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PENDIDIKAN DAN APLIKASI NANOTEKNOLOGI DALAM KEHIDUPAN TERHADAP SISWA SEKOLAH MENENGAH ATAS

NANOTECHNOLOGY EDUCATION AND APLICATION IN LIFE TOWARDS HIGH SCHOOL STUDENTS

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Abstrak

Salah satu dari tiga pilar pendidikan tinggi atau tridharma di Indonesia adalah pengabdian kepada masyarakat bagi sivitas akademika untuk melatih inovasi dan teknologi yang ditunjukkan dengan kemampuannya dan memberikan manfaat bagi banyak orang. Untuk itu, dosen Departemen Teknik Nanoteknologi, Fakultas Teknologi Maju dan Multidisiplin, Universitas Airlangga Surabaya mengadakan program pengabdian masyarakat yang diberi nama "Penerapan Nanoteknologi dalam Kehidupan: Pendidikan pada Siswa SMA" yang bertujuan untuk menyebarluaskan pengetahuan dan informasi tentang nanoteknologi khususnya untuk siswa sekolah menengah. Sebagai inovasi dan teknologi terkini, nanoteknologi masih belum populer di kalangan pelajar SMA di Indonesia. Dengan demikian, pengabdian masyarakat ini juga diharapkan dapat meningkatkan dan menyeimbangkan pengetahuan masyarakat serta mendukung tujuan ke-4 Sustainable Development Goals (SDGs) untuk pendidikan berkualitas yang dilakukan secara online saat ini. Kegiatan tersebut diikuti oleh 129 peserta dari sekolah mitra (SMAN 1 Sidoarjo, SMAN 1 Pamekasan dan SMAN 1 Trenggalek) dan beberapa peserta dari sekolah nonmitra di Jawa Timur. Webinar ini dilakukan dengan mengklarifikasi penggunaan nanoteknologi dalam kehidupan sehari-hari serta contoh-contoh nanopartikel emas yang disintesis baik secara kimiawi maupun biologis. Perluasan dan transfer pengetahuan berhasil ditunjukkan dengan rata-rata skor post-test (68) meningkat berbanding terbalik dengan skor pre-test (54). Kegiatan ini juga diharapkan dapat meningkatkan pengetahuan mahasiswa tentang perkembangan teknologi terkini dan minat mahasiswa terhadap ilmu pengetahuan dan teknologi sehingga nanoteknologi dapat digunakan untuk memecahkan masalah yang ada di Indonesia.
Kata kunci: pengabdian masyarakat, Sustainable Development Goals, pendidikan berkualitas, nanoteknologi dan aplikasi, webinar.

Abstract

One of the three pillars of higher education or *tridharma* in Indonesia is community service for academic community to rehearse their innovation and technology as indicated by their capacity and provide benefits to many. To this sense, lecturers from the Department of Nanotechnology Engineering, Faculty of Advanced Technology and Multidiscipline, Universitas Airlangga Surabaya conducted a community service program named "The Application of Nanotechnology in Life: Education to High School Students" which aimed to disseminate knowledge and information about nanotechnology particularly to secondary school students. As the most recent innovation and technology, nanotechnology was still being unpopular amongst high school students in Indonesia. Thus, this community service was also expected to increase and balance public knowledge and to support the 4th goal of Sustainable Development Goals (SDGs) for a quality education that conducted online nowadays. The activity was attended by 129 participants from partner schools (SMAN 1 Sidoarjo, SMAN 1

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Pamekasan and SMAN 1 Trenggalek) and several participants from non-partner schools in East Java. This webinar was conducted by clarifying the use of nanotechnology in daily basis as well as the example of gold nanoparticles synthesized both chemically and biologically. The expansion and transfer of knowledge were successful showing by the average of post-test score (68) increased contrasted with the pre-test score (54). This activity was also expected to improve students' knowledge on the latest technological development and students' interest in science and technology so nanotechnology could be used to solve problem existing in Indonesia.
Keywords: community service, Sustainable Development Goals, quality education, nanotechnology and application, webinar

INTRODUCTION

This current worldwide circumstance has arisen into the modern transformation alleged as industry 4.0 in which the cutting-edge technology enacts to overcome issued in different areas. Few instances of industrial technologies 4.0 are artificial intelligence, robot, Internet of Thing (IoT), Big Data, Cloud, cybersecurity, drone, Global Positioning System (GPS), sensor technology and nanotechnology (Maynard, 2015; Bai *et al.*, 2020). Preceding 2012, the idea of revolution industry 4.0 was firmly entitled for the turn of the nanotechnology development and utilixation (Liao *et al.*, 2018). Until today, nanotechnology is considered as one example of rapid development in modern interaction that are applicable to a few other industrial technology 4.0, for example, 3D printing, sensor technology, and robot (Delloite, 2015).

