

Role of Physics Community for the Development and Advancement of Physics Education in the Globalization Era

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Abstract

Knowledge of science generally and physics in particular is no longer the prerogative of the practicing scientists or physicists but has to be disseminated to the public. Thus physics education can be expected to play an important role in the era of globalisation. Physics education provides a person with the knowledge and understanding about how the physical world works. The knowledge and skills required by individuals differ, as different individuals need different levels of physics knowledge and skills. The decline in physics enrolment in schools and subsequently in institutions of higher learning has caused a serious shortage of candidates for physics teaching. Subsequently schools have only 4.7 percent teachers with background in physics. The balanced is made up by non-physics option teachers. These non-option physics teachers want to strengthen their physics background knowledge and understanding, and experimental skills. Science teachers and curriculum planners especially at school level are left on their own to conceptualise science and translate to the best of their ability the science curriculum content into classroom activities. Their understanding of what science is depends on what they have learnt from their professors or teachers. The presence of the physics community in the education sector is urgently needed. Physicists are the ones who better understanding of the nature of physics, how to think physics and how to approach physics experiments and problem solving. These aspects of physics make up the culture of physics. Physics societies need to include in their conferences or seminars topics related to the education and training of future physicists, their career development, and ultimately public awareness of physics to ensure a continuous supply of physicists for future needs. What need to be noted is that when teachers interact with physicists, they will sooner or later identify themselves with physics and the physics community. Only then teaching physics becomes more meaningful and satisfying. Teachers can be expected to be more committed to and responsible in teaching physics to their pupils. Physics education has a role in human resource development that a country needs to achieve the nations' developmental goals. There are different levels of physics that are needed by different groups of people. The fact that the system of education could not really overcome the perceptions that physics is difficult dry and dull requires input by the physics community to help inject the kind of excitement that physicists have when they do physics. There are many roles that the physics community can play towards curriculum development, innovating new approaches to physics teaching and learning. Physics societies are invited to give space for physics education in their technical meetings so as to bridge the gap that currently divide the physics community from the physics educators and the public at large.

Keywords: Physics education, Physics community, Globalisation,

1. Introduction

Globalisation can be seen as a process in the internationalization of standards and regulations, promoting global activities particularly in the area of economics and extending into other areas such as in physics, the Physics Olympiads and the INTEL International Science Engineering Fair (ISEF). Coming from outside, globalisation within the context of the free market policy, appears to be an external force coming from the west or the developed countries that will induce developing countries to change the ways we manage our economic activities vis a vis the production and distribution of goods and services and all other related activities. To ensure that we can cope with the demand of international standards and regulations, and at the same time safeguard our national, social and cultural integrity¹⁾, we have to have a knowledge based society and economy. This in turn means that we need skilled and knowledge workers with the capacity for critical, analytical thinking, creativity, innovation and informed decision making. Collectively such potential workers can provide the

country with a strongly motivated labour force comprising of responsible citizens with high moral and ethical values²⁾.

The system of education is closely linked to the supply of S & T human resources. This is an issue in Malaysia as Malaysia has not successfully achieved the desired target of 60:40 sciences to non-science enrolment ratio at the upper secondary level. Such a situation will not make it easy for Malaysia to have 60 researchers per 10000 population by the year 2010. Currently there are 15 researchers per 10000 population³⁾. To address the problem, the second S & T policy aims to increase the national capacity for R & D and technology development by improving the nations' capability of appreciating, acquiring and applying S & T knowledge and skills through education, training and life long learning.

2. Why Physics

Physics is a branch of knowledge about the material world, a common factor that binds physics to economics. In fact the material world is the common factor that binds all types of people cutting across the

different cross sections of the society (Figure 1). Nature provides all the material resources that men (generic term to include women as well) need to live and to manage their living. The man-material interaction cannot be on an ad hoc basis but must be based on some understanding on the properties of matter; how they behave and the laws that they are subjected to. Even man made technologies are not spared of the fundamental properties of the source material used to make these technologies. Further the presence and application of technologies and men's intervention and interaction with the ecosystem bring about changes in the equilibrium and balanced state of the natural ecosystem; often enough changing the parameters for safe living. The new equilibrium state can be comfortable for humankind as technologies available help us manage our lives better in terms of efficiency and speed or it can be distressful if the applications of technologies to development lead to environmental pollution, and health problems. The least that we can do is to ensure that members of society are equipped with the right knowledge, skills and attitudes to manage the physical and technological environment in a conscientiously responsible manner.

