Assessing the Effectiveness of a School Educational Video on Cancer and Radiotherapy

Masanari Minamitani[a], Atsuto Katano[b] and Keiichi Nakagawa[a]

[a]Department of Comprehensive Radiation Oncology, The University of Tokyo, Hongo Bunkyo-ku, Tokyo, Japan
[b]Department of Radiology, The University of Tokyo Hospital, Hongo, Bunkyo-ku, Tokyo, Japan

Abstract

Background: Japan has recently begun introducing educational programmes on cancer as part of Health and Physical Education (HPE) classes in schools. In support of this work, the Japanese Society for Radiation Oncology has developed an educational video to enhance children's understanding of cancer and radiotherapy.

Objectives: This study examined the perceived effectiveness of this video among teachers and clarified whether their specialisation played a role in their responses.

Methods: An online survey was administered to junior and senior high school teachers without a history of cancer. Respondents' demographic characteristics, healthy lifestyle habits, anxiety about cancer treatment, and knowledge about cancer and radiotherapy were surveyed pre- and post-video. We compared the data from science teachers, HPE teachers, and teachers of other specialties. Subsequently, we performed a multiple logistic regression analysis to estimate significant factors that predicted post-watch correct-answer rates.

Results: Science teachers were less anxious about radiotherapy and surgery than the other-specialty teachers. They were also the most knowledgeable about cancer and radiotherapy. Post-viewing correct-answer rates improved, except for questions about medical physics and damage to normal cells. The multiple regression analysis identified age ($\beta = 0.07$), sex ($\beta = 0.08$), anxiety about radiotherapy ($\beta = -0.09$), and pre-video correct-answer rates ($\beta = 0.46$) as significant factors predicting post-watch correct-answer rates.

Conclusion: The video was beneficial in enhancing teachers' understanding of cancer and radiotherapy. Compared to HPE and other-specialty teachers, science teachers were superior in terms of cancer and radiotherapy comprehension. There may be value in exploring possibilities for cross-disciplinary instruction involving not only HPE, but also science teachers in cancer education, especially radiotherapy education.

Corresponding Author:
Masanari Minamitani, Department of Comprehensive radiation oncology, The University of Tokyo, 7-3-1 Hongo Bunkyo-ku, Tokyo 113-0033, Japan
Email: minamitani-tky@umin.ac.jp

Introduction

Cancer is a major cause of death worldwide (Sung et al., 2021). In Japan, it has been the leading cause of death since 1981, and more than half the Japanese population is likely to be diagnosed with cancer at least once in their lifetime (National Cancer Center, Japan. n.d.). The Cancer Control Act was enacted in 2006 and revised in 2016, and a Basic Plan to Promote Cancer Control Programmes was formulated in 2007 (Ministry of Health, Labour and Welfare 2018a; Monden, 2013). A new statement regarding school cancer education was incorporated into the Third Basic Plan to Promote Cancer Control Programmes. It reads as follows: "The national government shall strive to enhance cancer education by developing a system to utilise cancer specialists (visiting lecturers) according to local circumstances, based on the nationwide implementation status of cancer education" (Ministry of Health, Labour and Welfare 2018a; Monden, 2013). Recent reports in Japan show that cancer education programmes have led to short-term improvements in understanding cancer (Yako-Suketomo et al., 2018; Nagaoka et al., 2022). However, Japanese children possess only a limited comprehension of cancer, making the development of cancer education modules a crucial undertaking (Ueda et al., 2014; Sugisaki et al., 2014).

Cancer education programmes are already being provided in elementary, junior high, and high schools throughout Japan. Japan's school curriculum incorporates instruction on cancer education in Health and Physical Education (HPE) classes and aims to help children (1) to properly understand cancer and (2) subjectively consider the importance of life and health (Ministry of Education, Culture, Sports, Science and Technology, 2016a). The Ministry of Education, Culture, Sports, Science, and Technology (MEXT) published guidelines for cancer education in 2016, which detail the programme contents and the effective use of visiting lecturers (Ministry of Education, Culture, Sports, Science and Technology, 2016a). A variety of teaching materials are freely available (Ministry of Education, Culture, Sports, Science and Technology, 2016b, n.d.). Japanese cancer education covers not only prevention, but a wide range of topics including screening, treatment, palliative care, and patient understanding (Ministry of Education, Culture, Sports, Science and Technology, 2016a, Yako-Suketomo et al., 2018; Kye et al., 2019). The educational contents of cancer education in Japan varies according to grade level, with senior high school education focusing on cancer treatment (Ministry of Education, Culture, Sports, Science and Technology, 2018).

Radiotherapy is a primary modality of cancer treatment. Although it is relevant to up to 50% of cancer patients, its implementation rate is low in Japan (Delaney and Barton, 2015; Numasaki et al., 2022). Many cancer patients express anxiety about radiotherapy (Shimotsu et al., 2010), and among the general population between30% to 40% of people feel negatively about radiotherapy (Watts, 2011). These impressions may be a result of the atomic bomb incident in Hiroshima during World War II, the 2011 nuclear accident in Fukushima, and the

subsequent media coverage thereof (Gillan et al., 2014, Hasegawa et al., 2020). Additionally, Japan exempted radiation education from the school curriculum between 1977 and 2011, and teachers have expressed concern about instruction on radiation due to their lack of understanding and experience (Hori et al., 2019).

