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Profile of High School Science Teachers and Students in East Java Indonesia toward Nanotechnology and Cancer Treatment Learning: Understanding and Need Analysis

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Abstract
This study aims to: 1) describe the understanding of East Java High School Science teachers on nanotechnology and cancer treatment; 2) describe the needs analysis of East Java high school science teachers on nanotechnology and cancer treatment, and 3) describe the analysis of the needs of East Java high school students on nanotechnology and cancer treatment. The type of research is descriptive research with a qualitative approach. The research subjects were 40 science teachers and 786 students from 21 cities/districts in East Java. The data collection process was carried out by distributing online questionnaires. The data collected are in the form of a profile of teacher understanding and an analysis of the needs of teachers and students in the knowledge of nanotechnology and cancer treatment. Data analysis was carried out descriptively, calculating the average, and calculating the percentage. The results showed that the understanding profile of high school science teachers in East Java had low insight into nanotechnology and cancer. High school science teachers need digital-based learning media in the form of a Mobile App to support the learning process on nanotechnology and cancer treatment materials. High school students have perceptions and expectations of the nanotechnology learning process and cancer treatment so that it can be carried out more effectively by using a Mobile App. The research concludes that the understanding of science teachers and students in the East Java region regarding nanotechnology and cancer treatment needs to be developed through digital-based learning media in the form of a Mobile App.
Keywords: Nanotechnology; need analysis; science teachers and students; understanding profile

Introduction

Technology and knowledge about science in the 21st Century are developing very rapidly (Al-Kfairy et al., 2020). At the same time, problems concerning the environment in everyday life are increasingly complex and can be solved based on deep knowledge in the field of Science (Gorghiu & Gorghiu, 2012). Science cannot be separated from the process of investigation in accordance with the scientific method (Nworgu & Victoria, 2013). Scientific research always develops in line with technological innovations to make it easier for humans to solve environmental problems. Technological innovations are widely applied by humans, so we need an innovation that can produce new functions from technology that has existed before (Hall & Jaffe, 2018). One example of such technological innovation is nanotechnology. Nanotechnology is a technology that can control material on a nanometer scale, meaning that the material is made with a very small size so that its properties and functions can be changed according to what humans want (Purohit et al., 2017). Nanotechnology in Indonesia still feels foreign, the introduction of nanotechnology is very necessary so that humans can master the industry and technology of the future (Joni et al., 2018; Wahyuni & Astuti, 2011).

The study of nanotechnology in research has a very broad scope. Nanotechnology is widely applied in various fields of life, such as agriculture, health, beauty, food, and energy. Nanotechnology in agriculture by using nanoparticles can increase the accuracy of providing nutrients to a plant in a certain time, and the use of nano-based chemicals has great potential to make agriculture more organized and efficient (Pandey, 2018). The beauty sector uses nanotechnology in cosmetics, for example, masks, sunscreens, shampoos, and nail cleaners (Katz et al., 2015). Materials in the form of nanoparticles can penetrate the skin more effectively and provide a good effect on the skin layer in the long term (Morganti et al., 2016). The study conducted by Li et al. (2019) in the field of health states that nano phototherapy in the treatment of cancer can destroy tumor cells more effectively. Immunotherapy has proven promising for cancer treatment, in combination with phototherapy can treat metastatic cancer, and nanomaterials play a role in enhancing the specific effects of immunotherapy and phototherapy approaches simultaneously. Various advantages of nanotechnology are very useful to facilitate human activities (Pandey & Jain, 2020; Prasad et al., 2017).

The use of nanotechnology is important to be taught in learning activities in schools (Ghattas & Carver, 2012). The development of nanotechnology in schools needs to be based on the teacher's understanding of nanotechnology. Nanotechnology can be one of the materials contained in Physics, Chemistry, and Biology subjects at the high school level (Pektas et al., 2015). Students need knowledge related to nanotechnology to adapt to current and future technological developments (Aji, 2016). Students' understanding of nanotechnology in Indonesia is still minimal because there is no integration of nanotechnology concepts in learning activities (Affandy, 2020). Chemistry teachers in East Aceh have an understanding of nanotechnology, but teachers find it difficult to teach these materials to students because they do not have good teaching materials to support the learning process (Sari & Jofrishal, 2020). In learning about cancer treatment, most students only know about chemotherapy. Nanotechnology can deliver drugs and target cancer cells specifically. Nanotechnology is also equipped with a slowdown system or protection from natural degradation processes by the body's system (Gmeiner & Ghosh, 2014). This study needs to be studied further by teachers and students in order to increase knowledge and insight through supportive learning activities.

