

ORIGINAL ARTICLE

Promoting Scientific Research Culture in Youth through Empirical Inculcation

Background: Empirical inculcation is vital for producing quality research professionals and upon realizing the increasing demand of emerging scientific research professionals, National Academy of Young Scientist (NAYS) launched its science for youth (S4Y) program in Pakistan with its emphasis on empiricism.

Methods: S4Y team was galvanized to undertake this task and different scientific activities were organized by them in different schools and colleges of Pakistan during 2011 – 2012. Scientific activities that were arranged included seminars on diverse scientific subjects and career counseling sessions.

Results: Response of students showed that the implementation of this program can contribute in achieving the target of producing qualified skilled research professionals and upturning the Pakistan literacy rate. Experimental activities were also planned but its implementation was restricted due to financial strains. 39 activities were conducted in 2012 in the schools and colleges of all the provinces of Pakistan on the importance of science in the world, scientific discoveries, and career counseling.

Conclusion: These activities at school and college level were appreciated by the students and staff members and proved very fruitful for defining the scientific fields and goals of scientific studies for Pakistani youth. Implementation of experimental activities in future will help students in getting awareness about the ways through which science explores this world.

Keywords: Empiricism, Inculcation, Bare Foot Schooling System, Science for Youth, Schools, Science Education

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رفع مستوى التحقیق العلمی عند الشباب من خلال الإلقاء التجربی

التمهید و الهدف: إن الإلقاء التجربی امراسی جدا فی إنتاج تحقیقات تخصصیه حیویه و نظرا الی الحاجه الیومیة الملحه الی تحقیقات العلمیه التخصیصیه اعلنت الأكادیمیة الوطنیه للشباب الباحتین فی پاکستان عن برنامجها تحت عنوان «العلوم لشباب» .

الطریق: تم تصمیم فریق «العلوم للشباب» لمتابعه هذا المرم و عمر الی بلوره فعالیتات الجامعات فی پاکستان خلال سنوات ۲۰۱۱ و ۲۰۱۲ میلادی و كانت نشاطا ترم فی مجال المؤتمرات و الموضوعات العلمیه المتعدده و قسم مشاوره المرم.

النتائج: إن تجارب الطلاب تشير الی أن هذا البرنامج استطاع تحقیق الهدف المرجوه مثل إنتاج و تحسین الممارات التحقیقیة المرفیه و رفع المستوى العلمی فی هذا المجال. نلاحظ أن هناك موانع کثیره فی مجال الفعالیات التجربیه نتیجه الی محدودیه البالیة. هناك ۳۹ فعالیة تم اجرائها فی مجالات الهیمة العلوم فی العالم و الکشفیات العلمیه و المشاوره المرمیه فی المراكز الجامعیة فی محافظات پاکستان عام ۲۰۱۲ .
الاستنتاج: تم تقدر هذه الجهود من قبل طلاب و اعضاء الریبه العلمیه فی الجامعات هناك و قد ثبت أن هذه الجهود كانت مثمره جدا فی المرمه العلمیه و اهداف المطالعات. إن هذه الفعالیات التجربیه تساعد الطلاب الی معرفه الطریق الی تبعمها العلم فی العالم.

ارتقا فرهنگ تحقیق علمی در جوانان از طریق تفهیم تجربی

زمینه و هدف: تفهیم تجربی برای تولید پژوهشهای تخصصی بسیار حیاتی است و با توجه به افزایش نیاز روز افزون به پژوهشهای علمی تخصصی ، آکادمی ملی پژوهشگران جوان برنامه خود تحت عنوان "علوم برای جوانان" را در پاکستان با تاکید بر روشهای تجربی آغاز نمود.

روش: گروه علوم برای جوانان به این منظور طراحی گردید تا این وظیفه مهم را به انجام رساند نظیر سازماندهی فعالیتهای متفاوت در دانشگاههای پاکستان در سالهای ۲۰۱۱ و ۲۰۱۲. فعالیتهای علمی این گروه مشتمل بر سمینارها و موضوعات مختلف علمی و بخش مشاوره شغلی بود.