Recently, there has been renewed interest in the use of visual instructional tools in higher education (Kay, 2012). Several studies have shown that educational videos about radiotherapy can enhance cancer patients' understanding of, and reduce their anxiety about, radiotherapy (Jimenez et al., 2018; Matsuyama et al., 2013). However, as late as 2021, classroom education material on radiotherapy was still lacking in Japan, prompting the Japanese Society for Radiation Oncology (JASTRO) to develop an educational video with a focus on cancer and radiotherapy. Although JASTRO did not clearly define the video's target audience, the video may be suitable for use with senior high school students, given that cancer treatment is primarily discussed in senior high schools (Ministry of Education, Culture, Sports, Science and Technology, 2018). That said, the video's content may also be understandable and of relevance to junior high school students.

Digital educational materials, including videos, can be effective as part of cancer education, but their use remains limited. (Sugisaki et al., 2014, 2019). Therefore, focusing on the future development of such materials is crucial. The video developed by JASTRO has English subtitles and is freely accessible from the MEXT and JASTRO websites (Japanese Society for Radiation Oncology, 2021), but its perceived effectiveness has not been investigated. The primary purpose of this study was to verify whether this video is beneficial in improving the understanding of cancer and radiotherapy. Additionally, although cancer education is conducted as part of HPE classes, given the technical aspects of radiation and radiation treatment science teachers may be better suited than HPE teachers to teach cancer and radiotherapy. Therefore, the second objective of this study was to clarify which specialisation of teachers has a better understanding of cancer and radiotherapy. We believe this study will contribute to enhancing cancer and radiotherapy education in future curricula.

Methods

Video content

JASTRO created the video in early 2021 under the supervision of affiliated radiological oncologists and medical physicists, including two of the authors of this paper (MM & KN), and released it in September 2021 (Japanese Society for Radiation Oncology, 2021). The video exists in two versions: a 90-second short version and the 8-minute original video. The latter targets cancer education classes. As shown in Figure 1, the video uses real life scenes and animations to explain the process of cancer formation, clinical practice, effectiveness and the

cost of radiotherapy, latest treatments (e.g., intensity-modulated radiation therapy (IMRT) and stereotactic body radiotherapy (SBRT)), and the possibility of achieving a balance between treatment and work (Japanese Society for Radiation Oncology, 2021). The contents of the videos were carefully curated to include technological advances that have improved the effectiveness of radiotherapy, minimised its adverse effects, and reduced treatment duration, thereby facilitating a better balance between treatment and work obligations. Previous research conducted by our team has established that radiotherapy was believed to be associated with a higher risk of cancer recurrence, a higher incidence of adverse events, longer treatment periods, increased costs, and a more demanding commute to hospitals compared to surgical interventions in Japan (Minamitani et al., 2021).

Figure 1 about here

Survey procedure

Due to the difficulty of accessing children, an online survey was conducted with schoolteachers from May 27 and June 8, 2022 through the internet research company Macromill, Inc. The company has access to information such as age, gender and address, of 10 million individuals who have registered as survey candidates. An email outlining the survey was sent to the candidates. The respondents accessed a web page, confirmed that they understood the study purpose, and provided informed consent, before completing the survey. After doing so, they receive a reward point equivalent to one dollar. We aimed to obtain approximately 2,000 valid responses.

We developed a survey instruments# specifically for this investigation. The opening questions screened the respondents; only junior or senior high school teachers with no personal history of cancer could proceed with the survey. The questions that followed enquired about the respondents' characteristics, such as their lifestyle (smoking/alcohol/exercise/diet/obesity), teaching specialisation, role and responsibility in school, school location and type, experience of watching the video, and whether they had anxieties about radiation therapy, surgery and chemotherapy. The anxiety score for each treatment was recorded on a 5-point Likert scale, on which a lower score indicated more anxiety. Additionally, the respondents answered 10 specific questions about cancer and radiotherapy, tailored to the video content, before watching the video. Their responses were coded: "correct," "incorrect", and "don't know." Respondents were not allowed to return to the previous page after answering all 10 questions and proceeding to the next page of the online survey to watch the 8-minute JASTRO video. They were free to pause but could not fast-forward or rewind the video while watching it. After finishing the video, they answered the same 10 questions again. Respondents between 22 and 69 years of age without any

history of cancer who were junior/senior high school teachers and provided informed consent were included in the analysis. Those with prior and unidentifiable experience of watching the video were excluded.

The questionnaire and methodology for this study was approved by the Institutional Review Board of the Graduate School of Medicine and Faculty of Medicine, the University of Tokyo (2019363NI).

Statistical analysis

Chi-squared tests were used for categorical variables and analysis of variance (ANOVA) for the continuous variables to compare background characteristics among the three groups of teachers: science teachers, HPE teachers, and teachers of other specialties (hereafter, other-specialty teachers). We referred to the Organization for Economic Co-operation and Development (OECD) regional typology to divide place of residence into two groups: predominantly urban and intermediate/predominantly rural (Organization for Economic Co-operation and Development, 2011, 2016). Each lifestyle was defined by a binary variable of recommended (1) and non-recommended (0) for five factors: smoking (recommended: never smoked), drinking alcohol (recommended: weekly alcohol consumption of < 150g), exercising (recommended: ≥ 37.5 and ≥ 31.9 metabolic equivalent hours per day for men and women), eating salted meals (recommended: consumption of < 0.67g of fish roe per day), and being overweight (recommended: body mass index [BMI] within the range of 21 – 27 for men and 19 – 25 for women); these were based on the thresholds used in a previous study (Charvat et al., 2013). Subsequently, the sum of the scores on these variables was calculated and the total was referred to as the "healthy behaviour score."

