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Awareness of Libyan Students and Academic Staff Members of Nanotechnology

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ABSTRACT

At the present time, nanotechnology is involved in every aspect of scientific life and its applications are being integrated into the economy, industry, trade and medicine. The world will require a skilled work force of more than two million nanotechnologists by 2015. The rapid advance in all fields of nanotechnology has led to integrate nanotechnology courses in high schools, institutes and university curricula all over the world. However, nanotechnology has not as, yet been integrated within the Libyan curricula at any level. Thus, this study focuses and explores the awareness of the academic staff and students in Tripoli (Alfateh) University about nanotechnology and nanoscience. Moreover their readiness to integrate the basics and applications into Libyan education curricula. The results show that education level and work place have an effect on the knowledge of the participants on nanotechnology, where about 65% of PhD degree holders knew about nanotechnology and were keen to learn and integrate this technology in the education system. Around 40 % of the participants' information about Nanotechnology were gained from the internet while only 17% had obtained information from their own readings. The majority of the participants (60%) supported the idea of introducing nanotechnology studies to the curricula at pre-graduate stage. However, 29% believed that it should be integrated only in postgraduate studies, and only a few of the participants (11.3%) advised that a continuing education program would be the proper way to study nanotechnology. This study showed that relatively little awareness about nanotechnology is seen among Libyan staff members and students. However, the majority of the participants have realized the importance of the field of nanotechnology and its application, and were eager to learn more about this advanced technology. Based on the preliminary study regarding the opinion and readiness of participants of the current study, it is believed that the integration of nanotechnology and nanosciences in Libyan curricula at different levels of education is an inevitable step to meet the very rapid advances in the field of nanotechnology and its applications.

INTRODUCTION

The advancement of nanoscience and nanotechnology is leading to a technological revolution in human life; the advances have had a significant qualitative impact on science (Kumar S et al., 2014, Malsch, 2008, Wacker, 2014). Nanotechnology application has enormous potential to greatly influence the world in which we live. From consumer goods, electronics, computers, information and biotechnology, to aerospace defense, energy, environment, and medicine, all sectors of the economy are to be profoundly influenced by nanoscience and nanotechnology (Luciano Kay and Philip Shapira, 2009, Mahbub Uddin and A. Raj Chowdhury, 2001). Education in nanoscience and nanotechnology has grown rapidly in recent years, especially when this field has provided numerous scientific and technological breakthroughs. The field has also, in some sense, changed the way in which a research topic can be tackled, unconstrained by traditional scientific disciplines. However, questions to be asked include what effect developments in research and applications in different aspects of life have had on the curriculum being taught in universities and education.

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It focused on what sort of education can nanotechnology offer in the future and the need to develop professional nanotechnologists. Nanotechnology and nanoscience is interdisciplinary, and can be taught throughout most relevant modules including physics, chemistry, biology, engineering, material sciences, medicine and pharmaceutics. The inclusion of main aspects of nanotechnology in educational hours may address, for example, the physical world of size, force, properties and time. Furthermore, it could address the dimensional aspects of nanostructure, one-dimensional space like thin film, two-dimensional space like nanotubes or three-dimensional space like quantum dots (Asmatulu and Misak, 2011, Luisa Filipponi and Duncan Sutherland, 2012).

Efforts to expose nanotechnology to the public in many places around the world demonstrated that nanotechnology is not a term most individuals are familiar with nor can most people define or imagine it (Sheetz et al., 2005).

In this paper, the current status of nanotechnology awareness and education is discussed. The need to raise public and professional awareness of nanotechnology has been assessed in a number of studies (Batt et al., 2008, Craig Cormick, 2009). However, none of these studies probed the knowledge of nanotechnology education at Libyan universities and among academic staff. Therefore, the challenge of the current study is to raise the minimal level of awareness of nanotechnology applications, and moreover to raise the awareness of creating educational programs and studies focused on the basics and applications of nanotechnology.

Methodology and data management

The methodology used in this study was the distribution of a study sample survey which was collected randomly from many campuses of Tripoli University (Alfateh), and two governmental research centers (polymer and plastic) in Tripoli over a period of about five months (March – July). The questionnaire aims to measure public awareness about this branch of science and technology. The overall questions asked have been analyzed statistically using software program SPSS (VOL.10, 11) which delivers accurate results of descriptive and hypothetic analysis in short time.

Descriptive Analysis

The study sample consists of 330 participants selected randomly. Of these, 145 were employed and the rest were students, and from this study sample 156 (47.27%) knew about nanotechnology and 174 (52.72%) did not. The first part of the questionnaire included general questions that specify the characteristics of study sample such as educational degree, occupation, place of work or study, experience, etc.

Nanotechnology aware and level of education

Figure (1) shows participants level of education and their awareness of nanotechnology. The classifications of educational background were Bachelor degree, postgraduate diploma, Master studies, PhD holders and others.