Nanotechnology is a technology based on nanomaterials which like wisely can be characterized as science, design, syntactical manufacture, manipulation, and utilization of functional material, device, or system of a nanometre-scaled (1-100 nm) substance (Salamanca-Buentello *et al.*, 2005). According to Bai, *et al.* (2020), nanotechnology is the most suitable industrial technology 4.0 in working on a sustainable industry. This notion appeared as a result of nanotechnology development in the bioplastic field and composite that can reduce the consumption of fuel and carbon dioxide emissions (Bai *et al.*, 2020).

Besides, nanotechnology is additionally another advancement technology that rapidly fills in a few field of application like energy, electronic, cosmetic, textile, medicine, agriculture and environment (Rai and Rai, 2015; Nasrollahzadeh, M., Sajadi, S.M., Sajjadi, M., Issaabadi, 2019). Several examples of nanotechnology usage could be found in nowadays daily basis among people including the use of sunblock, sunscreen, thermal clothing, and artificial fertilizer. However, nanoscience and its application are not commonly known by public, especially in Indonesia, caused by few challenges as follow; (41%) limited information, (32%) lack of technology, and (11%) absence of human resource (Rochman, 2008; Muhammadi, 2020). Therefore, the introduction of nanotechnology to public straightforwardly is fundamental considering that nanotechnology can possibly solve problems in Indonesia like obtaining purified water, waste, pollution, and energy. The maximum use of nanotechnology is also expected to raise the utilization of natural resources and economic interest in Indonesia.

Up to the present, nanotechnology has only been accessed and known by college students. There was not much nanotechnology learning and socialization undertaken in the field of school education like middle and high schools (Harta, 2017). Teachers' lack of approach and information on nanotechnology was the key reason of uneven dissemination of nanotechnology which become a challenge in this revolution industry 4.0 too. Various attempts have been made by teachers and schools to introduce nanotechnology to students in the form of independent study and nanotechnology study group which has not been executed by many other schools. They were found to be schools from Semarang and Yogyakarta and presented

nanotechnology through the approach of chemistry and subject at school (Aji, 2016; Harta, 2017; Siemeister *et al.*, 2019; Samuji, 2020).

The urgency of nanotechnology as the future technological development is in the contrary situation where less information on nanotechnology was given in the school education level. It turns into a major issue so education and socialization of nanotechnology to secondary school students could fix this problem. The learning of most current science and technology is very much required in the revolution industry 4.0 these days in order to support and provide solution for Indonesian problem in the near future. This community service intends to strengthen the students' understanding and knowledge on nanotechnology by giving enlightenment on the use of nanoscience regularly. Increasing students' enthusiasm in science and technology with the current education approach is also another objective of this casework. After completion the program, participants are expected to gain new perspective and insight about nanotechnology and be able to develop more advance nanotechnology in Indonesia hereinafter.

METHODOLOGY

The community service namely "Application of Nanotechnology in Life (Education to Secondary Students)" was organized as webinar in which socialization was given online on August 28, 2021, through Zoom by explaining the nanoscience application in everyday life. Models given were the video of chemical and biological synthesis of gold nanoparticles, the presentation and introduction on Faculty of Advanced and Multidisciplinary Technology and Department of Nanotechnology Engineering towards students. There were three sections in the implementation of this community service: preparation of materials and video, pre-test at the beginning of activity, presentation from resource person, and post-test at the end of activity.

RESULT AND DISCUSSION

As one of the obligations that should be performed by educational institution, "Application of Nanotechnology in Life (Education to Secondary Students)" was expected to give better comprehension on nanoscience towards public in general. Faculty of Advanced Technology and Multidiscipline was also committed to conduct a sustainable community service for education and socialization. The online seminar was conducted one day on August 28, 2021, from 08.00 to 12.00 West Indonesia Time through Zoom. During the implementation activity, based on the attendance list, in total there were 129 participating students joined from both partner schools (122 participants) and non-partner schools (7 participants as in Figure 1. In detail, from 122 participants of partner school, SMAN 1 Trenggalek delegated 73 participants, 43 participants were from SMAN 1 Pamekasan, and there were 6 participants from SMAN 1 Sidoarjo. Meanwhile, 7 other participating students from non-partner schools were delegates from SMAN 15 Surabaya, SM St. Carolus Surabaya, SMAN 1 Lawang, SMAN 1 Sumberejo, and SMAN 1 Giri Banyuwangi. As an addition, some teachers were also interested, and 7 teachers were participated.