Anxiety level toward each cancer treatment (radiotherapy/surgery/chemotherapy) was evaluated between the three teacher groups and among all of the respondents. A paired t-test was used to detect the change in the correct-answer rates for the 10 questions before and after exposure to the video. Pre- and post-test scores were also evaluated in each of the three groups using the t-test. Bonferroni's correction was employed for multiple comparisons, and multiple regression analysis was performed to estimate the significant factors that predicted respondents' post-video correct-answer rates. The independent variables were the teacher and school characteristics, healthy behaviour score, anxiety toward radiotherapy, and the pre-video correct-answer rates. Healthy behaviour score and anxiety were dichotomous variables based on a median split technique. In the multiple regression analysis, forced entry was employed to include all predictor variables simultaneously into the regression model, regardless of their individual significance. B values, known as unstandardised coefficients, and β values, standardised coefficients, were calculated to examine the relationships between the predictor variables and the outcome variable. All analyses were performed using SPSS version

27, with a significance level of 5%.

Results

Of the 39,821 respondents who started the survey by the deadline, 36,494 were excluded for not being junior/senior high school teachers. Due to their personal cancer history, 179 additional individuals were excluded. The remaining 3,148 proceeded with answering the survey, but 1,249 dropped out because of interruptions. A final 1,899 individuals completed the survey, of which 350 claimed that they had already seen the videos, and 145 did not describe their viewing experience. Therefore, a total of 1,404 responses qualified for analysis. Table 1 compares the background information for the three groups. The total number of other-specialty teachers was 1,141, including 233 mathematics teachers (20%), 198 English language teachers (17%), and 195 social studies teachers (17%). Science teachers were predominantly men ($p = 0.046$), and HPE teachers were younger ($p = 0.049$). Concerning lifestyle, the HPE teachers were superior in terms of exercise ($p < 0.01$) but less so in terms of smoking ($p = 0.075$) and diet ($p = 0.068$).

Table 1 about here

Table 2 shows the anxiety score of the three groups toward each treatment. We identified a significant difference between radiotherapy ($p < 0.01$) and surgery ($p < 0.01$). Multiple comparisons showed that the science teachers were significantly less anxious about both treatments (radiotherapy; $p = 0.01$, surgery; $p = 0.01$) than other-specialty teachers. Among all respondents, the means and standard deviations of each score were as follows: radiotherapy (2.52 ± 1.05), surgery (2.63 ± 1.10), and chemotherapy (2.65 ± 1.05) ($p = 0.004$). Multiple comparisons showed that radiotherapy was associated with the most anxiety relative to other therapies (radiotherapy vs. surgery; $p = 0.028$, radiotherapy vs. chemotherapy; $p < 0.01$, surgery vs. chemotherapy; $p = 1$).

Table 2 about here

The pre- and post-video correct-answer rates are displayed in Table 3. All questions, except those about medical physicists (Question 3) and damage to normal cells (Question 5), showed an increase in the rates of correct answers post-video. Three questions saw an improvement of more than 40% post-video, namely high-precision radiotherapy (Question 6), feasibility of outpatient radiotherapy (Question 8), and insurance coverage of radiotherapy (Question 9). However, the HPE teachers did not acquire enough knowledge after the video to improve the correct-answer rate for Questions 1 ($p = 0.57$), 3 ($p = 0.62$), and 5 ($p = 0.21$). In

comparing the pre- and post-video correct-answer rates independently between the three groups, the pre-video correct-answer rates were 55.0% ± 21.0% (science), 42.0% ± 21.9% (HPE), and 46.5% ± 22.9% (other-specialty) ($p < 0.01$); the post-video correct-answer rates were 74.6% ± 17.0% (science), 67.2% ± 23.4% (HPE), and 70.1% ± 22.0% (other-specialty) ($p = 0.013$). Multiple comparisons showed a significant difference between the science and HPE teachers (pre-video; $p < 0.01$, post-video; $p = 0.026$) and between science and other-specialty teachers (pre-video; $p < 0.01$, post-video; $p = 0.031$), although the scores of the HPE and other-specialty teachers showed no difference (pre-video; $p = 0.21$, post-video; $p = 0.21$).

Table 3 about here

Table 4 shows the results of the multiple logistic regression analysis. Age (β value = 0.07, $p < 0.01$), sex (β value = 0.08, $p < 0.01$), anxiety about radiotherapy (β value = -0.09, $p < 0.01$), and pre-video correct-answer rates (β value = 0.46, $p < 0.01$) were the significant factors for predicting post-video correct-answer rates (Adjusted $R = 0.23$, $p < 0.01$), while teachers' specialisation was not significant (science; β value = 0.022, $p = 0.36$, HPE; β value = -0.002, $p = 0.93$).

Table 4 about here

Discussion

Schools are key to helping young people develop knowledge, socioemotional skills like self-regulation and resilience, and critical thinking that provide a base for a healthy future (World Health Organization, 2021). In 1995, the World Health Organization launched a global school health initiative to promote health in schools and issued guidelines for school health services in 2021 (Ross et al., 2021; World Health Organization, 2021). In line with such global trends, cancer education in Japan began as a school health education programme following the 2016 revision of the Cancer Control Act (Ministry of Health, Labour and Welfare, 2018a).