Learning activities that can be applied are the Science, Technology, Engineering, Mathematics (STEM) approach. Several research results report that STEM learning has a positive impact, namely increasing student interest in learning (Becker & Park, 2011), improving student achievement in scientific disciplines (Simeon et al., 2022), learning more meaningful and relevant, developing critical thinking skills (Hafni et al., 2020), and produce competitive graduates. STEM education can be applied through various learning models such as scientific inquiry, engineering design, collaborative learning, and project-based learning (Kennedy & Odell, 2014). This research provides innovation in the form of learning media developed, namely the Hi-Nano Mobile App. STEM-based media can help teachers to teach nanotechnology material. Students can also learn independently about the study of the theory and application of nanotechnology. Based on the description of the background of the problem, the profile of understanding and analysis of the needs of teachers and students regarding nanotechnology is important to study before developing digital-based learning media. This study aims to: 1) describe the understanding of East Java High School Science teachers on nanotechnology and cancer treatment; 2) describe the needs analysis of East Java high school science teachers on nanotechnology and cancer treatment, and 3) describe the analysis of the needs of East Java high school students on nanotechnology and cancer treatment.

Methods

The type of research used is descriptive research with a qualitative approach. This study describes the profile of understanding and analysis of the needs of science teachers and high school students in the East Java region regarding nanotechnology and cancer treatment. The research subjects were 40 teachers and 786 students. Teachers and students come from 21 cities/districts in East Java. The teacher teaches the fields of Physics, Biology, and Chemistry. The research was carried out in November 2021. Data collection was carried out by distributing online questions and questionnaires which were converted into google forms to teachers and students. The research instruments used were

multiple choice test questions, and a questionnaire to analyze the needs of teachers and students about nanotechnology and cancer treatment. The data obtained are in the form of profiles of understanding of science teachers, analysis of needs of science teachers, and analysis of students' needs regarding nanotechnology and cancer treatment. The data were then analyzed descriptively by calculating the percentage of understanding and needs analysis from both the teacher and student aspects. Data in the form of the highest and lowest percentages in each aspect are presented and supported by a description of each of these aspects.

Results and discussion

Profile of East Java High School Science Teachers' Understanding of Nanotechnology and Cancer Treatment

Science teachers' understanding of nanotechnology and cancer treatment is measured through multiple choice questions that have been converted into a Google form. Science teachers in the East Java region have low insight into nanotechnology as indicated by the average value of 30.7. Science teachers also have low insight into cancer as indicated by an average score of 59.7. The value categories of nanotechnology insights and science teacher cancer insights in the East Java region can be seen in Figure 1.