Through research activities in physics, our knowledge and understanding of matter continue to expand. The application of such knowledge and understanding of physics lead to the creation of new tools that enable us to further probe the world. We can then explore physical systems that are getting more and more complex⁴⁾. The cycle of knowledge, understanding and probing the world of matter continues endlessly. Not only that, our workplace and everyday living is becoming more technological in character as our markets become flooded with high end technology products.

Since advancement in science and technology is coupled with the deterioration of the ecosystem and greater use of chemicals and technologies that affect our health systems, we therefore need the relevant science or physics knowledge and understanding that can help us understand the physical world around us. This will subsequently enable us to have better control over the applications of science and technologies that affect our lives. We can get the most out of the presence of technologies. We can also manage them better and be able to make informed decisions on public policies involving scientific matters when the need arises. To achieve all these members of society have to be scientifically literate. Knowledge of science generally and physics in particular is no longer the prerogative of the practicing scientists or physicists but has to be disseminated to the public. Thus physics education can be expected to play an important role in the era of globalisation. It is to provide the nation with competent human resources whose potential talents are well developed ensuring them to be wise, creative and productive.

Physics education provides a person with the knowledge and understanding about how the physical world works. Through training in physics one develops within himself/herself the analytical skills required for problem solving and problem management. This is because physics learning is not just about facts but also about the science process. Given the technological

environment that exists in present modern societies, these basic knowledge and skills need to be known by all irrespective of their social standing. However the knowledge and skills required by individuals differ, as different individuals need different levels of physics knowledge and skills. There are physics for the advancement of knowledge, physics for the industry, physics for application in everyday living and physics for appreciation.

We believe that physics education can contribute towards the intellectual growth and development of an individual within the context of globalisation. The understanding of nature normally results in people becoming enthusiastic, amazed and satisfied. Understanding the process of science on the other hand helps people to easily adapt to changes in lifestyle due to the changing technology and the environment. But understanding depends on the type of knowledge content that people have about the technology and the environment. Among members of society there are still people who seek for bomohs' (traditional medicine man) help for various types of problems including physical and social health or on matters related to environmental hazards. Such being the case there is all possibility that this approach towards problem solving will not induce them to look for scientific approach that is based on rationalization and logic. There is therefore a need for serious effort to bridge the gap between the physics community and the system of education.

3. Goals of Physics Education

The goals of physics education are therefore:

- (1) To provide the appropriate education, learning opportunities and facilities so that people are able to acquire the basic concepts, ideas, ability, attitude and habits essential to interact effectively and manage in a sustainable manner the material resources whether in natural, processed or waste forms.
- (2) To establish an environment geared toward the realisation that man-matter interaction brings about causal effect subjected to natural laws. The effect may not all the time be beneficial to humankind or to the environment. The effect is rate dependent on the kind and intensity of intervention and circumstantial conditions. Being educated human kind can make predictions and can exercise regulatory control on their physical environment.
- (3) To promote proper and correct use of technology to ensure safety and that the environment is safe and healthy for the population.

With a brief introduction on globalisation and physics, this paper then discusses issues in physics education, the need for physicists and the role that physicists can play in the development of physics education. It also suggests the strategies that can be adopted and mechanism whereby these strategies can be implemented.

4. Issues in Physics Education

Labels that physics is difficult, dry, dull have remained for many decades. Such perception of physics appears universal. Somehow the traditional system of physics education has not been able to overcome the problem.

Physics performance at O level equivalent national examinations in Malaysia has been for decades comparatively low. A survey was recently conducted by a group of researchers including the author to determine the level of science process skills, the entrepreneurial orientation and the correlation between the two among secondary school science pupils on 953 of the 1000 targeted size sample⁵⁾. These pupils were from the science stream taking physics, biology, chemistry, modern mathematics and additional mathematics. One of the findings was that the pupils were good in modern mathematics, above average in biology, chemistry and additional mathematics but below average in physics. A study by Abu Hassan⁶⁾ on the assessment of basic physics laboratory reported that the approach to laboratory work is traditional in nature. It does not contribute towards conceptual understanding and the development of physics thinking. Another study⁷⁾ on the public awareness of science and technology reported a time series observation for 1996, 1998, 2000 and 2002 that among the four categories of science and technology knowledge on earth, health, man and physics, the lowest score had always been in physics. This phenomenon has probably contributed to a decline in physics enrolment not just in Malaysia but also in other countries like Japan, USA and England.