یافته ها: پاسخ های دانشجویان نشان داد انجام این برنامه توانسته است در موفقیت رسیدن اهداف مهم برنامه نظیر تولید و بهبود مهارتهای پژوهشی حرفه ای و بالابردن سطح دانش ایفا کند. انجام فعالیتهای تجربی که برنامه ریزی شده اند به دلایل مالی بسیار محدود شده است. ۳۹ فعالیت در سال ۲۰۱۲ در مراکز دانشگاهی همه ایالات پاکستان انجام شد در باب اهمیت علوم در جهان، کشفیات علمی مشاوره شغلی.

نتیجه گیری: این فعالیتهای در سطوح دانشگاهی مورد قدردانی دانشجویان و اعضای هت علمی قرار گرفت و ثابت شده که برای تبیین حوزه علمی و اهداف مطالعات بسیار پرثمر بوده است. انجام این فعالیتهای تجربی این امکان را فراهم میسازد تا دانشجویان در باره راه هایی که علوم در دنیا می پیماید آگاه شوند.

بیک گراوند: آزمائشی روشون کی ترغیب سے نوجوان طلباء کو سائنسی تحقیق پر مائل کرنا. جوان طلباء کو تجربیاتی اور آزمائشی طریقوں سے تعلیم دینا نہایت ضروری ہے تا کہ اعلی مہارت کے محققین وجود میں آسکیں۔ اسی هدف کے تحت پاکستان میں قومی اکیڈمی فارینگ سائنٹسٹس نے سائنس فار یوتھ کے زیر عنوان ایک پروگرام شروع کیا ہے جس کا مقصد جوانوں کو تجربیاتی روشون سے آشنا کرنا ہے۔

روش: پاکستان میں یہ ادارہ قائم کیا گیا تاکہ وہ مختلف یونیورسٹیوں میں مختلف سائنسی سرگرمیوں کو منظم کرکے جوان سائنس دانوں کو سہولتیں فراہم کرسکے۔ اس ادارے نے پاکستان میں دوہزار گیارہ اور دوہزار بارہ میں مختلف سائنسی موضوعات پر سمینار اور ورک شاپ منعقد کیں۔

نتیجہ: طلباء کی کارکردگی سے واضح ہوتا ہے کہ اس طرح کے پروگرام انہیں علمی اور سائنسی لحاظ سے آگے لے جانے اور تعلیمی لحاظ سے ان کی پیشرفت میں نہایت موثر واقع ہوئے ہیں۔

سفارشات: چونکہ طلباء نے ان پروگراموں کو بہت پسند کیا ہے لہذا یہ ضروری ہے کہ ان پر توجہ دی جائے۔ ان پروگراموں سے طلباء کی سائنسی اور علمی صلاحیتوں میں نکھار آتا ہے اور وہ علمی اور تحقیقاتی روشون سے آشنا ہوتے ہیں۔

کلیدی الفاظ: علمی روشیں۔ سائنس اکیڈمی۔ پاکستان۔

INTRODUCTION

The traditional education system which is still prevalent in most of the public sector educational institutions led by federal and provincial government has five levels: Primary (from standard one to five), Middle (standard six to eight), High (standard nine and matric), Intermediate (first and second years of college) and university program including undergraduate and graduate ones [1]. Contrary to this system is a private sector run education system which offers quality education but the fees they charge is very high and unaffordable to majority of the population. Number of enrolled students is different for both of the systems and it depends on the extent of urbanity. People in urban areas prefer private sector schooling to conventional education system run by federal or provincial governments [2]. Public sector institutes are not widely accepted among urban population because the literacy rate of these areas is high comparing to the rural one and they have the realization that education quality needs to be improved in traditional education system which discourages the students' creativity and conceptual implementation process. The total literacy rate of Pakistan is approximately 58% having 68% literate men and 45% literate [3]. One prime reason for this low literacy rate is limited to budget reserved for education which is reported to be 95.442 million PKR, 2.2% of GDP (Institute of Social and Policy Sciences). Besides this, objections are also raised on curriculum designed by federal and local governments for primary and high school students. Major drawbacks of it are lack of conceptual implementation and relevancy with daily life examples. There are five parameters, the quality of which if maintained can help thrive a sustainable education system. It includes curriculum, assessment, teachers, textbooks, and the institutional educational ambience [4]. As mentioned earlier in the majority of areas, public sector institutes play major role in providing elementary level and primary education to students and have a nominal fee but the quality of some parameters is compromised due to many reasons.