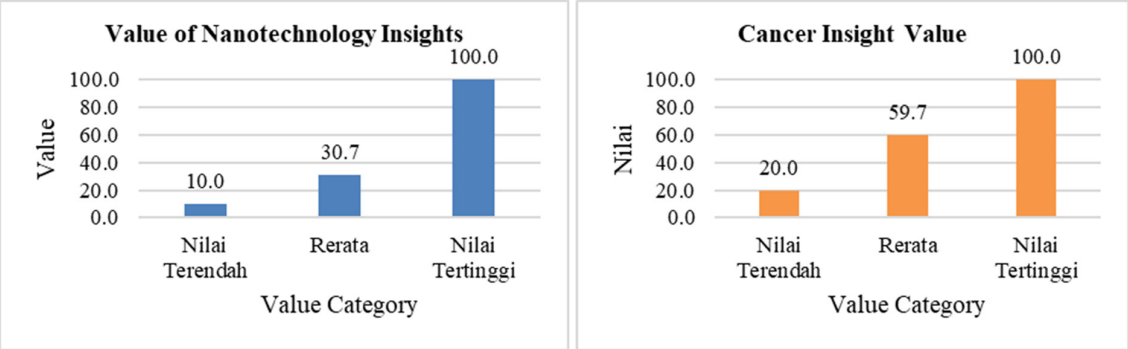


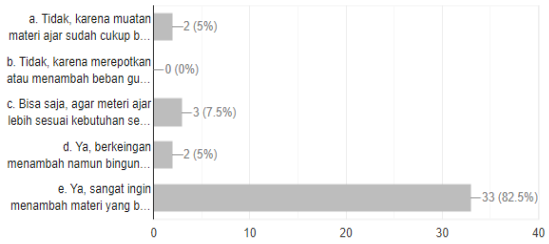
Figure 1 Category Value of Understanding Nanotechnology and Cancer Science Teacher East Java

Previous research conducted in Taiwan on Science teachers supported the results of this study and identified that Science teachers had a sufficient understanding of nanotechnology, and the government in Taiwan implemented a nanotechnology professional development strategy for teachers to better understand how to teach students about the material (Lin et al., 2015). The low understanding of science teachers related to nanotechnology and cancer is because they have not studied the literature more deeply and the material does not include material content in Physics, Biology, and Chemistry subjects. (Blonder, 2011). The development of modules related to nanotechnology and nanoscience for teachers is one way to improve teacher understanding (Blonder & Sakhnini, 2012).

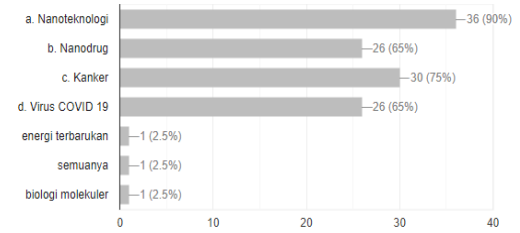
Needs Analysis of East Java High School Science Teachers on Nanotechnology and Cancer Treatment

Analysis of the needs of high school science teachers in East Java was carried out by distributing questionnaires through a Google form that measured two aspects, namely an analysis of learning needs about cancer and nanotechnology and digital-based learning media in the form of a mobile app. The results in the form of a percentage analysis of the needs of East Java Science teachers regarding learning about cancer and nanotechnology can be seen in Figure 2.

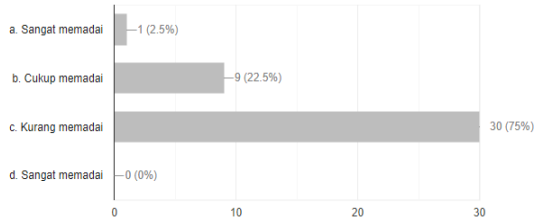
1. Teacher's Desire to Add Science Material/Content



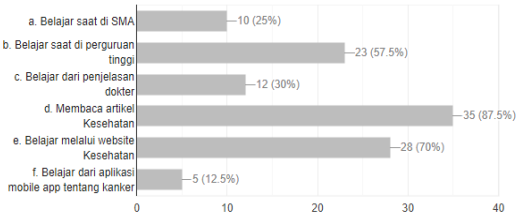
2. Addition of Fields/Materials/Science Content



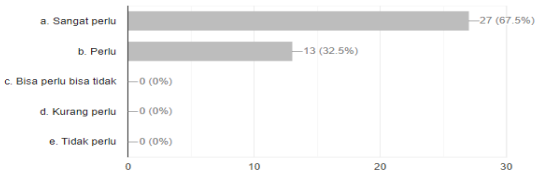
3. Teacher's Knowledge of Cancer



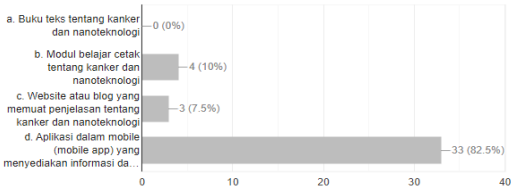
4. Teacher's Understanding of Cancer



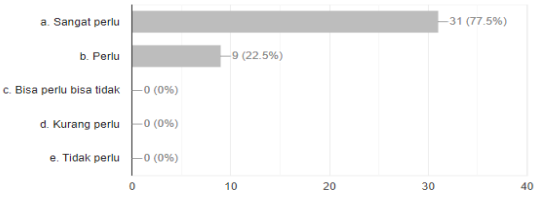
5. The Importance of Teachers Learning about Cancer