The decline in physics enrolment in schools and subsequently in institutions of higher learning has caused a serious shortage of candidates for physics teaching. Subsequently schools cannot be supplied with physics option teachers. Instead they are forced to appoint non-physics option teachers to teach physics in schools.

We also conducted a study on the problems of teaching by 516 physics teachers⁸⁾ who stated their background qualifications. Only 4.7 percent had background in physics while the rest were non-physics option teachers. Of these 26% had background in biology, 18.3% general science 13.6% in mathematics and 20.5% in horticulture, engineering, computers, English and geography. The non physics option teachers had learnt some physics when they were in secondary school. About 40 percent of them had at least a secondary level credit in physics.

The study further revealed that 70% of these teachers found 'Waves' and 'Electronic' to be the most difficult physics topics to teach. When these teachers were asked what did they do to prepare themselves to teach physics, 88.9% said they tried to learn the concepts on their own while 72.7% learn about science laboratory such as setting up experiments from the laboratory assistance. Only 32.8% said they look for extra teaching materials either through the Internet or by referring to reference books. Their effort should be commended but there is no certainty that they have the right understanding

and interpretation of what they had read and learnt. What is even uncertain is that these teachers did not experience the spirit of excitement that physicists have when they do physics. Teachers need that kind of spirit so that they appear lively and excited when they teach physics and can arouse their pupils to be interested in the subject matter taught.

These teachers also indicated that they have two types of needs. First they want to learn how to teach physics and second they want to upgrade their understanding of the subject matter. More than 10 percent of the non-option physics teachers want to strengthen their physics background knowledge and understanding, and experimental skills. What is least needed as perceived by these teachers was joining a physics teacher association or following a course either through long distance learning or on-line. We can take note that it is more of physics rather than pedagogy that these teachers are interested in.

With regards to the mechanics of teaching and learning, there are several common problems. As shown in Figure 1 there are three categories of problems related to (i) ability to raise questions, (ii) understanding and being able to explain everyday phenomena and (iii) teaching learning strategies. Ability to raise question is related to the individual's understanding of the goals and objectives of the lesson, topic to be learnt or subject to be mastered. Ability to explain physical phenomena is dependent on one's conceptual understanding of the subject matter that will in turn depend on one's experiences in doing experimental work and applications of knowledge and skills to conduct experiments. Ability to solve problems can in a way determine the strategies.

Regarding issues and problems in science education at the school level, the Malaysian Ministry of Education must be commended for making continuous effort to review and improve the science education curriculum. The latest concept of science education takes care of both the content and the process aspects of science⁹⁾. The general science and physics curriculum have been reviewed and changed several times since Malaysia achieved her independence in 1957. Although the revision in curriculum on the content and process of science, the methodology of instructions in the classrooms has not changed much. The system of education is still examination oriented. The perception that physics is difficult, dry and dull remain in the minds of the pupils, students and public at large unless these individuals are really interested in the subject and have the ability to learn the subject. Such feeling and attitude towards physics remain unchanged till present. As the problems have persisted for so long, this indicates that the formal system of education on the whole has not really succeeded in turning on peoples' interest what more commitment towards and involvement in physics either as a branch of knowledge or as a prerequisite for the pupils' career in the future.

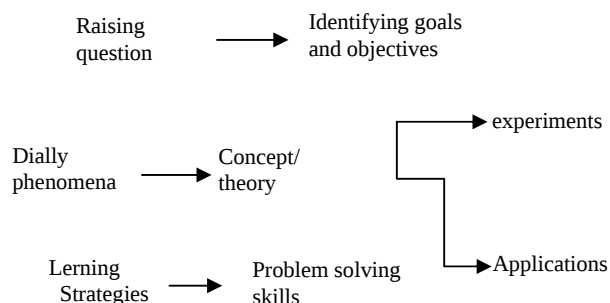


Figure 1: Physics Learning & Teaching Problems

Another issue that has surfaced recently is at the university level. Researchers in basic or fundamental sciences are expected to commercialize their research findings as the country prepares to meet the challenges of the global knowledge economy. Unfortunately most of the researchers concerned are not commercially oriented. It is not that they do not have the potential to do so but it is simply because the traditional form of training that they went through and the experiences that they have accumulated all these while were focused on science as a content of facts and conducting research for the generation of knowledge. Thus they cannot be easily converted to become commercially oriented overnight even though it is desirable that they do so. Scientists need proper training in order to equip them to make the move into commercialization. The process of transforming research findings into commercially marketable products is complex. It involves other areas of expertise and modes of resource management, funds and infrastructures. In fact knowledge on entrepreneurship is a prerequisite for those who want to venture into the commercialisation of research findings.

