Modi'In, but with no success.

The Training Program on Gender Sensitiveness

The program rationale: It is essential to provide information about the Gender Equality in general and specific information connected with daily life in order to sensibly the participants in the field. Therefore it is important to raise the awareness of all actors of educational process: students, teachers, parents, managers. All actors can benefit from conversation, encouraging openness and expression of emotions, creating a supportive / friendly emotional climate, but also oriented on the success.

Goal of the training program: the goal of the training program is to enhance the motivation of girls and boys to study science and technology.

The objectives are structured according to groups' specificity.

Special note: The sessions take place once a month. The training sessions are combined with different experiential activities. Parents and students are encourage to go together to museum, exhibitions, to meet women and men scientists; to interact more in the frame of different household activities

Evaluation of the intervention program: At the end of the training program the short questionnaire are distributed among teachers, parents. Results of the questionnaire served as indicators regarding the effectiveness of the program. Students presented the impressions during the evaluation discussion face-to-face and in small groups.

The Structure of the Training Session for students

Date of the session	Main Theme	Objectives	Methods
	Introduction in Gender : Sex / Gender; Equality and Equity	Discussing expectations Exploring the gender understanding Setting goals;	Brainstorming PPP Individual work
	Image of Women and Men in daily life	Exploring / transforming stereotypes	Work in the groups mixt boys and girls . Reflections. Presentations.
	Image of Women and Men in sciences	Exploring / transforming stereotypes	Work in the groups mixt boys and girls . Reflections. Presentations.
	The importance of secondary education in science and technology	Identification of the life strategies	Individual work. Reflections. Brainstorming
	The importance of involving girls and boys in science and technology	Identification of the life strategies	Individual work. Reflections. Brainstorming
	Gender stereotypes	Exploring / transforming stereotypes	Work in the groups mixt boys and girls . Reflections. Presentations.

	Modalities of cooperation between girls and boys in school and social activities	Exploring / transforming stereotypes	Work in the groups mixt boys and girls . Reflections. Presentations.
	Self esteem and career aspiration	Developing self-efficacy	Individual work. Reflections. Brainstorming
	Life and career strategies	Identification of the life strategies	Individual work. Reflections. Brainstorming
	Evaluation		