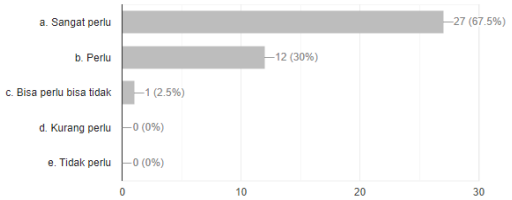
6. Learning Resources and Media for Teacher's Needs



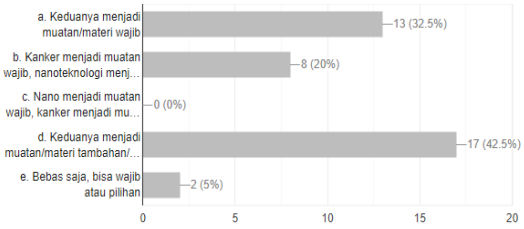
7. The Importance of High School Students Studying Cancer



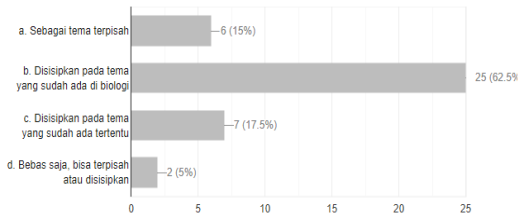
8. The Importance of High School Students Learning Nanotechnology



9. Mandatory/Optional Material Content



10. Cancer Material Insertion



11. Nanotechnology Material Insertion

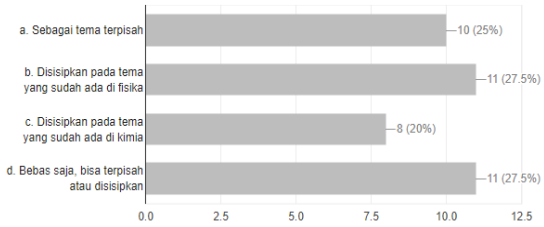


Figure 2 Percentage of Science Teacher Needs Analysis related to Cancer Learning and Nanotechnology

Figure 2 identifies that 82.5% of teachers want to add material related to the development of science in various fields, the other 5% only want to add, but still, feel confused about what material needs to be added. 90% of teachers choose to add nanotechnology materials to science learning. 75% of teachers have inadequate knowledge of cancer. 87.5% of teachers gain an understanding of cancer by reading health articles. 67.5% of teachers need to learn more about cancer. 82.5% of teachers need learning media resources assisted by mobile applications that provide information and interactive learning activities. 77.5% of teachers chose high school students who needed to be given lessons in understanding cancer, its prevention, and treatment. 67.5% of teachers chose high school students who needed to be given lessons in understanding nanotechnology and its use in various fields (health/medicine). 42.5% of teachers choose cancer and technology as additional/optional content/material. 62.5% of teachers chose cancer material to be inserted into an existing theme in Biology. 27.5% of teachers chose nanotechnology material to be inserted into an existing theme in Physics. The results of the analysis are also supported by the analysis of science teachers regarding the need for digital-based learning media in the form of a mobile app which can be seen in Figure 3.