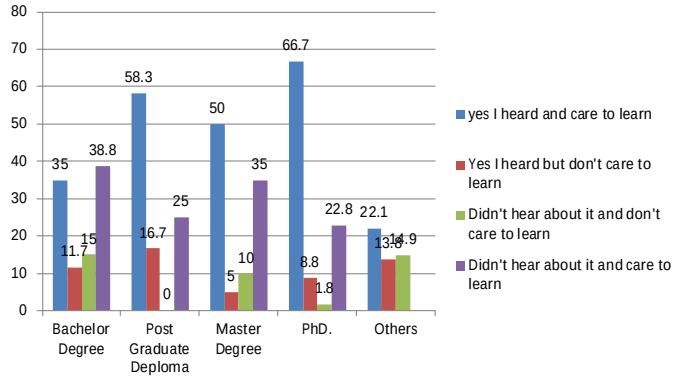

Fig. 1: The participants' level of education and their awareness of nanotechnology based on educational classification including Bachelor degree, postgraduate diploma, master studies, PhD holders and others.

Nanotechnology / work place

Figure (2) shows the participants institutional work place and their awareness level and knowledge about nanotechnology. The workplace included governmental research centers, faculty of medical sciences, Faculty of Engineering, Faculty of Applied Sciences and Faculty of Human Sciences at Tripoli (Alfateh) University.

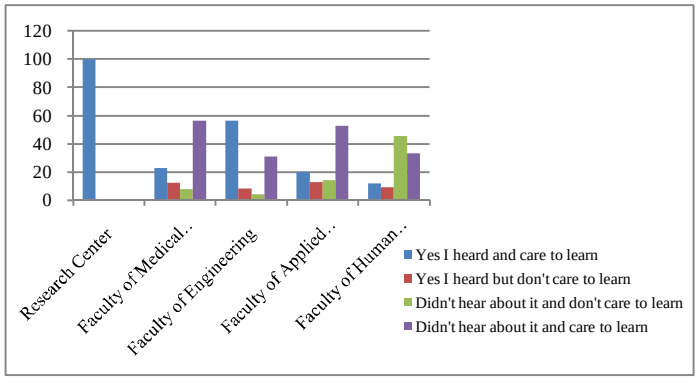

Fig. 2: The participant's institutional work place and their aware level and knowledge about nanotechnology. NOTE: add "more" to each legend entry.

Nanotechnology and years of work experience

Figure (3) shows the participants' level of experience and the number of years they spent at their work, and the relation between their knowledge of nanotechnology and their years of experience.

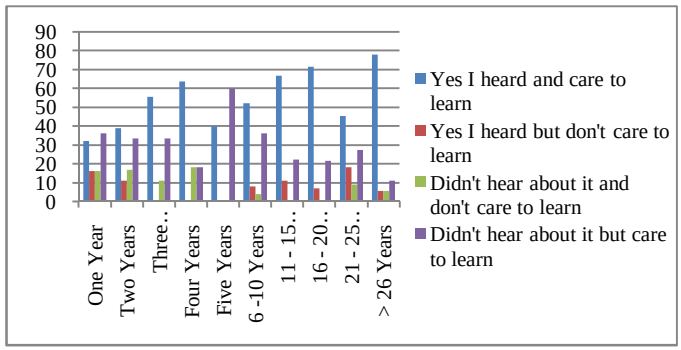

Fig. 3: The participant's experiences and how many years they spent in the workforce and their awareness of nanotechnology based on their years of experience.

Nanotechnology impact of work nature or study field

Figure (4) shows the participants' awareness of nanotechnology depending on the impact of their work nature or study field and their interest to learn it.

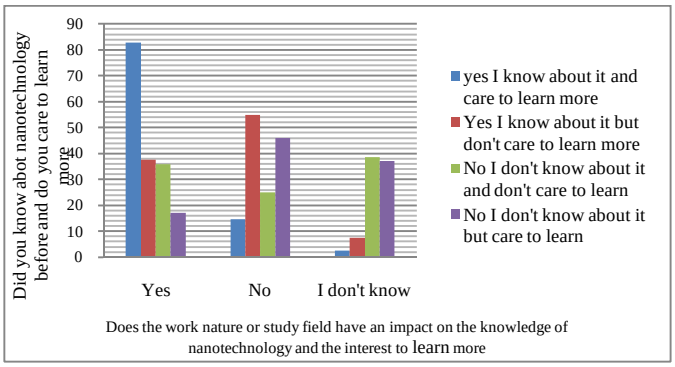

Fig. 4: The participants' awareness of nanotechnology depending on the impact of their work nature or study field and their interest to learn it.

Nanotechnology information sources

Figure (5) shows the participants own their source of information / education about nanotechnology. These sources could be scientific journals, conference papers, TV programs, academic studies, and internet among others.