The Structure of the Training Session for teachers

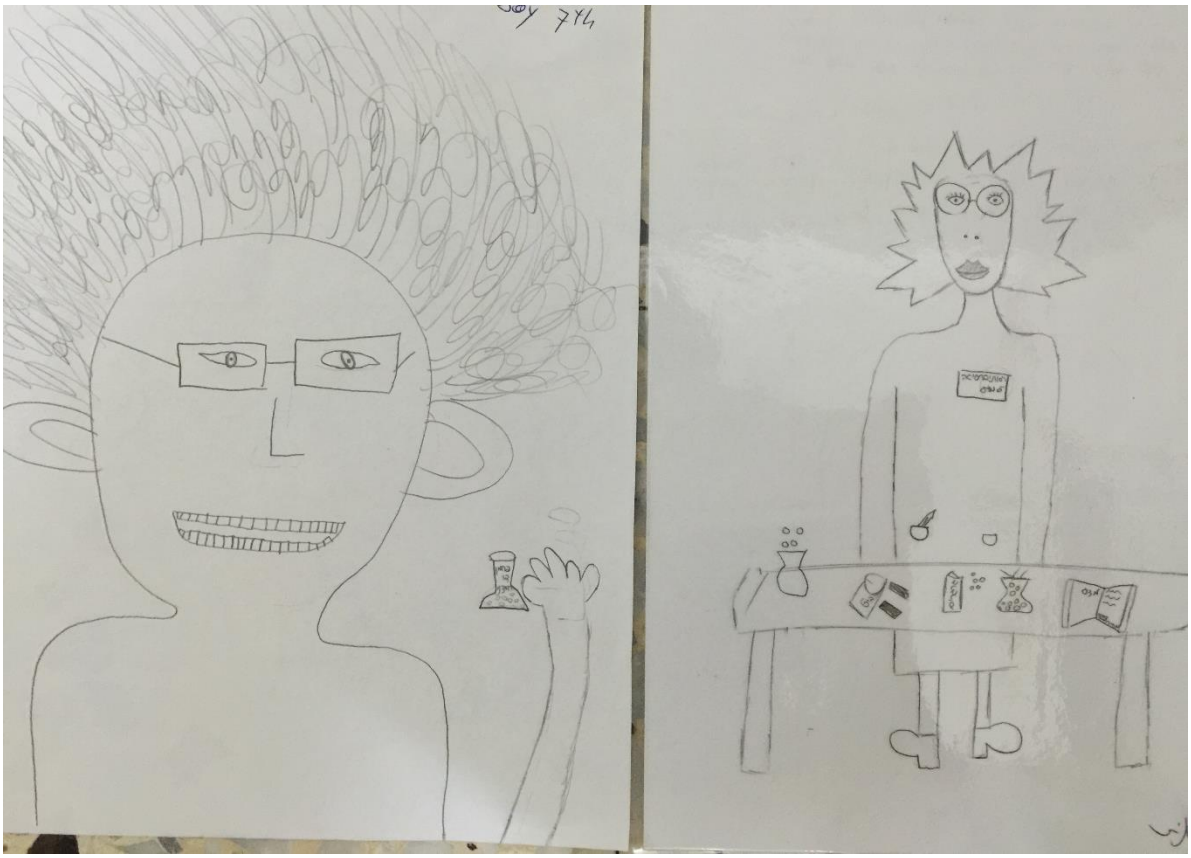
Date of the session	Main Theme	Objectives	Methods
	I ntroduction in Gender : Sex / Gender; Equality and Equity	Discussing expectations Exploring the gender understanding Setting goals;	Brainstorming PPP Individual work
	Gender equality and science/technology	Exploring / transforming stereotypes	Work in the groups . Reflections. Presentations.
	Image of Women and Men in daily life	Exploring / transforming stereotypes	Work in the groups. Reflections. Presentations.
	Image of Women and Men in sciences	Exploring / transforming stereotypes	Work in the groups. Reflections. Presentations.
	The importance of secondary education in science and technology	Identification of the life strategies	Individual work. Reflections. Brainstorming
	The importance of involving girls and boys in science and technology	Identification of the life strategies	Individual work. Reflections. Brainstorming
	Gender stereotypes in teaching, assessment and teaching material;	Exploring / transforming stereotypes	Work in the groups. Reflections. Presentations.
	Modalities of cooperation between girls and boys in school and social activities	Exploring / transforming stereotypes	Work in the groups. Reflections. Presentations.
	Defining professional aspirations beyond gender stereotypes	Developing self-efficacy	Individual work. Reflections. Brainstorming

	Life and career strategies	Identification of the life strategies	Individual work. Reflections. Brainstorming
	Evaluation		

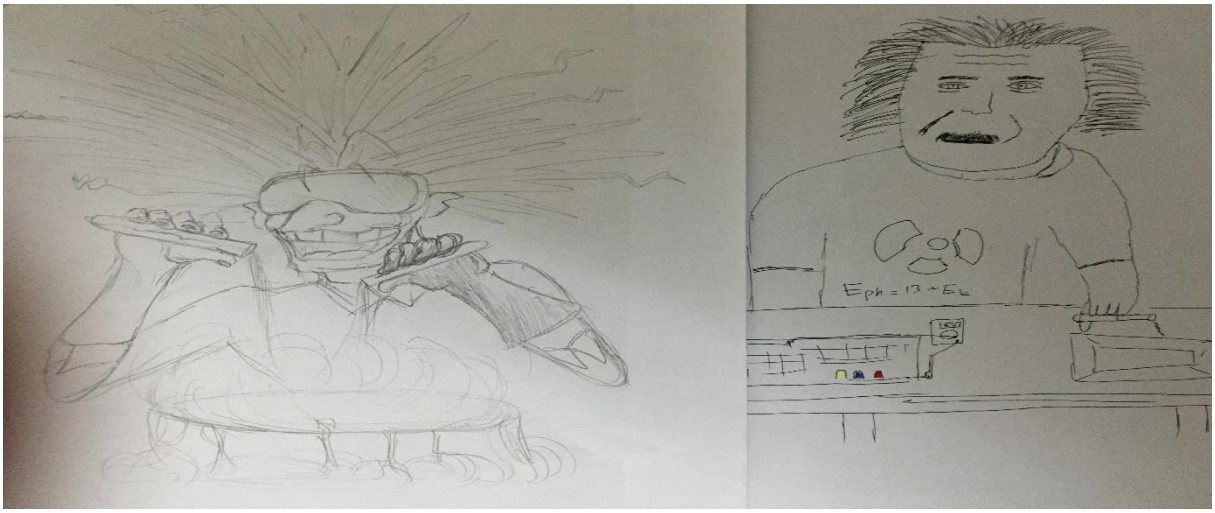
The Structure of the Training Session for parents