The problem just raised has implications toward the training of future scientists in general and physicists in particular. It is clear that science and physics curriculum have to be reviewed and revised to meet future needs of the students.

In the meanwhile the government within the national system of governance has recognized S & T as an important tool for development. Furthermore to be globally competitive the economy of the country must be knowledge based. Without doubt that much of the knowledge content will be science, thus the importance of S & T education.

Now the academia is concerned that the award of research grant may be affected by whether their research findings can contribute to the growth and development of the local industry. They are also concerned about the unemployment problem among the graduates of science/physics. Apparently our graduates have the necessary qualifications but lack other soft skills like both oral and written communication and self-confidence. These issues and problems have induced the faculty of science and the physics departments to review the curriculum to include courses that are industrially relevant.

5. Physicists – Public Relationship

The presence of the physics community in the education sector is urgently needed. There are no other people who can express the excitement of doing physics except the physicists themselves. Physicists are the ones who better understanding of the nature of physics, how to think physics and how to approach physics experiments and problem solving. These aspects of physics make up the culture of physics. They directly affect individuals' interest to the subject matter. So when there is an absence of linkage, interaction and communication between scientists/physicists. This creates a gap between scientists and the educators. The consequences are not healthy for the physics community.

The absence of a close association between the physics community and those outside its circle is an outcome of the work culture of scientists that has been developed over the years. The science/physics that we in the developing countries know came to our part of the world through the implantation of western science onto Asian countries during the time of western colonisation. It is now recognized that the western science we have inherited has been very technical oriented. Physics community become very specialised experts among themselves insulated and isolated from the general public at large. Society inclusive of school children in turn get themselves dissociated and detached from the physicists, the associated organisations and hence the culture of science/physics.

Along with that is the transfer of the culture of work that exclude consideration of human related dimensions of science. These are areas related to education, society and popular culture. These dimensions actually make the system of science/physics organic in nature in the sense that the system will automatically make the physics community obligated to consider matters related to regeneration of future scientists, the kind of standards that they should have, their welfare and their survival. It was then be natural for physics societies to include in their conferences or seminars topics related to the education and training of future physicists, their career development, and ultimately public awareness of physics. We bear in mind that the public provides the resource pool of future scientists. If physics turn off the public it will be the physics community that in the long run will suffer. If fact the physics community is now deprived of the number of physics pupils that are needed to ensure that there is a continuous generation of physicists for future needs.

Physicists as a community of scientists are not visible to schoolchildren. At least a well-known local scientist in the country was bold enough to remark that the local scientists are shy and therefore do not feel comfortable being with school children. I do not think that scientists are born shy. Shyness is an acquired personality trait. An understanding on socialisation process has an explanation. It is the traditional training of scientists, which focused on the technical dimension of science that has left its mark in the character development of budding scientists going through such system of education. The traditional science education and training of scientists had

not been comprehensive and holistic. It was unbalanced and confined to the material technical aspects of science. This therefore curtailed the balanced realisation of the totality of human faculties and capabilities¹⁰⁾ needed by scientists to open up to other dimensions of life vis a vis the moral, philosophical, political, economic and religious implications that give meaning and guide people to manage their lives¹¹⁾. Similarly physics educational programs had deprived science students the opportunities to learn, understand and see in context of science and technology matters related to the dynamics of social systems. They subsequently did not develop the social skills that they need to interact and communicate with people outside their own limited social circle.

To worsen the situation parents have fuzzy images of physicists and their scientific activities. Too often parents dissuade their children from doing physics. They feel justified in doing so particularly when they observe that career growth and development in physics is not worth the investment made in physics education and training. Traditional physics education makes a person a good worker but not necessarily develop the human potential to the fullest. Paradoxically there are children who are genuinely interested in physics and want to pursue their studies in physics. These children want to know what physicists are like and what they do. Therefore it is the physicists themselves that have to be role models for these school children.