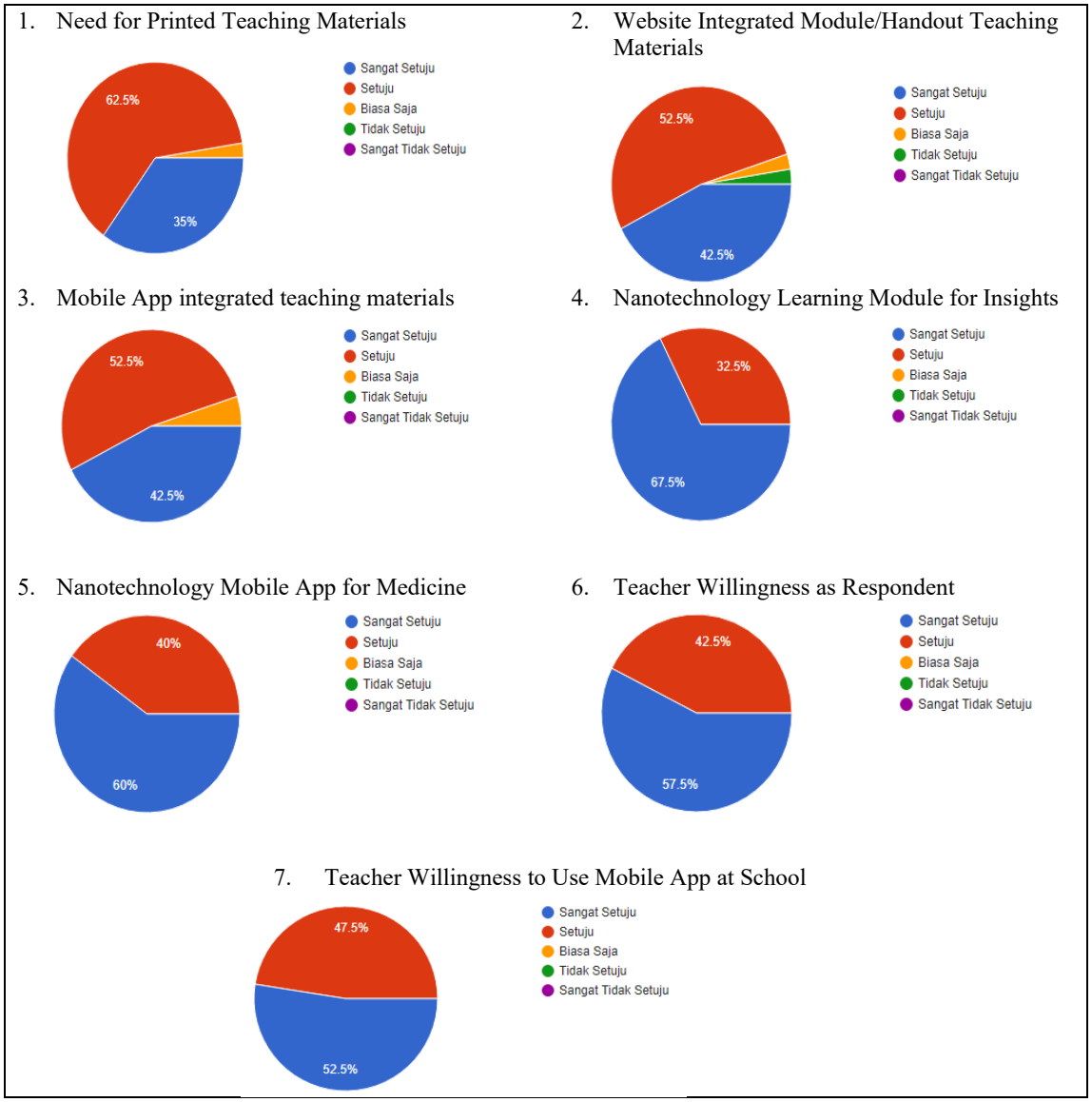


Figure 3 Percentage of Science Teacher Needs Analysis related to Digital-Based Learning Media

Figure 3 shows that 62.5% of teachers agree that teachers and students still need teaching materials or printed learning media to be used in learning activities. 52.5% of teachers agree and prefer teaching materials/learning resources in the form of modules/handouts that are integrated into the website that can be accessed at any time. 52.5% of teachers agree and like teaching materials or learning media that are integrated with the mobile app. 67.5% of teachers strongly agree that the learning module about nanotechnology in the field of medicine is needed to broaden the knowledge of science teachers. 60% of teachers strongly agree that the learning module in the form of a mobile app application is very necessary to make it easier to learn nanotechnology, especially for cancer treatment. 57.5% of teachers strongly agree and are willing to help play a role as respondents in the trial of nanotechnology learning media in cancer treatment in the form of a mobile app. 52.5% of teachers strongly agree and are willing to use the learning module in the form of a mobile app application at the school where they teach to enrich students' insights. Science teachers in the East Java region strongly support increasing students' knowledge about nanotechnology and cancer treatment, Science teachers hope to have learning media that are easily accessible to teachers and students such as digital-based learning media in the form of a Mobile App.