A survey by MEXT in 2021 clarified that the popular settings for cancer education were physical and health education (57.0%), special activities (26.9%), and integrated learning (15.6%) (Ministry of Education, Culture, Sports, Science and Technology, 2022). The school utilisation rate of visiting lecturers was low at 8.1%. The most common teachers were cancer survivors (22.9%), while only 19.3% were oncologists (Ministry of Education, Culture, Sports, Science and Technology, 2022). This means that only 1.5% of schools were able to use oncology experts as visiting lecturers. The 2018 report revealed that palliative care (6.8%), quality of life among cancer patients (11.0%), and cancer treatments (15.9%) were minimally covered in the teaching (Ministry of Education, Culture, Sports, Science and Technology, 2022),

and it should be assumed that it is difficult for school teachers to teach children about actual clinical practice. Importantly, a previous study has reported that adolescents prefer learning through online videos and in school (Abraham et al., 2021).

The usefulness of visual materials in higher education and medical education has been reported (Dong and Goh, 2015; Kay, 2012). Although there are existing learning videos on radiotherapy, most of them aim to ease the anxiety of patients undergoing the treatment. The video used in this study is widely available in Japan, where fewer than 0.5% of the total 330,000 physicians being radiological oncologists (Japanese Society for Radiation Oncology, 2018; Ministry of Health, Labour and Welfare, 2018b), and involves situations of clinical relevance to cancer patients and radiotherapy. It seeks to support cancer education in Japanese schools mainly by providing an accurate and straightforward explanation of radiotherapy. With online information about radiotherapy being a complex for the public to understand (Rosenberg et al., 2017), the video could be beneficial in enhancing school students' understanding of basic information on radiotherapy.

This study found that watching the video increased knowledge about cancer and radiotherapy (Table 3). It helped improve comprehension, at least in the short-term. However, knowledge about medical physicists, who play an essential role in radiotherapy, showed no improvement despite exposure to the video. The International Labor Organization states that medical physicists are multidisciplinary team members engaged in diagnosing and treating patients with ionising and non-ionising radiation (International Atomic Energy Agency, 2013). In Japan, the Japanese Board of Medical Physicist Qualification (JBMP) started certifying medical physicists in 1987, but the certification remains poorly recognised and is not considered a national qualification (Iramina et al., 2022; Khaledi et al., 2020). As such, including information on medical physicists in the video may be beyond the scope of what cancer education should cover. Furthermore, concerning Question 5, "Radiation therapy damages not only cancer cells but also normal cells," the correct-answer rate declined post-video. The video emphasised decreasing damage to normal organs through high-precision radiotherapy, which may have confused some respondents. While high-precision radiotherapy reduces adverse events, it does not prevent damage to normal cells.

Compared to HPE and other-specialty teachers, science teachers proved to be significantly more knowledgeable about cancer and radiation therapy pre- and post-video. The number of teachers in Japan anxious about teaching radiation is significantly higher among general teachers than among science teachers (Hori et al., 2019). This difference is consistent with the significantly lower level of anxiety science teachers have about radiation therapy (Table 2). A previous study found that the level of health literacy among health and science teachers was similar; however, the study was relatively small scale (Denuwara and Gunawardena, 2017). Even though health knowledge and health literacy are separate issues, it is undeniable that, to some extent, science teachers are well qualified to contribute to

cancer education programmes, especially those focusing on radiotherapy.

The multiple regression analysis showed that age, sex, radiotherapy anxiety, and pre-video correct-answer rates significantly affect post-video correct-answer rates. A past study found that women and older adults have a better understanding of cancer (Minamitani et al., 2022), which aligns with the results of this investigation. Although a video-based class requires teachers to understand the content of the material, it is practically unfeasible to administer pre-tests or measure anxiety levels pre-video to identify the types of teachers most appropriate for cancer education programmes. In this study, a multiple regression analysis without a pre-test and anxiety score was performed. The results suggest that science teachers better understood the video content ($p = 0.01$), although the adjusted R^2 value dropped substantially (adjusted $R2 = 0.014$, $p < 0.01$) (Supplemental table) from before subtracting pre-test and anxiety level (Table 4). This suggests that science teachers may be better suited to teach cancer and radiation therapy to children to a small extent. Our results implied that for radiotherapy education, cross-disciplinary instruction involving both HPE and science teachers might be more effective strategy.

Limitations

This study has some limitations. First, the survey questions created in relation to the video content were not validated. Watching the video did not necessarily lead to an overall improvement in understanding of cancer and radiotherapy. Second, the video was developed for cancer education classes. Since the present study targeted teachers, we cannot conclude whether the video would likely lead to improved understanding among students. A future study targeting students is worth considering. Third, we mentioned the possibility that science teachers may be better suited to teach about radiotherapy. However, we recognise that good comprehension does not necessarily guarantee the ability to teach effectively. Fourth, cancer education programmes cover a broad range of cancers and cancer-related topics. This study discussed only a small subset of cancer education programmes. Despite these limitations, the JASTRO video has the potential to improve teachers' understanding of cancer and radiation therapy and may be used as a valuable teaching tool as part of cancer education programmes.