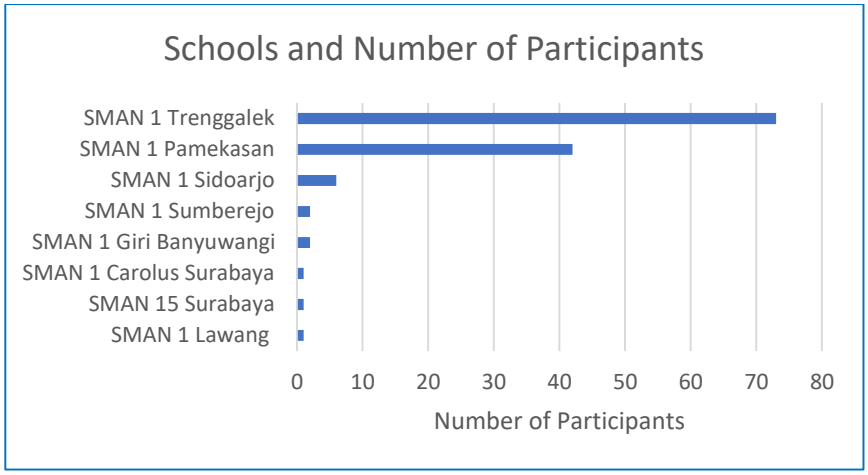

Figure 1. Distribution of schools and number of participants

The opening of the event was led by Prof. Dr. Retno Sari, M.Sc, apt. as the Head of Nanotechnology Engineering program and followed by pre-test that must be filled by all participants. To this sense, pre-test aims to capture students' comprehension about nanoscience before the socialisation. It was then continued with intensive explanation on nanotechnology and how it very well may be found in everyday use by Prastika Krisma Jiwanti, S.Si, M.Sc. Eng, PhD. Then, demonstration video and discussion on chemical and biological synthesis of gold nanoparticles were given by Dr. Eng. Intan Nurul Rizki, S.Si, M.T. Particularly, there were several informations of the gold nanoparticles (AuNPs) synthesis process chemically which also be displayed in the video as follow: synthesizing AuNPs into base material solution, qualitatively testing the presence of AuNPs using laser beam, and observing colour contrasts of different nanoparticle metal solution along with the gold nanoparticles size changes. Last subject on the profile and activities of Faculty of Advanced Technology and Multidiscipline and Department of Nanotechnology Engineering was given by Tahta Amrillah, S.Si, M.Sc, PhD. The following 30 minutes were used for question and answer session in which participants were able to give comment and question related to the application of nanotechnology. Lastly, post-test was given to evaluate and measure students' understanding on the knowledge given compared to pre-test score.

According to the attendance list receiving, there were 129 participants who took pre-test while only 96 participants fill in the post-test. However, the average score of pre-test was 54 and 68 for post-test. The increase score of post-test compared to pre-test showed that the knowledge and information transfer on nanotechnology positively went well. Closer look to histogram of each pre-test and post-test result is available in Figure 2. As program evaluation, from feedback form given to participating students, it is concluded that 88% of participants agreed that the subject and content provided was very useful in giving them new knowledge while 12% of the participants concluded the webinar on nanoscience have gave them enough knowledge (Figure 3). Overall participants considered that this community service was very interesting (66%) and quite interesting (32%) (Figure 3).