The curricula designed by the federal and local government systems are different from each other and this explains the difference in education quality at provincial level. The text books written for the students of very basic levels lack local context and this hinders the conceptual knowledge implementation process. Majority of the students fail to comprehend the relevancy of topic in local context which is critical for the quality education system [4]. Many of the science books explain the natural phenomenon in an epistemological manner, and finding correlation with daily life examples becomes difficult for students. This is the major hindrance in the process of quality researchers' production from most of the educational institutions [4, 5]. Scientific education should not focus on memorizing the facts but it should be based on scientific way of thinking and deeper understanding of concepts [6]. For the promotion of science and research culture in Pakistan, National Academy of Young Scientist (NAYS) has launched science for youth program for primary, middle, high school and college students [7], and this project has been extended

to many other countries through GYA [8]. In many conventional schooling systems of Pakistan, the approach of teaching science subjects is epistemological which prevents the conceptual implementation process in learners. NAYS comes up with the idea of spreading the message of empirical inculcation and for this young researchers themselves took initiative and they conducted scientific activities in different schools and colleges all over Pakistan. NAYS has established an extensive network of young researchers nationwide and they are actively participating in accomplishing the NAYS objective of promoting scientific research culture in Pakistan.

Majority of the students are not aware of the latest applied science fields and this is the primary reason why Pakistan is lacking in these areas. Most of the students prefer medical sciences or engineering science fields because they believe it will provide them better career opportunities. To change this traditional trend and to encourage students for pursuing emerging science fields, career counseling service was initiated along with science for youth program. Information regarding technological advancements and innovations in such fields are being shared with them to kindle thirst for knowledge among youngsters.

Scientific activities that were conducted during the last year mostly included lectures and seminars to apprise students with the latest science fields. However, NAYS science for youth program also includes the idea of conducting different scientific experimental activities for the promotion of empiricism oriented inculcation method. Due to limited financial resources, implementation of this approach is difficult but this project will be expanded upon receiving support from some governmental or non-governmental financier. Different young researchers were assigned with responsibilities of conducting such activities at provincial level. NAYS has established a hierarchy for it and every province has a province coordinator who directs the district coordinators of science for youth program and demonstrators as well. All the province coordinators report s4y activities to the country and project coordinator.

NAYS also facilitates the novice researchers to acquaint themselves with research expertise by providing them internship opportunities in different industries and research institutes. It is bridging the gap between academia and industry which is crucial for further advancement and development.

S4Y have strong emphasis on research oriented inculcation as it is vital for developing research potential in school and college students. In many conventional schooling system classes, the process of conceptual implementation is ignored and the students don't have any ideas in how they can benefit from the knowledge they acquire from there. Such systems are prevailed in majority of the government regulated schools and colleges. S4Y team has targeted those systems and many sessions have been conducted in which students were asked to think over the different natural phenomena. Observation based learning method was introduced by team members and in most of the activities students gave vigorous responses and showed eagerness to learn things through this way.

NAYS, S4Y team has a plan to introduce bare foot schooling system [9] in Pakistan where quality education is accessible to all those individuals who are deprived of it because of financial strains. If this project will be implemented at large scale, the literacy rate of Pakistan will get upturned. Complete execution of this project at national level needs support from higher authorities and we expect to progress with our consistency and diligence.

Goals

The objectives of this program are:

- To show the youth that science can be a great opportunity for a career.
- To make the students and their parents aware of the importance of scientists in helping to compete with the global community.
- Motivated young students will choose to be a scientist as their first preference and will be the science leaders in future.

Accomplishments of the mentioned objectives will sustain a balance in the applied and emerging science research professionals in Pakistan in comparison to the rest of disciplines.