Implications

There are at least three stages to the delivery of health education in school: the transmission of basic information, the opportunity to develop skills, and the chance to engage with classroom and community learning opportunities that address health-related problems. Each of these stages leads in turn to the development of functional, interactive and critical health literacy (St Leger, 2001). By nature of its medium, the video only conveys information, thus we

believe it should be made available as part of classwork whenever possible to reach its full-educational potential (Dong and Goh, 2015; St Leger, 2001). Providing opportunities for a more interactive experience could promote cognitive engagement and improve the learning process (Dong and Goh, 2015).

Conclusion

This study evaluated responses to a cancer and radiotherapy educational video developed by JASTRO through a web survey targeting junior and senior high school teachers. The findings revealed that viewing the videos improved teachers' understanding of cancer and radiotherapy. Although HPE teachers are assigned to conduct cancer education in schools, science teachers showed the highest level of post-video understanding. Thus, the video could beneficially be used in a cross-disciplinary fashion in conjunction with science teachers to further enhance its effectiveness.

Competing Interests

The authors declare that there are no conflicts of interest. The Department of Comprehensive Radiation Oncology, to which Masanari Minamitani and Keiichi Nakagawa belong, is an endowed department, supported with an unrestricted grant from Elekta K. K. However, the sponsor had no role to play in this study, and no funding was received for conducting this study.

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Data availability

The datasets analysed during the current study are available from the corresponding author up on reasonable request.

References

Abraham O, Szela L, Feng E, et al. (2023) Exploring Youth Perceptions About Cancer Prevention and Preferences for Education: a Qualitative Study. *Journal of Cancer Education* 38(1): 50–59.

Charvat H, Sasazuki S, Inoue M, et al. (2013) Impact of five modifiable lifestyle habits on the probability of cancer occurrence in a Japanese population-based cohort: Results from the JPHC study. *Preventive Medicine* 57(5): 685–689.

Delaney GP and Barton MB (2015) Evidence-based Estimates of the Demand for Radiotherapy. *Clinical Oncology* 27(2): 70–76.

Denuwara HMBH and Gunawardena NS (2017) Level of health literacy and factors associated with it among school teachers in an education zone in Colombo, Sri Lanka. *BMC Public Health* 17(1): 1–9.

Dong C and Goh PS (2015) Twelve tips for the effective use of videos in medical education. *Medical Teacher* 37(2): 140–145.

Gillan C, Abrams D, Harnett N, et al. (2014) Fears and misperceptions of radiation therapy: Sources and impact on decision-making and anxiety. *Journal of Cancer Education* 29(2): 289–295.

Hasegawa S, Suzuki T, Yagahara A, et al. (2020) Changing Emotions About Fukushima Related to the Fukushima Nuclear Power Station Accident—How Rumors Determined People's Attitudes: Social Media Sentiment Analysis. *Journal of Medical Internet Research* 22(9).

Hori H, Orita M, Taira Y, et al. (2019) Risk perceptions regarding radiation exposure among Japanese schoolteachers living around the Sendai Nuclear Power Plant after the Fukushima accident. *PLOS ONE* 14(3): e0212917.

International Atomic Energy Agency (2013) Roles and responsibilities, and education and training requirements for clinically qualified medical physicists. *IAEA Human Health Series* (25): 1–88.

Iramina H, Masashi K, Sodai T, et al. (2022) Introduction of Young Researchers' Association of Medical Physics and Questionnaire Survey on Medical Physics Education and Medical Physics Training System in Japan for Young Researchers in 2021. *Japanese Journal of Medical Physics (Igakubutsuri)* 42(2): 88–105.

Japanese Society for Radiation Oncology (2018) Current climate of radiation treatment, according to data. Avaliable at: https://www.jastro.or.jp/en/information/2018/10/post.html (accessed 5 Jun 2023).

Japanese Society for Radiation Oncology (2021) Animation-based learning about radiotherapy. Available at: https://www.jastro.or.jp/animation/movie/jastro_animation_en202209.mp4 (accessed 5 Jun 2023).

Jimenez YA, Wang W, Stuart K, et al. (2018) Breast Cancer Patients' Perceptions of a Virtual Learning Environment for Pretreatment Education. *Journal of Cancer Education* 33(5): 983–990.

Kay RH (2012) Exploring the use of video podcasts in education: A comprehensive review of the literature. *Computers in Human Behavior* 28(3): 820–831.

Khaledi N, Fujibuchi T, Wang X, et al. (2020) The current status of medical physicist certification program in Iran, compared to Turkey, China, Japan, UK, and USA. *Physical and Engineering Sciences in Medicine* 43(2): 467–471.

Kye SY, Hwang SY, Oh KH, et al. (2019) Effects of a cancer prevention education program on elementary school students' knowledge, attitude, self-efficacy, and intentions in South Korea. *Epidemiology and Health* 41: e2019027.

Macromill Inc. (n.d.) Available at: https://www.macromill.com/. (In Japanese) (accessed 5 Jun 2023).

Matsuyama RK, Lyckholm LJ, Molisani A, et al. (2013) The value of an educational video before consultation with a radiation oncologist. *Journal of Cancer Education* 28(2): 306–313.

Minamitani M, Mukai T, Ogita M, et al. (2021) Relationship between Consulting for Second Medical Opinions, Radiotherapy, and Satisfaction with Therapy, Analyzed by Structural Equation Modeling: A Web-Based Survey. *Asian Pacific Journal of Cancer Prevention* 22(9): 2889–2896.

Minamitani M, Mukai T, Yamashita H, et al. (2022) Development of Japanese Cancer Intelligence Quotient to Measure Cancer Literacy and Knowledge among Japanese Laypersons. *JMA Journal* 5(4): 446–457.