In the field of education, the work culture of traditionally trained scientists has brought about separation between educators and researchers. Teaching learning problems have always been regarded as pedagogical. Science teachers and curriculum planners especially at school level are left on their own to conceptualise science and translate to the best of their ability the science curriculum content into classroom activities. Their understanding of what science is depends on what they have learnt from their professors if they went to university for their higher education or on their school physics or science at the very least for those who are non-physics option teachers. Educators have organised seminars, conferences, and workshops to understand and solve these teaching learning problems. Often enough these conferences lack subject specialist mentors who can give them guidance and help when they are faced with physics content related problems that teachers face in the cause of their teaching. In the meantime knowledge content of physics school teachers hardly grow with the exponential advancement of physics and related fields unless they on their own read about the subject matter.

6. Bridging the Physics Community and the Educators

We learn from the dynamic social impact theory¹²⁾ that individuals, who share a common social space will share common attributes like shared beliefs and practices that allow them to communicate, interact and influence each other. The truth of such proposition needs to be explored. It is obvious if these individuals have common background level of education, interest and activities as found among members of the physics community. There

are evidences that show the positive effect of experts–pupils interaction.

Last April 2003 MARA Division of Secondary Level Education Malaysia organized for the MARA Junior Colleges a nationwide Budding Scientist Competition for their upper secondary pupils. Several groups of pupils from the biology section who participated in the competition were par excellent in terms of content and presentation of their projects. It was found that these pupils had researchers from research institutes or universities mentoring them. Not only that these pupils had access to the laboratory facilities, and received professional guidance regarding the project they undertook. What this boils down to is that direct interaction between scientists and school pupils through such activities allow school pupils to have better understanding of who scientists are and what experimental science is all about. It is also clear that given the opportunity these pupils are able to emulate the scientists at work. I believe that these experiences leave a long lasting positive impact in the minds of these pupils.

Another example is a collection of letters¹³⁾ from the readers of a popular science magazine, *estidotmy*¹ about the magazine and about their career choices. These readers found the content interesting. They could see the application of science in their lives. They want more information about current development in science and technology. When it comes to a section on career choices, what was found is that there are many children who want to take up careers in astronomy, medicine or marine science etc. Physics as a potential career domain of the children was hardly quoted.

Why were the children's responses likewise can, I think be explained. Dato Prof Dr. Mazlan Othman, an astrophysicist and currently the Director General of the Malaysian National Space Agency (MNSA) has been very active popularizing astronomy among the public. MNSA has its own planetarium (officiated and conducts programs of interest to the public like star gazing, sighting the new moon for the coming or Ramadhan and Syawal, observing the eclipses of both the moon and the sun. These activities are meaningful to the people as there are related to people's everyday life. They leave an impact on peoples' feelings which in turn influence their interest towards the subject matter. More than 40,000 people have visited the planetarium since it was officiated about seven years ago. At this juncture I could not help remembering al-Marhum Pak Parangtopo's (Chairman of Asian Physics Education Network then) remark 'Khalijah, it's feeling that will bring people to physics and not the dry facts of physics'.

¹ This magazine is managed by an editorial at the Amlaysian Academy of Sciences. It has a variety of sections; focus on science, science facts, scientist's world, chait chat with guest scientist, Muslim scientist, science trials, careers in science and readers' corner. The magazine uses both Malay and English as the language of communication. It first went into circulation in February 2002. The magazine meant for school children is very much liked by adults as well. For the moment the magazine is free of charge. It is sponsored by the Ministry of Science, Technology and the Environment and distributed once a month as an insert of a daily newspaper Utusan Melayu. Those interested can visit the website at <http://www.tutor.com.my/tutor/estidotmy/>.

What need to be noted is that when teachers interact with physicists, they will sooner or later identify themselves with physics and the physics community. Only then teaching physics becomes more meaningful and satisfying. Teachers can be expected to be more committed to and responsible in teaching physics to their pupils. Teachers can then align their teaching with the idea of students as scientists rather than as receptacles of facts and information. Teachers feel better prepared and have the confidence that they are well supported. So there is a good chance that they introduce the teaching and learning of *physics* in a manner that is enjoyable, exciting and stimulating while reluctant or poorly qualified teachers can discourage even enthusiastic pupils. (Neuschatz & McFarling, 2000)¹⁴⁾. In turn the physics community particularly those involved with higher education can be better assured that they are going to receive students who are not just academically qualified but culturally prepared to study physics. Over time teachers and practicing physicists can then be expected to share common attributes like shared beliefs and practices that allow them to communicate and transmit the work culture of physics to their pupils. Scientists to reported that they gained valuable perspective and insight into common barriers to learning¹⁵⁾.

