

Learning Content Acquired by Middle School Students through Cancer Education Provided by Cancer Survivors: Among Different Types of Learning

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Background: School-based cancer education by cancer survivors has been shown to enhance students' knowledge of cancer prevention and reduce the stigma against cancer patients. Although online education has become more prevalent in schools since the COVID-19 pandemic, there is a lack of evidence to determine whether it is as learned as in-person cancer education.

Objective: This study aimed to clarify the characteristics of learning content acquired by middle school students through cancer education provided by cancer survivors according to different types of learning.

Methods: From October 2020 to March 2021, cancer education by cancer survivors was provided to second-year middle school students (N=1,501) in 15 schools in prefectures A and B. Anonymous essays from middle school students who attended class were used as the data. Text mining was conducted using KH Coder software and all analyses were performed separately for face-to-face and online courses.

Results: A total of 873 students were taught face-to-face with cancer patients in their schools, whereas the remaining 628 students were taught online. Essays were collected from 784 students in face-to-face courses and 585 in online courses. The results of the co-occurrence network analysis indicated the following three key themes in both face-to-face and online courses: "understand the word that is loaded for death," "attitude of appreciation for living," and "acquisition of knowledge about cancer." A correspondence analysis comparing each class and school assembly identified different characteristics in the descriptions.

Conclusions: This study revealed that cancer education provided by cancer survivors, whether in person or online, might help students develop respect for their own and others' lives and gain knowledge of cancer. In particular, students who participated in cancer education in each class were more likely to describe their attempts to connect what they had learned to actual actions.

Keywords: cancer education, life education, cancer stigma, student, text mining

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I. Introduction

In Japan, cancer remains the leading cause of death, with 999,075 new cases diagnosed in 2019¹⁾. Many risk factors for cancer are influenced by the accumulation

of lifestyle habits from childhood onward²⁻⁴⁾. Thus, educating children about the causes and risk reduction of cancer may have a significant impact on cancer control. Educational practices on cancer for children have been developed within educational programs tailored to the

characteristics of each country, yielding meaningful educational outcomes^{5,6}). For instance, a meta-analysis using data from 13 randomized controlled trials conducted in Western countries reported that school-based cervical cancer education may enhance knowledge about cervical cancer prevention and vaccination intentions⁷). Another systematic review suggested that elementary and junior high school interventions to prevent skin cancer due to ultraviolet radiation may positively impact sun-safety knowledge and behaviors⁸). Previous studies in the United Kingdom and Korea have shown that school-based cancer education can improve students' general knowledge and attitudes toward cancer prevention⁹⁻¹¹). A study from Japan examined students' awareness and understanding of cancer and found that students who had parents or relatives with cancer tended to have more negative perceptions, pointing to the need to improve their knowledge of cancer¹²).

In Japan, the Second Basic Plan to Promote Cancer Control Programs in 2012, based on the Cancer Control Act, emphasized cancer education and public awareness¹³). This plan has led to the introduction of educational activities for students in public elementary, middle, and high schools nationwide, with the goals of (1) correctly understanding cancer and (2) subjectively considering the importance of life and health¹⁴). In 2017, cancer education was reflected in the curriculum guidelines for junior high schools, and it was adequately implemented for second-grade students in middle schools¹⁵). In addition to lifestyle-related cancer prevention, Japanese cancer education also includes content related to secondary and tertiary cancer prevention, such as cancer screening, treatment, palliative care, and mental health care¹⁴). One review reported that adolescent teenagers with a parent with cancer might experience high levels of psychosocial problems¹⁶). In particular, given the increased risk of developing cancer in the late 40s¹⁷), considered to be the child-rearing years, children should properly understand cancer, which may potentially affect their parents and relatives. Prior research on Japanese students has suggested that the inclusion of visiting lecturers, such as cancer healthcare providers or cancer survivors, in classes not only improves students' knowledge of cancer prevention but also alleviates the stigma associated with cancer patients¹⁸).

A study focusing on the benefits of incorporating cancer survivors into cancer education programs confirmed that when students interact with cancer survivors in class, they gain a deeper understanding of living with cancer and become aware of the importance

of health and life for themselves and others¹⁹). Collaboration with visiting lecturers, such as cancer survivors, is recommended. Nonetheless, according to a nationwide survey, only 8.4% of the schools provide cancer education in collaboration with visiting lecturers. Recruiting visiting lecturers and ensuring their quality are barriers²⁰). Recently, there have been a few cases of visiting lecturers providing online cancer education in response to school requests to overcome these issues. Although online education is becoming more prevalent in schools, evidence to determine whether online education is as learned as in-person cancer education is lacking. Furthermore, while cancer is primarily addressed in health classes, cancer education by cancer survivors may be incorporated into other subjects and conducted in school assemblies as part of special activities^{18,21}). The impact of class size (large vs. small) on student learning remains controversial, and it is unclear whether class size results in differences in students' perceptions of learning in cancer education²²). If the effectiveness of different approaches to cancer education becomes evident, it could provide high-quality cancer education, even in regions where there may not be enough cancer survivors willing to participate in classes for children.