Ministry of Education, Culture, Sports, Science, and Technology (2016a) Guidelines for cancer education using visiting lecturers. Available at: https://www.mext.go.jp/a_menu/kenko/hoken/20210312-mxt_kouhou02-1.pdf (In Japanese) (accessed 5 Jun 2023).

Ministry of Education, Culture, Sports, Science, and Technology (2016b) Teaching materials for promoting cancer education. Available at: https://www.mext.go.jp/content/20210310-mxt_kenshoku-100000615_1.pdf (In Japanese) (accessed 5 Jun 2023).

Ministry of Education, Culture, Sports, Science, and Technology (2018) Explanation of high school learning guideline health and physical education. Available at: https://www.mext.go.jp/content/1407073_07_1_2.pdf (In Japanese) (accessed 5 Jun 2023).

Ministry of Education, Culture, Sports, Science, and Technology (2022) The survey results on cancer education implementation status in 2021. Available at: https://www.mext.go.jp/content/20220928-mxt_kenshoku-000023841_3.pdf (In Japanese) (accessed 5 Jun 2023).

Ministry of Education, Culture, Sports, Science, and Technology (n.d.) Supplementary teaching

materials for promoting cancer education. Available at: https://www.mext.go.jp/a_menu/kenko/hoken/1385781.htm (In Japanese) (accessed 5 Jun 2023).

Ministry of Health, Labour and Welfare (2018a) Third basic plan to promote cancer control Programs. Availabe at: https://www.mhlw.go.jp/stf/seisakunitsuite/bunya/0000183313.html (In Japanese) (accessed 5 Jun 2023).

Ministry of Health, Labour and Welfare (2018b) Statistics of physicians, dentists and pharmacists 2018. Available at: https://www.mhlw.go.jp/english/database/db-hss/dl/spdp_2018.pdf (accessed 5 Jun 2023).

Monden M (2013) The basic plan to promote cancer control in Japan. *Gan to Kagaku ryoho.* 40(5): 559–564. (In Japanese)

Nagaoka T, Okayama M and Sugisaki K (2022) Original article Impact of cancer education class for cancer awareness and knowledge among Japanese junior high school students. *Niigata Journal of Health and Welfare* 22(1): 51–62.

National Cancer Center, Japan (n.d.) National Cancer Registry (Ministry of Health, Labour and Welfare). Available at: https://ganjoho.jp/reg_stat/statistics/data/dl/en.html (accessed 5 Jun 2023).

Numasaki H, Nakada Y, Okuda Y, et al. (2022) Japanese structure survey of radiation oncology in 2015. *Journal of Radiation Research* 63(2): 230–246.

Organization for Economic Co-operation and Development (2011) OECD Regional Typology, 1–16.

Organization for Economic Co-operation and Development (2016) OECD Territorial Reviews: Japan: 2016, 31–40.

Rosenberg SA, Francis DM, Hullet CR, et al. (2017) Online Patient Information from Radiation Oncology Departments is too Complex for the General Population. *Practical radiation oncology* 7(1): 57.

Ross DA, Plummer ML, Montgomery P, et al. (2021) World Health Organization Recommends Comprehensive School Health Services and Provides a Menu of Interventions. *The Journal of Adolescent Health* 69(2): 195.

Shimotsu S, Karasawa K, Kawase E, et al. (2010) An investigation of anxiety about radiotherapy deploying the Radiotherapy Categorical Anxiety Scale. *International Journal of Clinical Oncology* 15(5): 457–461.

St Leger L (2001) Schools, health literacy and public health: possibilities and challenges. *Health Promotion International* 16(2): 197–205.

Sugisaki K, Ueda S, Monobe H, et al. (2014) Cancer understanding among Japanese students based on a nationwide survey. *Environmental Health and Preventive Medicine* 19(6): 395–404.

Sugisaki K, Sawada M, Sami Y, et al. (2019) Using digital teaching material for cancer education: A pilot study. *Niigata Journal of Health and Welfare* 18(2): 122–128.

Sung H, Ferlay J, Siegel RL, et al. (2021) Global Cancer Statistics 2020: GLOBOCAN Estimates of Incidence and Mortality Worldwide for 36 Cancers in 185 Countries. *CA: A Cancer Journal for Clinicians* 71(3): 209–249.

Ueda S, Sugisaki K, Monobe H, et al. (2014) Actual Status of Cancer Awareness among Japanese School Students. *Japanese Journal of School Health* 56(3): 185–198.

Watts G (2011) Radiotherapy in UK is feared and underused. *BMJ* 342(342): d616.

World Health Organization (2021) WHO guideline on school health services. Available at: https://www.who.int/publications/i/item/9789240029392 (accessed 5 Jun 2023).

Yako-Suketomo H, Katanoda K, Kawamura Y, et al. (2019) Children's Knowledge of Cancer Prevention and Perceptions of Cancer Patients: Comparison Before and After Cancer Education with the Presence of Visiting Lecturer -Guided Class. *Journal of Cancer Education* 34(6): 1059–1066.

