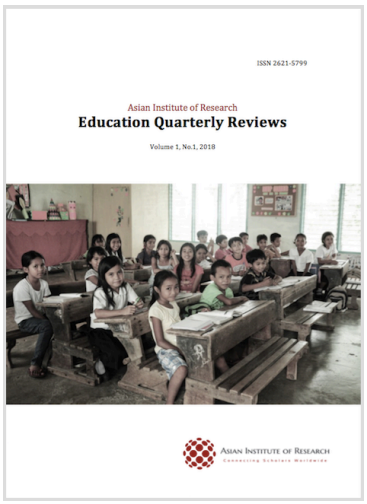

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Public Engagement: Talking Science to Laypersons as Perceived by Postgraduate Students in Jordan

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Abstract
This study aimed at investigating how and why to engage laypersons with science as perceived by postgraduate students in Jordan. A questionnaire consisted of (24) items, with 5 point Likert-Scale was used after conducting the validity and reliability of the questionnaire. Findings showed that the respondents showed positive perception towards engaging laypersons in science as it is vital for their daily life and using technology properly, and the importance of using layperson knowledge in communicating with them. Finally scientists need practice and knowledge to communicate with laypersons.

Introduction

Long time ago science just used logical thinking; hands-on activities were not allowed. Scientists suffered and faced challenging times in their life, with many jailed and others killed. It was Thomas Bacon (1561-1622) who started talking about the practical aspect of science. He used his power during his work in the royal palace of the king at the time, and was very brave to mention hands-on activities. We can say that science was created in the elbows of scientists. Science is defined as knowledge and process. Knowledge is the concepts, facts, laws, principles and theories, while process is the basic and integrated science process skills, such as observing, predicting, operational definitions etc. Technology is the product of science, so science produces technology, while technology produces new scientific knowledge.

The main aim of science should be to improve, protect, and change the quality of human life, rather than destroy or degrade it. The rapid development of science could cause some threats to human life. Products of science could cause some kind of dangers to the people, but it is possible that some of these problems could have been avoided if lay people had been involved in the science and its application. This does not mean that science has improved human life.

Science and its application is *of* people, *by* people and *for* people (Bakuwa, 2014). There is a need for people to understand science to a certain depth not as scientists themselves. People

need to know the ways of selecting choices (*Merz,Fischhoff ,Mazur, &Fischbeck (1993)*). That knowledge might include just estimates of some outcomes (e.g., amount of farm products, health costs). Or, it might require enough knowledge to understand why the experts make those estimates (*Bruine , Bruine , and Bostrom (2013*). Knowing that science allow members of the public to follow future improvement in the products of science. (Lupia , *2013*, Reyna *2012).*

This means that human will be the users of science and producer of science products (technology). A long time ago scientific experts carried out the development of science, such as engineers and technologists, while society was at the receiving end. It is important for everyone, but the general public lack an understanding of different parts of knowledge such as (concepts, scientific facts, and scientific theories) and the real methodology used by scientists.

Background of the Study

There is a real gap in the understanding of what most scientists do, and how their work relates to the real world, as seen from the perspective of the lay person. It is of great value that scientists should communicate the importance and value of their work to the community. This is an art that needs to be practiced, as scientists need to avoid technical details in order to summarize the body of their research in a very short time. So this study came to elucidate why and how to communicate with laypersons as perceived by postgraduate students at Jordan.

Study Objectives

This study aimed at investigating the following questions:

a) Why scientists should interact with lay people and the public as perceived by postgraduate students?
b) How to communicate with lay people and the public as perceived by postgraduate students?

Literature Review

In 1995 Carl Sagan (1934-1996) as cited in (Bakuwa, 2014). Said that “We've arranged a global civilization in which the most crucial elements…profoundly depend on science and technology. We have also arranged things so that almost no one understands science and technology. This is a prescription for disaster. We might get away with it for a while, but sooner or later this combustible mixture of ignorance and power is going to blow up in our faces”.

A study by the “Pew Research Center” in the USA showed that 87% of 3748 American–based scientists connected to the “AAAS” agreed with the statement that “Scientists should take an active role in public debates about the importance of science and technology”. Only 13%

supported the opposite statement that "Scientists should focus on establishing sound scientific facts and stay out of public policy debates".