Date of the session	Main Theme	Objectives	Methods
	Introduction in Gender : Sex / Gender; Equality and Equity	Discussing expectations Exploring the gender understanding Setting goals;	Brainstorming PPP Individual work
	Image of Women and Men in daily life	Exploring / transforming stereotypes	Work in the groups mixt boys and girls . Reflections. Presentations.
	Image of Women and Men in sciences	Exploring / transforming stereotypes	Work in the groups mixt boys and girls . Reflections. Presentations.
	The importance of secondary education in science and technology	Identification of the life strategies	Individual work. Reflections. Brainstorming
	The importance of involving girls and boys in science and technology	Identification of the life strategies	Individual work. Reflections. Brainstorming
	Gender stereotypes in the impact on life strategies	Exploring / transforming stereotypes	Work in the groups. Reflections. Presentations.
	Modalities of cooperation between girls and boys in school and social activities	Exploring / transforming stereotypes	Work in the groups. Reflections. Presentations.
	Self esteem and career aspiration	Developing self-efficacy of the girls and boys	Individual work. Reflections. Brainstorming
	Life and career strategies	Identification of the life strategies	Individual work. Reflections. Brainstorming
	Evaluation		

APPENDIX NO. 9- Projective drawing students**- Scientist**



Paintings Scientist Grade 7 , very wierd.