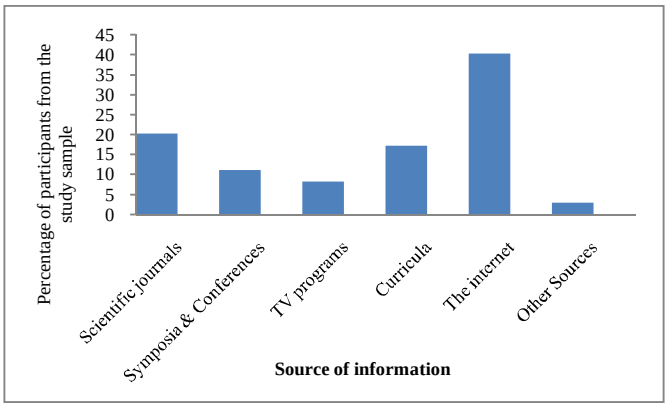

Fig. 5: The participants' source of information / education about nanotechnology.

Difficulties in obtaining information on nanotechnology

Figure (6) shows the participants opinion on whether or not they faced difficulties accessing additional information, knowledge and news on this technology or its application.

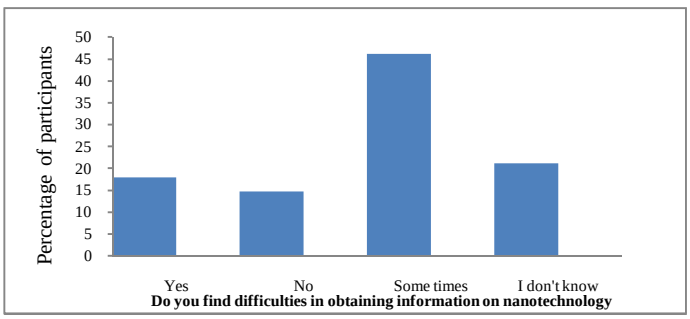

Fig. 6: The participants opinions whether they faced difficulties to access further information, knowledge and news on this technology or its application.

Nanotechnology education preferred stage

Figure (7) shows the preferred education stage of participants' opinions and recommendations about integration of teaching and learning of nanotechnology in the educational system. The teaching levels were undergraduate, Master and PhD studies.

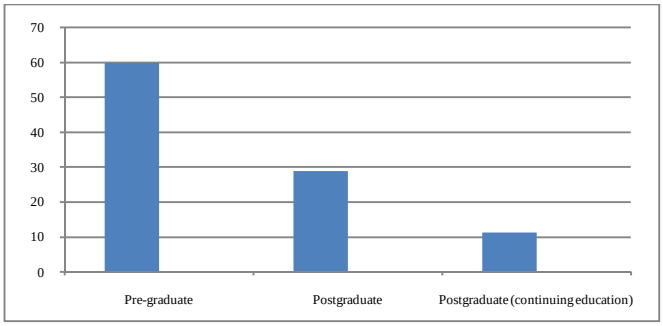

Fig. 7: The preferred educational stage of participant's opinions and recommendations about integration of teaching and learning of nanotechnology in the educational system.

Participants open opinions for prerequisites for introducing nanotechnology

Figure (8) shows the participants open question opinion in the study about the prerequisites foundation, skills and role of the media in promoting and circulating information about nanotechnology and its impact on the community.

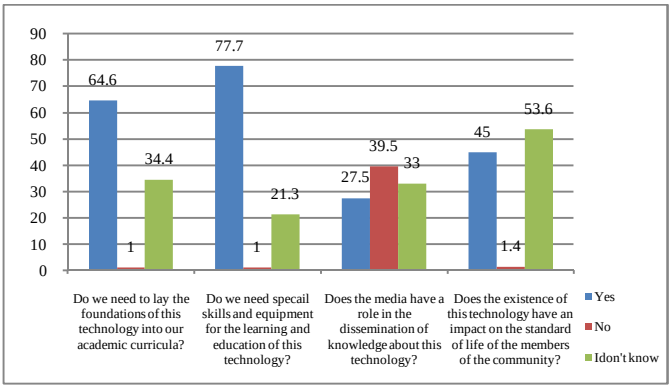

Fig. 8: The participants open question opinion in the study about the prerequisites foundation, skills and role of the media to introduce and circulate information about nanotechnology and its impact on the community.

DISCUSSION

The effort to comprehend the respondent's opinion and recommendation about the actual need for nanotechnology education and awareness was not easy. In addition, explaining the concept of nanotechnology and the instilling the ability to imagine the actual size of nanometer as one billionth of a meter were also not easy (Wei-xian Zhang, 2003). The questionnaire conducted for this study were all done in Libyan university, and while the general education level is considered high, lack of familiarity with the field of nanotechnology is significantly obvious . The higher the education level the greater the knowledge of nanotechnology and the greater the willingness to learn more about. The majority,

or 66.7% of PhD holders in the study sample, knew about nanotechnology and were keen to learn more where only 35% of Bachelor degree holders knew about it and cared to learn more.