AAAS, Project 2061, and Science for All Americans: "The life enhancing potential of science and technology cannot be realized unless the public in general comes to understand science, mathematics, and technology and to acquire scientific habits of mind; without a scientifically literate population, the outlook for a better world is not promising, but most Americans are not scientifically literate. …The United States should be able to do better."

Science is a vital way in representing the nature of science (Irwin & Wynne, 1996). The real argument for understanding science is clearly presented by the United Kingdom's Royal Society Report (1985)—also known as the Bodmer Report—which states that: "…better public understanding of science can be a major element in promoting national prosperity, in raising the quality of public and private decision-making and in enriching the life of the individual…Improving the public understanding of science is an investment in the future, not a luxury to be indulged in if and when resources allow" (The Royal Society, 1985: 9). Analysis and identifying are the few scientific results that people need to know among the scientific knowledge that it would be important to know (von Winterfeldt , 2013, Raiffa 1968)). Scientists should start with the most valuable fact and then their benefits. (Kahneman (2011). Although one can formalize such analyses (Merz, Fischhoff, Mazur And Fischbeck, 1993; von Winterfeldt ,2013; and Raiffa 1968), in fact the matters that are important to scientists are also important to public. (Dietz ,2013; Schwartz and Woloshin , 2013; Raiffa, 1968; Lupia, 2013; Von Winterfeldt. 2013).

Research Methodology:

Sample of the study: (128) of the postgraduate students at Yarmouk University were selected and answered the questionnaire

Instruments: A questionnaire was developed, it has 25 statements following 5 points-scale Likert scale, (strongly agree, agree, neutral, disagree and strongly disagree), were divided into two main domains (Why to interact with laypersons and how to interact with the laypersons), validity and reliability were conducted using face and content validity, while cronbach-α for internal consistency was calculated and it was (0.83).

Findings and Discussion:

The results and discussion will be presented according to the sequence of the objectives as follows:

Findings and discussion of Objective 1: Why scientists should interact with lay people and the public as perceived by postgraduate students?

Table (1): Means and standard deviations of postgraduate student's responses on why to engage laypersons with science

Domain	Statements	Means	Standard deviations
Why to engage laypersons with science	I believe that science engagement with laypeople will improve their daily life	3.68	0.82
	I believe that science engagement with laypeople will help them to use technology easily	3.68	0.74
	I believe that science engagement with laypeople will help them solve problems they face in their daily life	3.73	0.74
	I believe that science engagement with laypeople will help them to understand the value of science	3.67	1.06
	I believe that science engagement with laypeople will help them use tools and equipment in their daily life	3.64	1.18
	I believe that science engagement with laypeople will help them communicate with their neighbors and friends	3.51	1.01
	I believe that science engagement with laypeople will help them change their values and attitudes towards science	3.51	1.o2
	I believe that science engagement with laypeople will Improve their health	3.51	0.88
	I believe that science engagement with laypeople will Improve their critical thinking	3.47	0.95
	I believe that science engagement with laypeople will Improve their trust in new technology	3.45	0.99
	I believe that science engagement with laypeople will Improve their trust in natural phenomena	3.44	1.08
	I believe that science engagement with laypeople will Improve their trust in the new inventions	3.42	0.89
	Total	3.56	1.03

***highest value 5.0**

As shown in Table (1) the means of postgraduate responses came between 3.86 and 3.42, out of 5 or 73.6%-69.0% and overall percentage of 71.2%. Lay persons should be able to understand the basics of science to make correct decisions. Because science communication seeks to inform decision making, it must listen to the people, to identify the problems that its members face—and, the information they need. While science education begins by hearing to scientists and learning the facts that they wish to present, Klahr (*2013)*. One of the examples of the negative consequences of poor communication between scientists and the laypersons is the issue of climate change. (Somerville and Hassol, 2011). Some studies (Wynne 1989, 1991, 1996; Irwin and Wynne, 1995) have demonstrated knowledge that complements that of science experts. For example, Wynne (1989), in his study of the relationship between the Ministry of Agriculture and Fisheries (MAF) and Cumbrian sheep farmers after the Chernobyl disaster, found that sheep farmers knew more about the effect of radioactivity on their local environment and sheep farming than scientists. Wynne (1989, 1991) argues that scientists should not show that they knew everything, and concentrating on the layperson ignorance of science, but that they should learn from the public, culture, and people's

experience. In Jordan as an example some farmers have better knowledge about olive trees than some agriculture engineers, as they deal with these trees as their babies, from sawing them till they grow up. It is clear that it is important to engage laypersons with science as it is important in their daily life, using and trust in technology, and help them to in problem solving.