METHODS

Team Formation

A team of young qualified researchers was galvanized to undertake this task from all over Pakistan and the established hierarchy for this project is given (Fig. 1). In addition to team, there is also an advisory board for

suggestions and recommendations.

Pattern of System Implementation:

All the science for youth activities which are organized in different schools and colleges follow this pattern:

- *Seminars:* Lectures on important science issues (health, food, environment etc.) by young researchers or eminent scientists
- *Experimental Activities:* Performing small and easy experiments to promote curiosity among students.
- *Visits to science labs:* Research institute and laboratory visitations day
- *Science Competition:* Other possible extracurricular activities to develop the interest students like arranging science project competition between different schools and colleges.
- *Career Counselling:* One day meeting with students and parents to make them aware of uses of science and possible careers choice and development.

Monitoring of Activities

NAYS, higher authorities monitor all the activities which are organized by S4Y team and for the project success evaluation, detail report of each activity is kept in record. Annual survey reports are released to apprise all the concerned authorities about the project progress. A rendezvous is arranged each year for the appreciation of team members and project strategy revision to bring out further improvement in it.

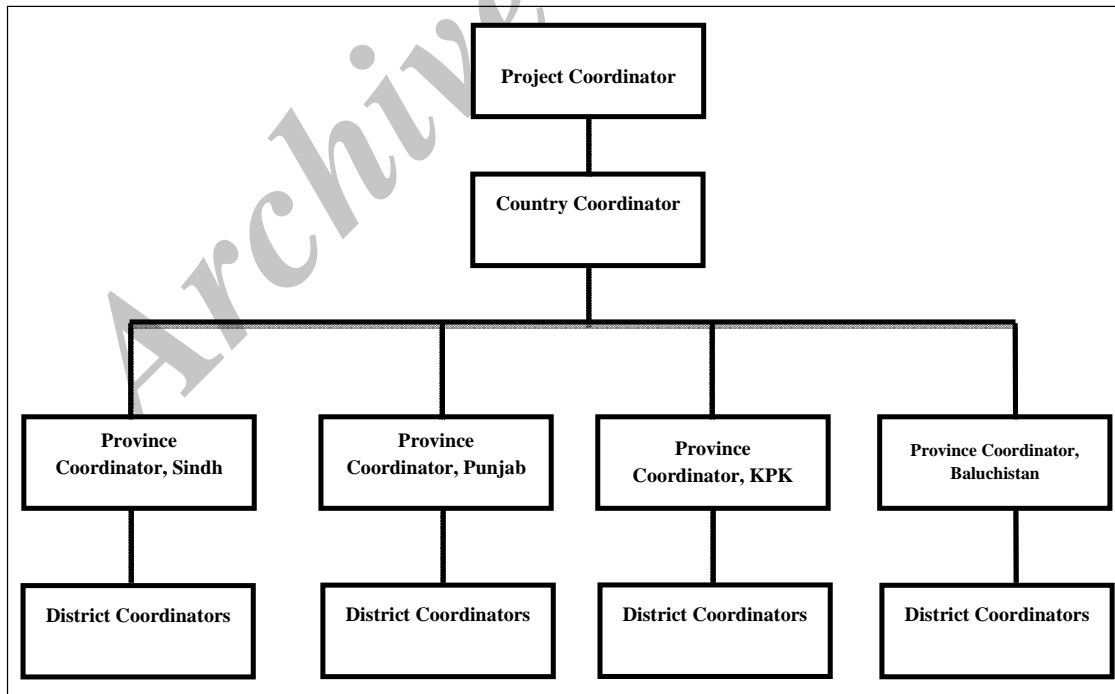


Fig. 1. Hierarchy of working body of S4Y program

RESULTS

Initially, a pilot project of 50 schools and colleges was launched for year 2012 and it is further expanded to 100 schools and colleges for year 2013. Experimental workshops have been planned for year 2013 after analyzing students' requirements and demands. Officials of schools and colleges are showing great interest and inviting S4Y officials and team members on monthly basis for such lectures to train and guide their science students.

. With the request of school and colleges administrations, S4Y team has planned to conduct more consecutive activities in a school or college on annual basis. Detail outcomes of activities employing empirical inculcation strategy are discussed in the following case studies.