Digital-based learning media has many benefits, including facilitating technological mobility, information specification, evaluation process, and increasing student motivation (El-Hussein & Cronje, 2010). Students can easily access information in the form of subject matter anywhere and anytime because the learning process can be done remotely (Widodo & Nursaptini, 2020). Currently, practical learning media are needed, one of which is digital-based learning media in the form of a Mobile App, this is because smartphones have larger memory storage and students can operate them individually more easily (Kibona & Rugina, 2015). Related to the study conducted by Nofitasari et al. (2021), stated that the Mobile App can make it easier for students to learn digestive system material in Biology subjects, and there is an increase in student motivation and learning outcomes. Previous research by Samsudin et al. (2019), develop a Mobile App for the learning process in the classroom which includes a description of the material with an attractive design and there is a quiz to measure the extent to which students understand certain materials or sub-materials. Materials related to nanotechnology are complex materials, so the Mobile App that is developed needs to pay attention to various aspects such as design, content, and quizzes so that the learning media is effectively used by teachers and students.

Needs Analysis of East Java High School Students on Nanotechnology and Cancer Treatment

Analysis of the needs of high school students in East Java is measured by distributing a questionnaire that has been converted into a google form. This analysis was conducted to see the perceptions and expectations of students in learning by using a Mobile App about nanotechnology materials and cancer treatment. The results of the analysis in the form of percentages regarding students' perceptions and expectations can be seen in Figure 4. The results show that 80.9% of students think cancer knowledge is useful in increasing knowledge about scientific developments and efforts to maintain personal health. As many as 46.6% of students get information about cancer from reading news/health articles, while 41% get information when studying Biology/Science subjects at school. 61.8% of students stated it was necessary to learn about cancer as an insight into the health sector. As many as 65.1% of students have the opinion that it is very necessary to be given the subject matter, understanding of cancer, and efforts to prevent and treat it. 53.6% of students have the opinion that knowledge of nanotechnology is very useful in adding insight into the development of new science and technology.