Findings and discussion of Objective 2: How to communicate with lay people and the public as perceived by postgraduate students?

Table (2): Means and standard deviations of postgraduate student's responses on how to engage laypersons with science

Domain	Statements	Means	Standard deviations
How to engage lay-person with science	I believe that scientist should use simple and clear words	3.45	0.83
	I believe that scientist should use their students and assistants to interact with laypeople	3.44	0.96
	I believe that scientist should Be close and build good relations with laypersons	3.43	1.29
	I believe that scientist should not go deeply in scientific explanations	3.4	1.12
	I believe that scientist should Use social media to explain scientific concepts	3.25	1.03
	I believe that scientist should Use newspapers and media to explain scientific concepts	3.2	1.17
	I believe that scientist should Use lectures and seminars	3.2	1.05
	I believe that scientist should dialogues and metaphors	3.19	1.02
	I believe that scientist should Cooperate with other scientists all over the world	3.17	1.07
	I believe that scientist should Use journals and stories	3.13	1.00
	I believe that scientist should use Science fictions	3.11	1.18
	I believe that scientist should use Conferences and symposiums	2.95	1.16
	Total	3.24	1.16

***highest value 5.0**

Table (2) shows that the perception of postgraduate students range from 3.45 to 2.95 out of 5, with average percentage of 64.8%. Communication to a lay person audience is difficult. Scientists should know how to communicate, meanwhile communication is not an easy process especially with lay people. Some scientific ideas are too complicated so to present and communicate with laypersons becomes too difficult. Real communication skills need extensive training and practice in order to communicate to lay people. It is clear as perceived by postgraduate scientists should use different strategies and ways to communicate with laypersons as follows:

a) Simplify (break down the concept): It is a real mistake when scientist's breakdown the concept to layperson and oversimplify it. Also the overestimation of their knowledge can leave them confused and form misconceptions among them.
b) Follow the funnel model: This means to start from broad concept then go down to narrow concept. This way you will increase the layperson attention to the subject you are going to describe. Finally make conclusion of your results.
c) Storytelling: Storytelling in science is the best way for layperson attention to science subjects. Analogies or metaphors will allow layperson to engage with your scientific ideas.
d) Use friends/family and your neighbors to your advantage: practice your spiel on family members or friends and take their feedback. Give your attention to what they face difficulty to understand and try to tailor your story according to their knowledge. Alternatively, sometimes you need to use text and drawings to explain some scientific ideas.
e) Speaking to the media: Scientists must speak with the media and the key points to remember:
   Be confident, because you are the high knowledgeable person.
   Say no if you are not sure of the scientific concept.
   Reflect on what you want (or do not want) to be on record days, months or years later, and use that as a filter.
f) Social media. can be tricky, but on balance it is good for science communication, as long as you are able to deal with.
g) Don't turn your nose up at laypersons who choose to take their knowledge beyond journals or conferences. Current and future challenges: As much as we understand the current and future challenges associated with our changing life, it is a struggle for many layperson to see beyond simple scientific concept which affecting their daily life. The science communicator must keep this in mind and find ways to relate the message to the core values of the layperson.

Conclusion

Communications are useful if they reach people with the information they need and they can use. This requires collaboration between scientists with subject matter knowledge to communicate and scientists with expertise in communication processes—along with laypersons. Such collaboration affords the sciences the best chance to tell their stories It is clear that there is no doubt about the importance of communicating with laypersons, and communicating with them is not an easy it needs experience and special skills of communication in addition of using different strategies, methods in communicating with them. Companies should play an effective role in social responsibility. Train scientists in how to communicate with laypeople. Universities and colleges should also train scientists on how to communicate with laypeople.

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