1- First seminar of S4Y program was conducted at Saint Gregory's High School Karachi, Sindh on Thursday October 13, 2011. The main objective of this program was to create awareness in youth about different advanced scientific disciplines and also to promote scientific research culture in Pakistan. In this seminar different areas of biotechnology were explored and their applications in coping with global issues were discussed. Different areas of biotechnology e.g. food, medical, and environmental domains were focused during the lecture and issues related with implementation of its application were also explained. Students showed keen interest in the lecture and their concepts of biological and applied sciences were built up with real life examples. School administration also co-operated with the organizing team and their attitude was very encouraging. Students were willing to pursue this field as a career and they were willing to have such further future activities in future.

2-Cloning and its application were explored in a S4Y activity organized by Aftab Ahmad, President NAYS for students of Azam International School and College, Alipur Chhattah, Punjab on October 18, 2011. More than 25 students of grade nine and ten actively participated in the lecture. Concepts of stem cells and their future prospects of being potential therapeutic agents were given to students. Real life examples and disease therapeutic issues were discussed in details to facilitate and expedite the concept comprehension and grasping process in students. Students were eager to learn new things and they insisted on further arrangements of such kind of activities in future.

3-Robust response was received from the students of Government Kinnaird High School for Girls, Lahore during an activity organized by Syada Samra Jafri, Syed Hassan Bukhari, Sadaf Badar and Khurram Shehzad on November 11, 2011 where Educational District Officer (EDO) Lahore was invited as a chief guest. Approximately 300 students took part in the sessions. The approach adopted for this S4Y activity was different from others and the speaker recognized students' talent by asking questions on diverse scientific subjects. The student's response on each question depicted their potential to carry on responded domain of science as a field of their interest. Real life examples and scientific innovations were discussed to give them an insight and they were advised on how they can further improve the knowledge of their interested subjects. EDO and Mrs. Rizwana Khaleel, Headmistress of Government Kinnaird

High School for Girls, Lahore admired and appreciated the efforts of S4Y team for the uplift of Pakistan.

4-With the cooperation of administration of Government Middle School, Naiwala Chhattah, Punjab, another activity was organized by Aftab Ahmad on December 9, 2011. He emphasized on the significance of normal human microbial flora and he explained the hazards associated with consumption of unhealthy foods. Infections caused by different pathogenic organisms were also demonstrated and their modes of transmission were elaborated to students of grades 4 to 8. How infectious diseases can be prevented by simply adopting hygienic principles and good habits were told to students. Approximately more than 50 students joined the seminar and showed interest in learning things through practical examples.

5-NAYS area coordinator Mohammad Moosa Abro from Hyderabad arranged S4Y activity on January 28, 2012. More than 100 students of Al-Mehran Public School and Royal City College attended the seminar and students were informed about the recent research activities of different areas of applied and basic sciences. Career prospects of zoologists in Pakistan were discussed in-depth and students showed interest in this field. There was a question answer (QA) session at the end of lecture during which many participants asked questions related to basic and applied sciences. College and School administration cooperated in making it a successful event and they assured future collaboration for arranging such informative scientific activities.

6-Saman Sajid conducted activity in Kohat in Feb 2012 and she delivered a lecture on Entrepreneurship skills. Students were informed about the hurdles that one faces while setting up a business venture in Pakistan and they were apprised with tactics needed to tackle them and different cases were presented to them where problems that Pakistani professionals suffer due to the lack of technological advancement were described and it was compared with the conditions in the developed countries. A comparative analysis was presented to make them realize the need of professionals in areas where we are lacking. Career counseling session was also arranged to help students define the career that suited them best and how they could excel in it by improving their expertise of their interested domains. Students gave a very encouraging response and the objectives of this activity were attained successfully.