Figure 1 Examples of video content

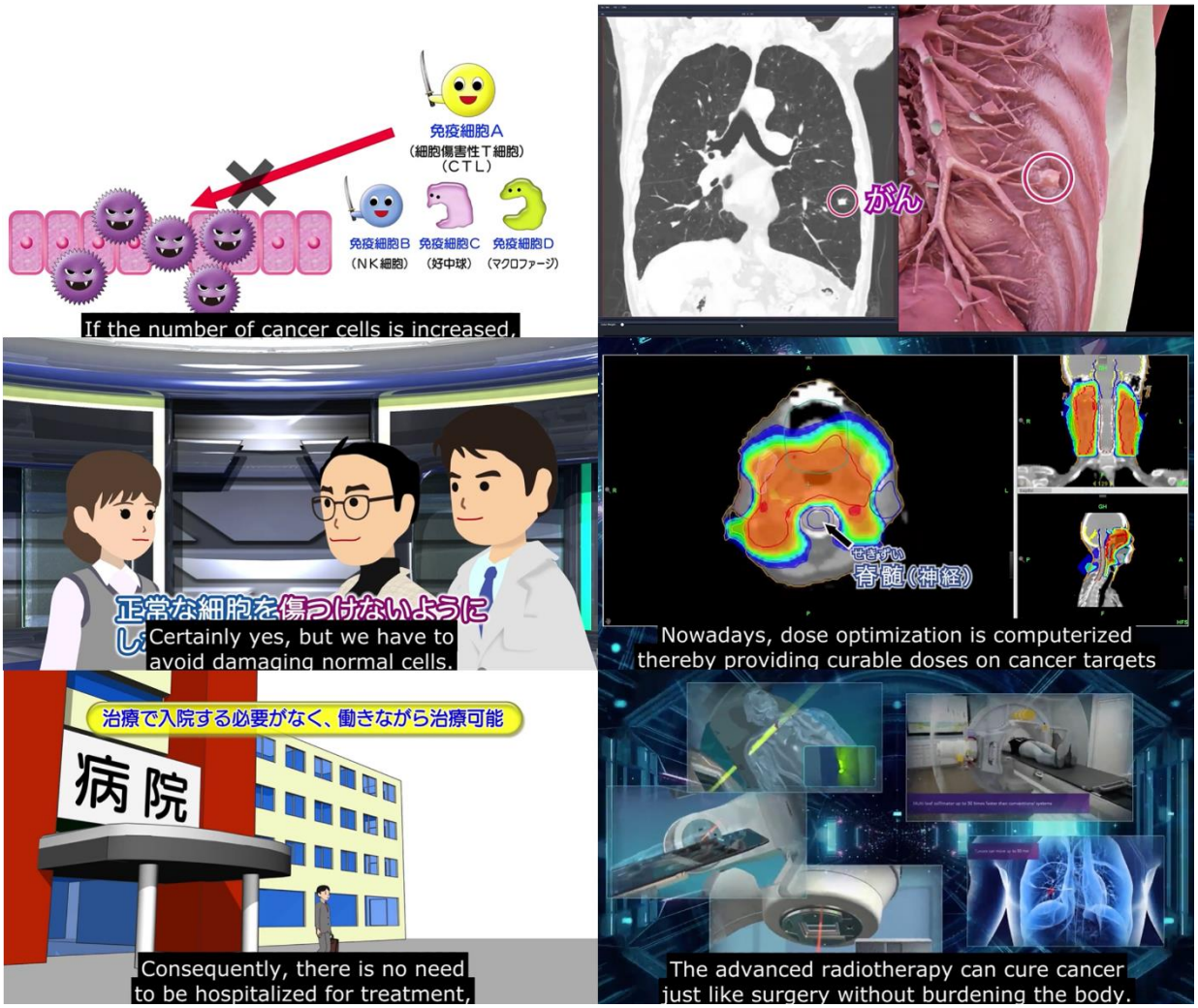

Table 1. Demographic characteristics of study respondents

	Science teacher (N=173)		HPE teacher (N=90)		Other-specialised teacher (N=1141)		
	N	**%**	**N**	**%**	**N**	**%**	**P value**
Age							0.049
Mean (SD)	49.4	(11.3)	45.7	(13.2)	48.0	(11.6)	
Sex							0.046
Male	133	77%	64	71%	772	68%	
Female	40	23%	26	29%	369	32%	
School location							0.46
Predominantly urban	83	48%	50	56%	594	52%	
Intermediate/ predominantly rural	90	52%	40	44%	547	48%	
School grade							0.49
Junior high	79	46%	45	50%	500	44%	
Seninor high	94	54%	45	50%	641	56%	
School type							0.045
Public	138	80%	77	86%	858	75%	
Private	35	20%	13	14%	283	25%	
Rank in school							0.69
leading teacher	137	79%	68	76%	871	76%	
Chief teacher/ head teacher/ principal	36	21%	22	24%	270	24%	
Smoking							0.075
Recommended	115	66%	51	57%	779	68%	

	Non-recommended	58	34%	39	43%	362	32%	
Alcohol								0.81
	Recommended	147	85%	74	82%	950	83%	
	Non-recommended	26	15%	16	18%	191	17%	
Exercise								< 0.01
	Recommended	42	24%	44	49%	324	28%	
	Non-recommended	131	76%	46	51%	817	72%	
Salt with a meal								0.068
	Recommended	157	91%	77	86%	1054	92%	
	Non-recommended	16	9%	13	14%	87	8%	
Obesity								0.69
	Recommended	136	79%	73	81%	883	77%	
	Non-recommended	37	21%	17	19%	258	23%	