Knowledge of nanotechnology varies among university staff members. Only 56.3% of Faculty of engineering members knew about nanotechnology and cared to learn more, followed by 23% in Faculty of Medical Science, 20% in the Faculty of Applied Sciences and 12.1% in the Faculty of Human Science.

The number of years of work experience is reflected in a higher knowledge and awareness of nanotechnology and increased interest in learning more about it. The majority of the participants 82.8% knew about this technology and were interested to learn more and the nature of their which has an impact on their knowledge about nanotechnology.

The majority of the participants 40.25% obtained their information from the internet, 20.25% obtained it from scientific journals, and only 17.25% of the participant obtained their information on nanotechnology during the course of their studies. However, 8.25% had obtained it from TV programs.

The respondents referred to difficulties when looking for more information about nanotechnology. 17.9% of the participants always faced difficulties, where the majority 46.2%, sometimes faced difficulties in obtaining nanotechnology and its application knowledge. The respondents from medical science 32.25% sometimes faced difficulties in obtaining information where 19.35% always did. The majority of participants from engineering and applied science sometimes faced difficulties in obtaining information.

To remedy the lack of accessibility of information is not only the responsibility of individual people. Rather, it is a collective strategy involving scientists, academic staff, higher education authorities and the community.

The majority of the participants 60% strongly supported the idea of introducing nanotechnology studies to the curricula at pre-graduate stage (Undergraduate). However, 29% believed that nanotechnology studies should be integrated only in post-graduate studies, and only a few of the participants about 11.3% advised that a continuing education program would be the proper way to study Nanotechnology and Nanoscience as it not an easy branch to study.

Nanotechnology education programs can be implemented at all these stages of education, as nanotechnology programs have even been designed for the high school level (Chow L and Chia Sung, 2011).

Many of the participants (64.6%) agreed with the need to lay a foundation for programs of this technology into our academic curricula, and 77.7% commented on the need for special skills and equipment for the teaching and learning of nanotechnology. Only 27.5% of participants thought that the Media has a role in dissemination of knowledge about nanotechnology, and a good percentage of the participants, 45%, were confident that nanotechnology has an impact on the standards of life of the members of the community (Auplat, 2012). Nanotechnologies are projected to have at least a $ 3 trillion impact on the global economy by 2020 .

Nanotechnology education is being offered by a large number of universities around the world in Bachelor, Master and PhD studies as presented in table 1. Generally, nanotechnology education involves a multidisciplinary natural science education with courses in nanotechnology, physics, chemistry, math and molecular biology (Joachim, 2004) in addition to a diversity of higher education philosophy value and learning. Nanotechnology is a growing aspect of virtually every industry, is integrated strongly with the global economy and has a profound influence on the lives of people in the 21st century.

Table. 1: Examples of Nanotechnology and Nanoscience Teaching Programs by the UK based Institute of Nanotechnology (Auplat, 2012).

University	Education level	Country
University of Antwerp	PG	Belgium
Technical University of Ostrava	UG	Czech Republic
University of Aarhus	UG - PG	Denmark
Grenoble Institute of Technology	PG	France
University of Elangen-Nuremberg	UG - PG	Germany
National Technical University of Athens	PG	Greece
University of Venice	PG	Italy
Leiden University	PG	Netherlands
Norwegian University of Science and Technology	UG - PG	Norway
Jagiellonian University	UG - PG	Poland
Lund University	UG - PG	Sweden
University of Basel	UG - PG	Switzerland
University of Leeds	UG - PG	UK
Istanbul Technical University	PG	Turkey
Rice University	PG - UG	USA
University of Melbourne	PG	Australia
Massey University	UG	New Zealand
University Alberta	UG	Canada
SRM University	UG – PG	India
Hong Kong University of Science and Technology	PG	Hong Kong
National University of Singapore	UG	Singapore
Chulalongkorn University	UG	Thailand
Malaysia Multimedia University	UG	Malaysia
University of Electro-Communications	PG	Japan
Nile University	PG	Egypt
Universidade Federal do Rio de Janeiro	UG - PG	Brazil
Instituto Nacional de Astrofisica	PG	Mexico

CONCLUSION

Enhancement in the awareness of nanotechnology in the Libyan university community has generally attracted little attention. However, many display a favorable attitude towards nanotechnology and in the near future dream of incorporating it into the Libyan undergraduate and postgraduate curriculum and education.

Research centers, higher education authorities and university bodies should foster collaboration among themselves and work in the short term to plan strategies to create nanotechnology courses.

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