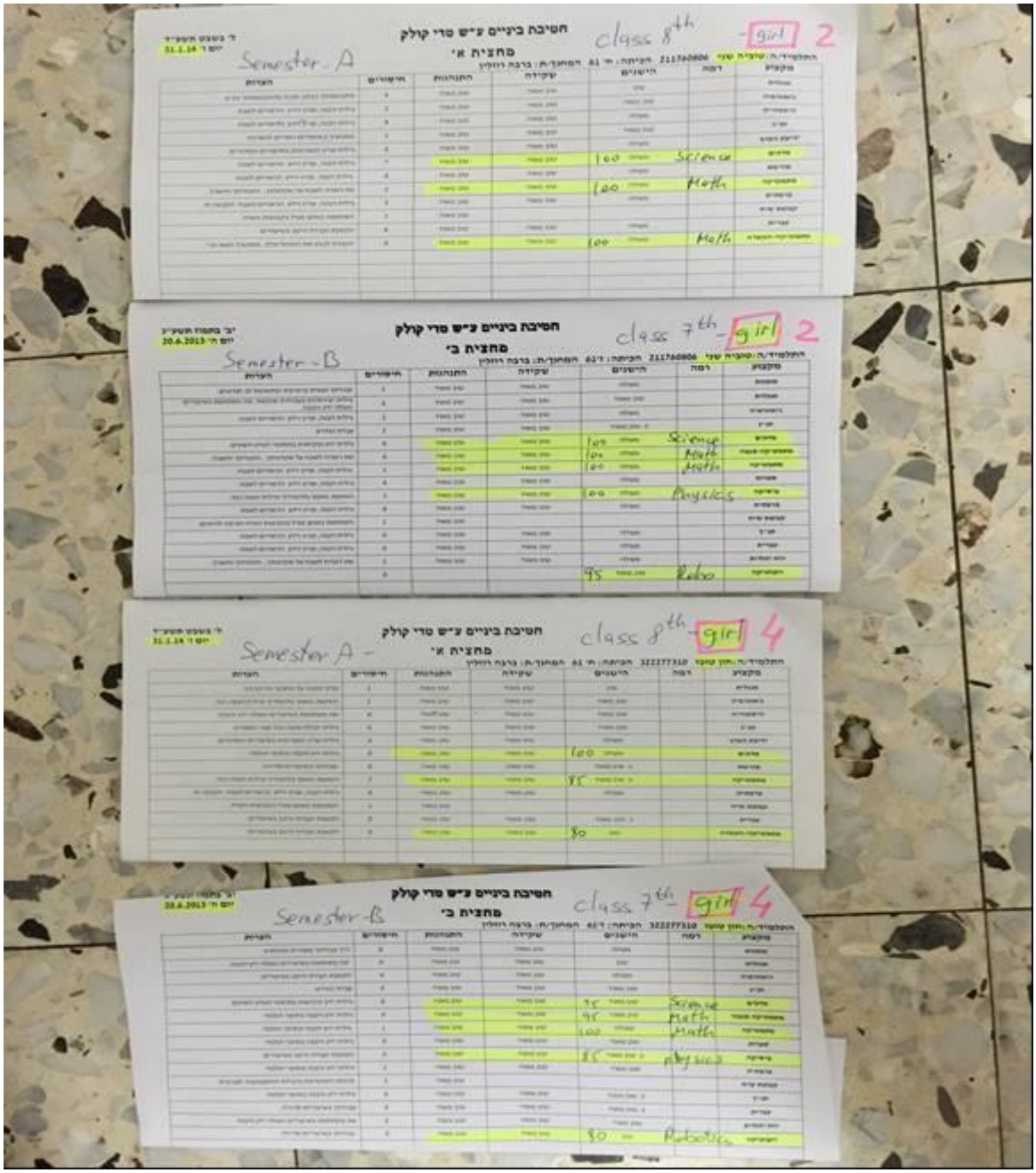


Paintings Scientist Grade 9 – science female with tie clothes

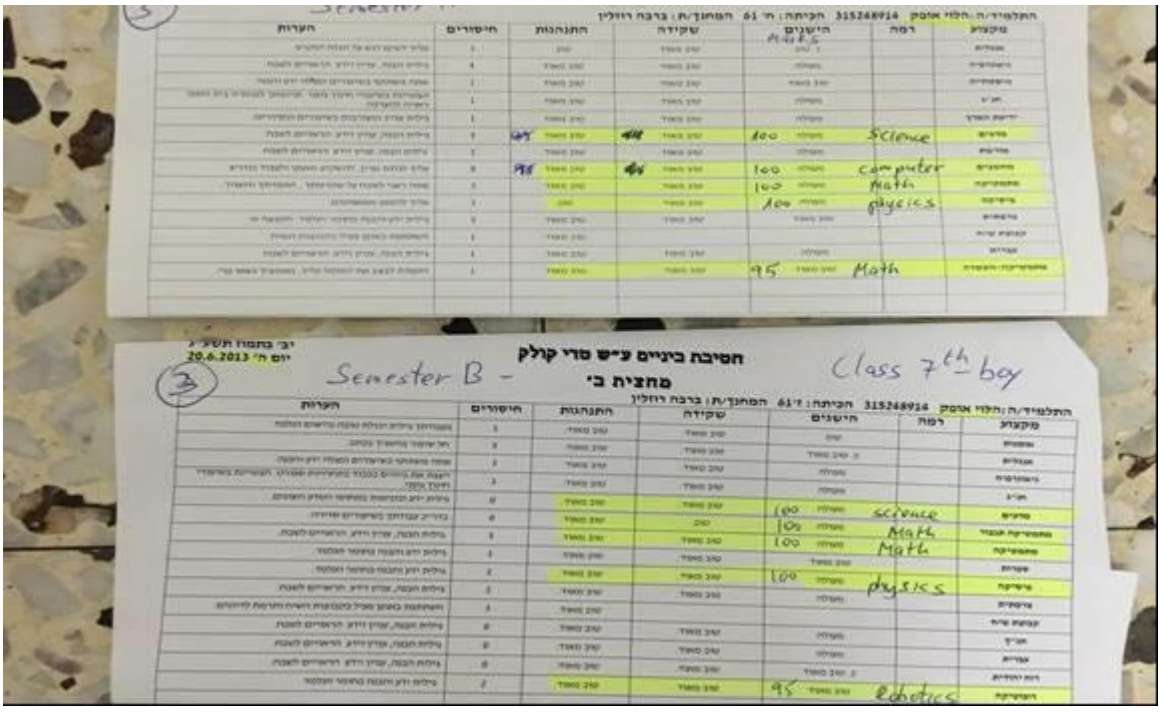
APPENDIX NO. 10- MARKS

Students' marks learners at technology scientific reserve class. Attached boys and girls scores at semester A and semester B in seeing the highest grades in all the sciences subjects.

GIRLS MARKS IN SCUENCES 2013,2014



BOYS MARKS IN SCIENCES 2013,2014



COMPLIANCE REGULATION

For doctoral theses elaborated in the state language

The undersigned, declare on my own responsibility that the materials presented in the present doctoral thesis are the result of my own researches and scientific achievements. I am aware of the fact that, otherwise, I will bear the consequences in accordance with the law in force.

NISSEL ORLY

Signature

February , 2016

AUTHOR'S CV

First name: ORLY
Surname: NISSEL
Date of birth 13.6.1960
Country of birth ISRAEL.
Citizenship Israeli.

Studies:

2011-2015- PhD Thesis , General Pedagogics, Faculty of Psychology and Educational Sciences, Department of Educational Sciences. *Moldova State University* .

1996-1998- management studies, school headmasters' training, *David Yellin College* Jerusalem, Israel.

1985-1988- M.A. studies, Faculty for Social Sciences, geography and Urban Studies, the *Hebrew University* Mt . Scopus in Jerusalem , Israel.

1981-1985- B.E.D. graduate of David Yellin College, Junior High School track, teaching certificate in science subjects and geography , Jerusalem, Israel.

Areas of scientific interest:

2009-2014 - General Pedagogics, Faculty of Psychology and Educational Sciences, Department of Educational Sciences.

Professional activity:

2015- **Director of junior high school** MOR- Maccabim Reut,Israel.

2014- 2015- **School Principal a Head of Science**, Technology and Art Center. The head of the center is in charge of applying the science curriculum in schools and in charge of exposing the students and teachers to different projects in STEM education, Gilo, Israel.

1988 -2014- Teacher in the Junior High **Teddy Kollek** in Jerusalem, Israel.

2009-2014- Sciences and technology instructress in Junior High School on behalf of Manhi , the Ministry of Education in Jerusalem, Israel.

2009-2014- Teachers' instructors and leaders course and teaching- learning- assessment in **Weitzman Institute** and the Ministry of Education- Manhi ,Jerusalem education administration, Rehovot, Israel.

2006-2014- sciences and technology subject **coordinator** in Teddy Kollet Junior High School in Jerusalem, Israel.

2013-2014- Homeroom teacher of 8th grade scientific class for exceptional students – the

scientific reserve of Israel, Jerusalem Israel.

1993-2013- teacher for sciences **in advanced classes** 7th, 8th, 9th grades , Jerusalem , Israel.

1999-2011- teacher for Sciences and **Astronomy** in **scientific classes.**

1988-1993- teacher for sciences and ***geography coordinator*** in the junior high school Jerusalem , Israel.

1985-1988- teacher for geography and biology in ***High School beside the Hebrew University*** – *"LEYADA"* in Jerusalem, Israel.

1983-1985- Flight Attendant in El- Al Company.