Abbreviations: HPE: Health and Physical Education, SD: Standard deviation

Recommendation cut-off points: never smoked (smoking), weekly alcohol consumption of < 150g (alcohol), : ≥ 37.5 and ≥ 31.9 metabolic equivalent hours per day for male and female (exercise), consumption of < 0.67g of fish roe per day (salt meal), body mass index within the range of 21 – 27 for male and 19 – 25 for female (obesity)

Table 2. Anxiety score toward each cancer treatment

	Science teacher (N=173)		HPE teacher (N=90)		Other-specialised teacher (N=1141)			All respondents (N=1404)	
	Mean	SD	Mean	SD	Mean	SD	P value	Mean	SD
Radiothearpy	2.73	1.10	2.63	1.14	2.48	1.03	< 0.01	2.52	1.05
Surgery	2.85	1.16	2.73	1.16	2.59	1.08	< 0.01	2.63	1.10
Chemotherapy	2.72	1.03	2.61	1.09	2.64	1.05	0.64	2.65	1.05

Abbreviations: HPE: Health and Physical Education, SD: Standard deviation

Anxiety score was investigated on a five-point Likert scale, where a lower score meant more anxiety.

Table 3. Change in the correct-answer rates to 10 questions before and after watching the video

	Answer	Science teacher (N=173)			HPE teacher (N=90)			Other-specialised teacher (N=1141)			All respondents (N=1404)		
		Pre test	Post test	P value	Pre test	Post test	P value	Pre test	Post test	P value	Pre test	Post test	P value
Question 1) Cancer cells appear every day, even in healthy people.	Correct	85%	96%	< 0.01	80%	87%	0.57	76%	91%	< 0.01	78%	91%	< 0.01
Question 2) Cancer cells evade immune cell attacks and grow.	Correct	75%	95%	< 0.01	59%	82%	< 0.01	60%	88%	< 0.01	62%	89%	< 0.01
Question 3) A medical physicist is a technician who irradiates patients under the doctor's order.	Incorrect	18%	13%	0.083	14%	17%	0.62	18%	19%	0.40	18%	18%	0.72
Question 4) Patients feel the irradiated lesion hot during radiotherapy.	Incorrect	41%	69%	< 0.01	20%	53%	< 0.01	31%	60%	< 0.01	31%	61%	< 0.01
Question 5) Radiation therapy damages not only cancer cells but also normal cells.	Correct	75%	54%	< 0.01	61%	53%	0.21	64%	54%	< 0.01	65%	54%	< 0.01
Question 6) Radiotherapy delivery systems can change the beam shape correctly to fit the shape of cancer.	Correct	64%	93%	< 0.01	39%	84%	< 0.01	42%	85%	< 0.01	45%	86%	< 0.01
Question 7) Radiotherapy cannot completely cure cancer patients.	Incorrect	25%	63%	< 0.01	18%	63%	< 0.01	22%	56%	< 0.01	22%	58%	< 0.01

Question 8) Most patients can undergo radiation therapy on an outpatient schedule.	Correct	58%	94%	< 0.01	36%	83%	< 0.01	45%	87%	< 0.01	46%	87%	< 0.01
Question 9) Most radiotherapy are expensive and not covered by health insurance.	Incorrect	34%	82%	< 0.01	26%	69%	< 0.01	33%	77%	< 0.01	33%	77%	< 0.01
Question 10) Patients don't have the right to decide their treatments, but their doctors have it.	Incorrect	76%	87%	< 0.01	68%	80%	< 0.01	73%	83%	< 0.01	73%	84%	< 0.01

Abbreviations: HPE: Health and Physical Education

Table 4. Multiple logistic regression analysis: association between post-watch correct-answer rates and other characteristics

		B value	SE	β value	t	P value	95% Lower	95% Upper
(constant)		0.44	0.06		7.0	< 0.01	0.31	0.56
Age		0.001	0.00	0.07	2.7	< 0.01	0.00	0.002
Sex								
	Male				(reference)			
	Female	0.04	0.01	0.08	2.8	< 0.01	0.01	0.06
School location								
	Predominantly urban				(reference)			
	Intermediate/ predominantly rural	-0.02	0.01	-0.04	-1.7	0.09	-0.04	0.003
School grade								
	Junior high				(reference)			
	Senior high	0.01	0.01	0.02	0.94	0.35	-0.01	0.03
School type								
	Public				(reference)			
	Private	0.01	0.01	0.01	0.47	0.64	-0.02	0.03
Rank in school								
	Leading teacher				(reference)			
	Chief teacher/ head teacher/ principal	-0.01	0.01	-0.02	-0.89	0.37	-0.04	0.01
Healthy behaviour score								
	0-3				(reference)			
	4-5	0.01	0.01	0.01	0.55	0.58	-0.02	0.03
Anxiety score of radiotherapy								
	Anxious				(reference)			

	Neutral/ not anxious	-0.04	0.01	-0.09	-3.6	< 0.01	-0.06	-0.02
Teacher specialisation								
	Science	0.01	0.02	0.02	0.92	0.36	-0.02	0.05
	HPE	-0.002	0.02	-0.002	-0.09	0.93	-0.04	0.04
	Other-specialised				(reference)			
Pre-watch correct-answer rates		0.44	0.02	0.46	19.5	< 0.01	0.39	0.48

Abbreviations: HPE: Health and Physical Education, SE: Standard Error

B: regression coefficient, β: standardised regression coefficient

Adjusted R2 = 0.23 (N = 1404, P value < 0.01)