7-Series of lectures were arranged by Asif Raheem Qaisarani in his district Dera Ghazi Khan during March, 2012. His lectures focused on the emerging science fields and its scope, if pursued as a profession was discussed with them. More than 50 students participated in lecture series conducted at Moonlight Public School and Suffah Science Academy. Students who attended the seminar were of grade 9 and 10 and the shared knowledge gave them a new insight of diverse science research fields and they asked questions regarding the pursuance of such scientific disciplines as career or their field of interest. Supportive response was received from the school and academy administrations and they were willing for the continuance of such activities arrangement in future.

8-During a lecture conducted at Civil Aviation College, Karachi, students gave interesting responses when scientific discoveries and significance of research were demonstrated to them. They asked queries regarding different environmental and health related issues prevailing in Pakistan and they were eager to know how scientific research can help resolve such issues. This activity was organized to emphasize the promotion of research oriented inculcation approaches. Students already had very good biological and scientific concepts but after this activity they realized how their concepts can be implemented for making scientific innovations. Topics of research types, ongoing applied science researches and its significance were covered in a 45 minute lecture. A feedback survey form was distributed among all students and upon surveying, results showed that majority of the students had research-oriented mind and they had the passion to continue higher studies in these fields. The most encouraging session was the one when students came to get the contact details of NAYS so that they could share their innovative research ideas with us and seek help regarding their fields of interests.

9-Faiza Khurshed from Khwera, Punjab arranged S4Y activity for the students of a local Government Girl's High School on April 14, 2012 and her 45 minute lecture was delivered to create awareness about Dengue fever and the health issues associated with it. Dengue being the widely prevalent epidemic disease in Pakistan was targeted. More than 80 students participated in this activity and they showed concerned about Dengue fever prevalence and measures to control it and eradicate it from the community. Clinical manifestations, Dengue fever types, infection process and preventive measures were the topics of discussion. In the end, many students helped identify the areas which could be potential breeding habitats for Dengue mosquito vector in their locality. With the cooperation of school administration, this activity was successfully conducted and ended with vigorous student's responses.

10-Ammad Abbass, area coordinator of NAYS, S4Y program reported an activity conducted by him at Government High School, Sahiwal on April 24, 2012. In his activity, he focused on building up fundamental biological concepts in students through practical examples, contrary to the traditional epistemological approaches. He covered diverse topics in his lectures including origination of life, diversity in nature and evolution. Students of primary as well as secondary grades attended the session and they showed consistent interest throughout the session. This event was highly appreciated by the students and school administration and teaching staff.

DISCUSSION

Science and technology and their education are very important to improve the conditions of people's lives and also have important impact on cultural development [10]. Understanding the increasing demand of applied science research professionals, NAYS launched its science for youth program in 2011 and successful events were conducted in schools and colleges from all over Pakistan. In the beginning, young researchers were recruited for assigning the responsibilities of expanding science for youth program at provincial level and initially all the province coordinators themselves organized S4Y event in their respective provinces which was a big initiative from them. S4Y program series began with its first activity in Sindh province and the first seminar was arranged in Saint Gregory's High School, Karachi. Students showed keen interest in the topic of discussion which was focused on different arenas of biotechnology. Students were informed how research in applied sciences is contributing to cope with global environmental, food, and health issues. Subsequently, a cascade of activities began in different provinces and all organizers received encouraging responses from students and high school administrations. Student counseling service and information about scientific innovations and advancements in life and health sciences were provided to the students. In one of the S4Y events conducted in Lahore by Syada Samra Jafri, S4Y project coordinator and Syed Hassan Bukhari, ex-province coordinator for Punjab, students were asked questions on different unusual scientific phenomena and their response in this regard showed their potential to pursue a career in the relevant field. Demonstrators encouraged the talent of the students and advice on further information obtainment approaches for their subject of interest was given to them.

CONCLUSION

Our remarkable success has motivated us to expand this project with our diligent team so that quality education will be made accessible to all the individuals who are deprived of it by introducing nontraditional teaching, career counseling and guidance at school and college level. Complete execution of science for youth program at national level is only possible with the cooperation of concerned higher governmental and non-governmental authorities and we look forward to their collaboration in attaining our aim of upturning Pakistan literacy rate by producing skilled research professionals of emerging sciences fields and future science leaders. Pakistan Science Foundation (PSF) promised to support this project in Pakistan.

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