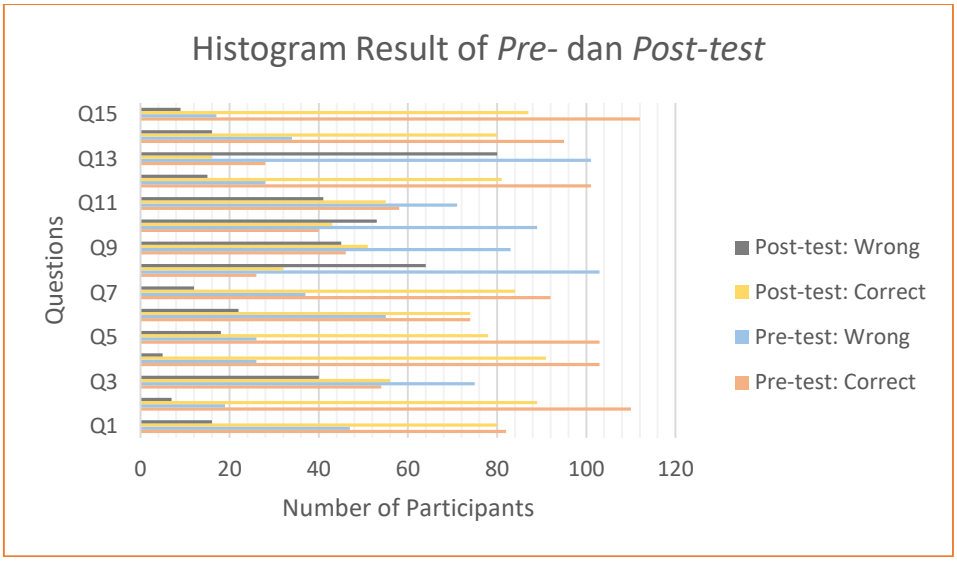

Figure 2. Histogram result of pre-test dan post-test

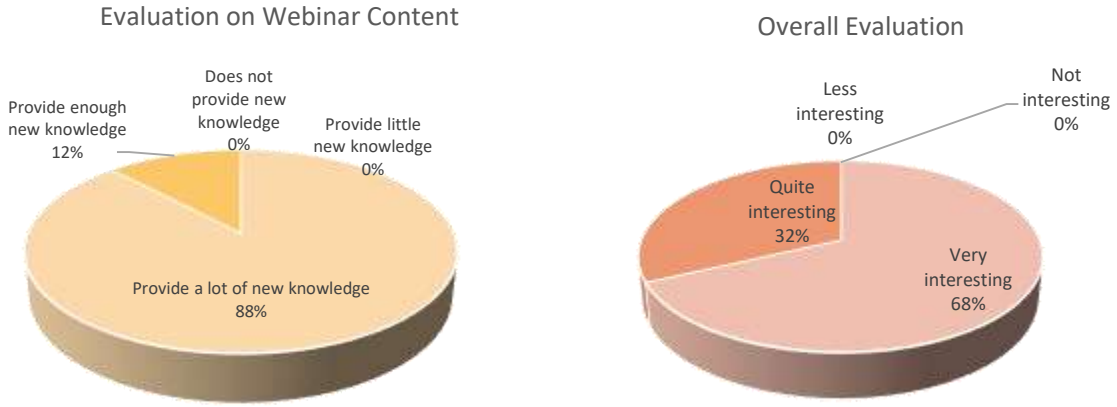

Figure 3. Participants' assessment on the subject and overall webinar

46% of all participants recommended this webinar entirely in the future, 36% of them would recommend while 18% of participants might recommended this event to their friends or colleagues for the next similar community service in a form of webinar event (Figure 4).

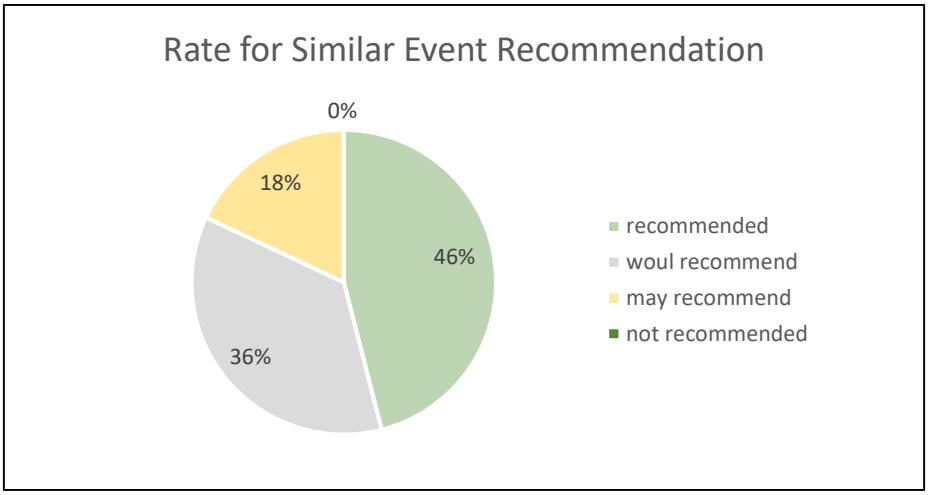

Figure 4. Community service feedback from participants

From the feedback given and data shown, it is inferred that participants have acquired new understanding and insight on nanotechnology that rarely known before. For that reason, this event has been very beneficial for participants proven by the increase average of post-test in general compared to pre-test.

CONCLUSION

Community service program organized by Department of Nanotechnology Engineering in a form of webinar entitled Application of Nanotechnology in Life (Education to Secondary Students)" have provided new knowledge and insight to targeted participants. Moreover, the lecture and presentation were well received by participants demonstrated by the raise of post-test average score.

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