7. Scientists' and Physicists' Involvement in Science/Physics Education: Experiences in the West

Despite such effort by educators problems in science teaching and learning persists. Kuhn¹⁶⁾ in *The Structure Of Scientific Revolutions* had said that when existing paradigms can no longer be used to solve existing problems then new paradigms have to be looked into. Until now it is uncommon to find science faculty members at home seriously and actively involved in issues of education. However this situation is slowly changing in developed countries like USA, Europe and Japan. In fact these countries had experienced the problem of declining enrolment two decades ago, earlier than we did. Physicists in these countries have embarked on collaborative research with educators in physics education. They have been given space by their respective department of physics. The effect and impact of having subject specialists researching into teaching learning problems at the various levels of education have definitely bring about changes in perception and classroom approaches towards the content aspect of physics education. Students centred teaching are not mere rhetoric but actually get translated into classroom activities. Instructors see the need to equip their students with cognitive tools and give assignments that promote peer and collaborative learning, etc. Being student centred instructors become concerned about preparing students for their future careers. New subjects like communication and ethics have been introduced into science programs. Thus we see science/physics programs become alive keeping up with needs of time and making the program useful, relevant and desirable.

Scientists/physicists are always excited when they are able to connect their ideas about the physical world to real world explorations. It is this excitement of physics, the intellectual stimulus in physics that the physics

community has which have to be tapped and transferred to the younger generation. It is such excitement that pushes the individuals to want to know more of physics. So the challenge is how can two different groups of people linked by the common bond of physics background whether as researchers in physics, graduates of physics or teachers of physics are brought together? Bringing these two groups of people into proximity will inevitably cause them to interact and communicate thus working towards understanding each other. Hopefully the bond that is created will allow the physics community to at least understand and appreciate the educational issues and problems faced by the physics teachers in particular and the system of education in general. In turn the physicists through their activities can help these teachers to have a better understanding of the epistemology of physics, enhance their practical experimental skills and the current advancement in the knowledge of physics.

Practicing physicists can contribute significantly towards the development of standards in physics education at school level right through university so that continuity of physics content can be assured. Physicists can also help determine the fundamental physics concepts and abilities that all students should know and develop¹⁷⁾ for the various types of needs; appreciation, understanding, application and mastery depending on the level of physics knowledge and skills that these pupils need in their future life.

Physicists can work together with teachers and curriculum developers to identify the essential characteristics of effective physics teaching, the physics curriculum and assessment techniques. Subject experts can help teachers understand more about the mechanisms of physics learning, a process that have been problematic for many pupils. Ability to learn physics rests upon an understanding on how physics information is acquired, processed, structured, stored and applied. With such an understanding teachers can develop new approaches to learning physics effectively. Teachers can also be facilitated to access data and other facilities to help them write textbook, and curriculum developers to include the latest information, achievement and practices in physics. Physicists can play the roles as advocator, resources, partner, or role models for budding physicists.

Other roles that can be played by the physicists include making school visits, or conduct single lessons. Through such roles pupils learn about how physicists develop and use their talents, time, and interests. They can provide pupils with real world exploration in physics. Physicists at college level can also develop collaborative research projects with members of the faculty of education or work together with science centres on constructions of museum exhibits.

There are different types of involvement for the physicists: at school level, in service teachers program, school of education, systemic change, educational materials development and informal education (*Figure 2*)

Formal education	Informal Education	Public outreach	Brochures Press Releases
Links to systemic reform	Museum exhibits And programs	Educational TV	
Educator workshops	Planetarium shows	Radio programs	Public relations Media relations
Secondary school program	Youth programs	webcast	
Distance learning courses	IMAX Films	Popular science Articles in magazines	Posters, video clips

Sample of EPO products and services Source: Scientist Involvement in Education and Public Outreach

Figure 2: Formal/informal/public outreach

8. Conclusion

Globalisation is a force that cannot be ignored by developing nations if we are to ensure our survival in this century. Physics education has a role in human resource development that a country needs to achieve the nations' developmental goals. The state of physics education at school and at institutions of higher level is not suited for meet the needs of the future human resources. There are different levels of physics that are needed by different groups of people. The fact that the system of education could not really overcome the perceptions that physics is difficult dry and dull requires input by the physics community to help inject the kind of excitement that physicists have when they do physics. There are many roles that the physics community can play towards curriculum development, innovating new approaches to physics teaching and learning. Physics societies are invited to give space for physics education in their technical meetings so as to bridge the gap that currently divide the physics community from the physics educators and the public at large.

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