Participation in scientific forums national and international:

1. Participation in an international project in the field of robotics – FLL. As part of this project, I have led 40 pupils, which means 4 research groups at the age group of 8th grade, ages 13-14. The pupils have designed robots out of LEGO according to the requirements and wrote various research papers, including building of models – prototype that improves the lives of citizens in the field of urban transportation. In this project we were the only ones from the city of Jerusalem and reached the first places.
2. Participation for several times in a competition named after the first Israeli astronaut – Ilan Ramon in cooperation with NASA, leading of 9th grade pupils ages 14-15, writing a study paper according to the research requirements. The competition includes writing of a study paper, creating a model and a presentation. We have reached the first places.
3. Hosting 40 teachers and educators from Africa and South America. The state of Israel, the Ministry of Education and the Ministry of Foreign Affairs approached me as an excelling teacher to host these educators in the school I teach in. The teachers have observed an example lesson in the subject of science. Following that, the projects I were promoting with my pupils throughout the years were presented in order for them to learn from the successes, for colleagues learning while implementing them and enriching teaching methods in their home country.
4. Leading a research paper writing in 9th grade, ages 14-15. Second year in a row, instructing pupils and teachers in research paper writing, as an instructor and coordinator in the subject of science. One research study was elected as the first place from each school. Following that, district competition and finally national one. One of the schools under my leading has won the national competition.
5. Participation in a national project, the first national bird in 2014, Weizmann Institute Rehovot, Israel.

Publications on the topic of the doctoral thesis

1. **Nissel O., Bodrug-Lungu V. Valorificarea dimensiunii de gen în programul de ştiinţe exacte (exemplu Israel**) In: *Şcoala modernă: provocări şi oportunităţi*. Materialele Conf. Ştiinţ. Internaţ., 05-06 noiembrie 2015. Chişinău, Inst.Ştiinţe ale Educaţiei, 2015. P.276-281.
2. **Nissel O.** "**Sciences education in ISRAEL**". In: *Studia Universitatis Moldaviae*. Nr 9 (7959) 2012, p.155-159. ISSN 1857-2103
3. **Nissel O. Impact of curriculum on the achivements of students in Israel**. In: *Rezumate ale comunicărilor.* Conferinţa ştiinţifică INTEGRARE PRIN CERCETARE şi INOVARE, 28-29 setembrie 2013. Ştiinţe sociale. Chişinău, CEP USM, 2013. P.131-132.
4. **Nissel O. Education system in ISRAEL: Opportunities and challenges.** *In: Studia Universitatis Moldaviae.* Nr 5 (65) 2013, p.157-163. ISSN 1857-2103
5. **Nissel O."A comparative analysis of new study programs in sciences in Israel, United Kingdom and Finland."** In: *Studia Universitatis Moldaviae*. Nr 9 (79) 2014, p.181-185.
6. **Nissel O. Strengthening the studies of science and technology amongst pupils taking gender aspects into consideration".** In: *Univers Pedagogic*. Chişinău, Institutul Ştiinţe ale Educaţiei, Nr.1 (45) 2015, p.47-51
7. **Nissel O. The new study program in the subject of sciences – as leading a change in achievements amongst boys and girls in junior high school.** *In: Eficientizarea învăţământului – vector al politicilor educaţionale moderne.* Materialele Conferinţei Ştiinţifice Internaţionale, 11-12 decembrie 2014. Chişinău, Inst. Ştiinţe ale Educaţiei, 2014. P.276-281.
8. **Nissel O. STUDY on "SCIENTIFIC TECHNOLOGICAL LEADERSHIP RESERVE" (gender dimension). In: Materialele Conferinţei Ştiinţifice Internaţionale, 21 noiembrie 2014. Chişinău, USM,** P.411-417
9. **Nissel O. " Twist and space to encourage education and science education ILAN and ASAF RAMON"- Participation in conferences , ISRAEL, 2014. http://mcd.org.il/site/wp-content/uploads/2014/10/publication-conference-carmel-1.pdf**

Awards: Won a scholarship about the research program in Ma'ale-Edomim, 1986.
Languages: Hebrew mother's tongue**,** English very good, French good.

Contact information: Dov Sadan street 19 ap. 9, Pisgat Zeev
City: Jerusalem, Postal Code 97844
Country: ISRAEL
Mobile: +972-52- 8025553 E-mail: nissel.orly@gmail.com