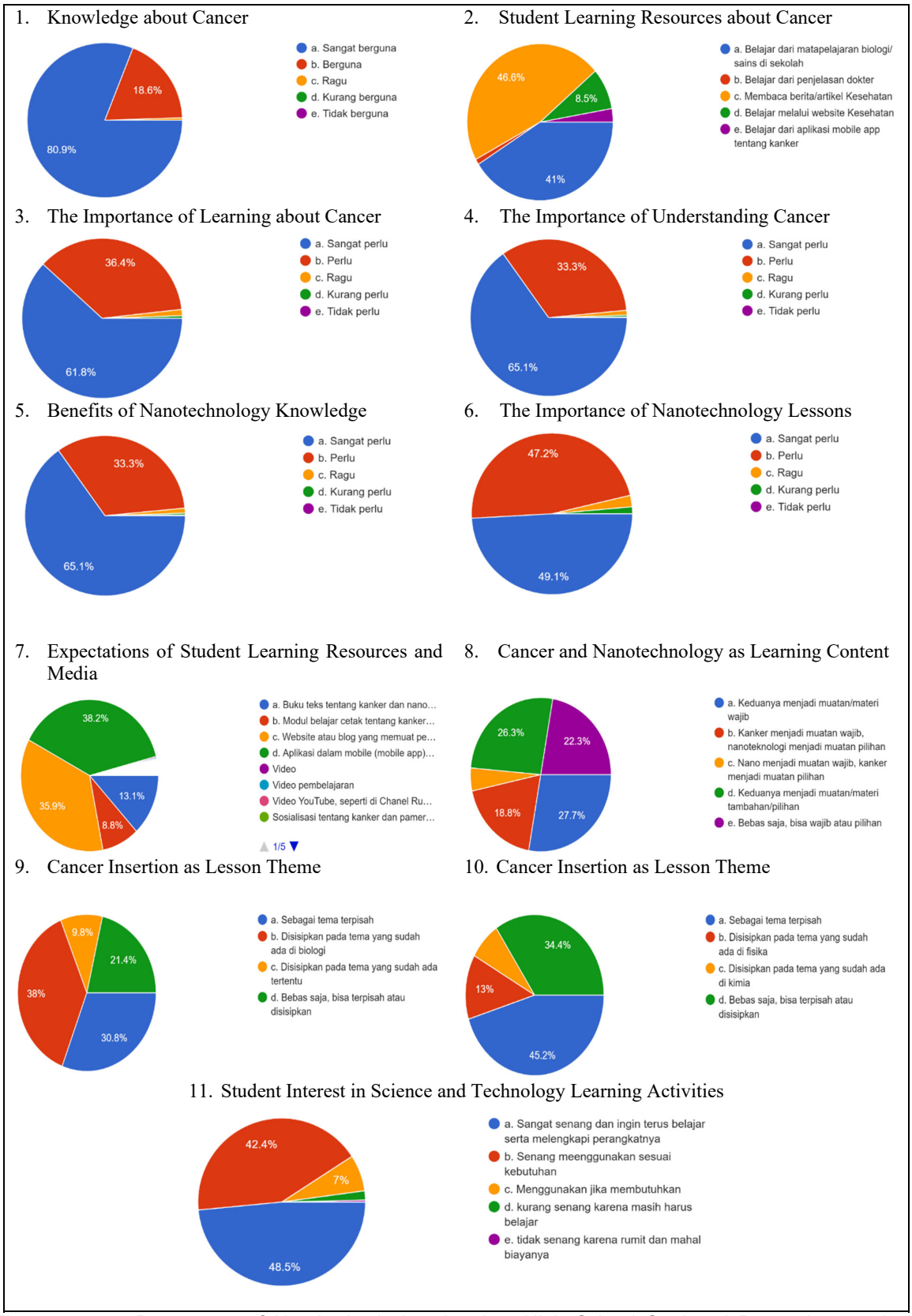


Figure 4 Percentage of Needs Analysis related to High School Students' Perceptions and Expectations

As many as 49.1% of students stated that it was very necessary and 47.2% of students stated that there was a need for learning to understand nanotechnology and its use in various fields including health or medicine. As many as 38.2% of students stated that the preferred and expected learning resources and media were applications in the form of mobile (Mobile App) that provided information and interactive learning activities. A total of 27.7% of students stated that cancer and nanotechnology should be made mandatory content. 38% of students stated that cancer material was inserted in an existing theme in Biology. 45.2% of students chose that material on nanotechnology should be studied as a separate theme, 34.4% of students stated that nanotechnology material could be separated or inserted into certain science subjects, while 13% of students stated that material should be inserted into an existing theme in Physics. Students' perceptions and expectations to learn about nanotechnology and cancer treatment are very enthusiastic, students expect to learn about these materials through digital-based learning media in the form of a Mobile App. This is because students can more easily run the application individually on their respective smartphones (Udeani & Akhigbe, 2020). The previous study conducted by Klimova (2019) stated that digital-based learning media can satisfy the student learning process so that it has an impact on improving learning outcomes.

Conclusion

Based on the research objectives, the conclusions of the study are as follows: 1) the understanding profile of high school science teachers in East Java shows that the insight into nanotechnology and cancer treatment is still relatively low; 2) high school science teachers in East Java need materials related to the development of science in various fields, namely nanotechnology and cancer treatment as lesson content for students, science teachers also need digital-based learning media in the form of mobile apps that can support the learning process; 3) High school students in East Java have perceptions and expectations of the nanotechnology learning process and cancer treatment so that it can be carried out more effectively by using the Mobile App. This research is limited to a descriptive analysis related to the analysis of the needs of teachers and high school students in the East Java region with a qualitative approach. The suggestions that can be given to further researchers are that it is necessary to conduct research related to the effectiveness of using digital-based learning media in the form of a Mobile App in learning nanotechnology materials and cancer treatment.

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