Thus, the first objective of this study was to clarify the learning content acquired by middle school students through cancer education provided by cancer survivors, for face-to-face and online courses. Subsequently, the characteristics of the essays regarding cancer education received in each class and school assembly were examined.

II. Methods

1. Study design

This study employed a quantitative text analysis approach that incorporated quantitative and qualitative data. Quantitative text analysis systematically organizes and examines textual data using quantitative methods (text mining) for content analysis²³). The advantages of employing text mining in this exploratory qualitative study include its ability to enhance reliability and objectivity through the automated counting of words, as well as its appropriateness for offering a comprehensive overview of large volumes of textual data²³⁻²⁶). Initially, text mining was used to obtain a quantitative and visual overview of full-text data. This was followed by a thorough qualitative analysis that explored the characteristics of the learning content acquired by middle

school students through cancer education delivered by cancer survivors, achieved through an in-depth reading of the original data to gain a deeper understanding of the implications of automated data classification.

2. Data source and participants

Cancer education by cancer survivors, titled “Life education,” was conducted with second-year middle school students (N=1,501) in 15 schools in prefectures A and B from October 2020 to March 2021. The 50-minute class aimed to educate students about the cancer experience and significance of life by answering pre-submitted questions about cancer. Essays from middle school students who attended the class were used as data. Based on discussions between the teachers at each school and the Cancer Survivor Association, cancer education was conducted in one of the following four types of learning: 1) face-to-face courses with each class, 2) face-to-face courses with a school assembly, 3) online courses with each class, and 4) online courses with a school assembly. Each class in this category refers to classroom-based learning formats in which a small number of students are taught by a classroom teacher and a cancer survivor (and possibly a school nurse). The category “school assembly” refers to an instructional approach in which multiple classes from the same grade level gather in a gymnasium or similar venue to receive cancer education in a large group setting, typically as part of subjects such as special activities. The students were asked to write freely about their feelings and thoughts after receiving the cancer education. The Cancer Survivor Association collected essays with the cooperation of teachers in each classroom after class. The essays were provided to the authors through the Cancer Survivor Association, without identifying individuals or schools. This study was approved by the Ethics Committee of the Japan Women’s College of Physical Education (application no. 2022-2).

3. Statistical analysis

This study utilized KH Coder version 3, a text-mining software, to analyze quantitative text for each face-to-face or online course²⁷⁾. KH Coder analyzed textual data from numerous genres, such as interviews, mass media, and social surveys²³⁾. The software KH Coder, which incorporates natural language processing, is well suited for this study, as it was originally developed to analyze Japanese—a language that has historically been

challenging to examine quantitatively²³⁾. The authors first imported the text data into a computer and conducted morphological analysis to decompose the dataset into words. The analysis divided the language into smaller segments, with morphemes being the minor meaningful units of language with grammatical meanings, and examined the words frequently described in the essays of each learning type.

Second, a co-occurrence network diagram was drawn to visually represent the relationships between words that are often used simultaneously in a text. The Jaccard coefficient was used to measure the strength of the co-occurrence relationships between words. This coefficient expresses the relationship as a number ranging from 0 to 1, with a coefficient closer to 1 representing stronger co-occurrence. In the chart, thicker solid lines indicate stronger co-occurrence relationships, and larger circles depict words with higher occurrences. The co-occurrence network was illustrated based on word centrality, which measures the importance of a word within the network. The circles indicate words and are colored according to their centrality. The darker the color of the circle, the higher the centrality of the word. The keyword in context (KWIC) concordance feature was used to determine the contexts in which the words were used, focusing on words derived from highly centralized words. Themes representing the learning content acquired by middle school students through cancer education by cancer survivors were manually identified through thematic analysis by closely reading the original texts, focusing on words derived from highly centralized words in the co-occurrence network. The first author primarily conducted the analysis, and the process from theme exploration to naming was iteratively reviewed until consensus was reached among the co-authors.

Finally, class size (school assembly or each class) was entered as an external variable, and a correspondence analysis was performed to extract the characteristic words for each learning type. In the correspondence analysis plot, words lacking a distinctive pattern of occurrence were located near their origin (0, 0). Words plotted away from the origin in the direction of external variables, either the school assembly or each class, can be interpreted as words characterizing the external variable. The KWIC concordance function confirmed the context surrounding the words specific to each external variable.

III. Results

1. Characteristics of the study participants

Table 1 shows the characteristics of the study participants. Of the 1,501 students, 873 students were taught face-to-face with cancer survivors in school, while 628 students were taught online. In face-to-face courses, 455 students (52.1%) were male, and 732 students (83.8%) participated in the school assembly session. In the online courses, 291 students (46.3%) were male, and 553 students (88.1%) were studied as class units. The essays were collected from 784 students in face-to-face courses (89.8% response rate) and 585 students in online courses (93.2% response rate).

2. Characteristics of learning content in cancer education by cancer survivors

Table 2 presents a list of words frequently used by the learning type. From the morphological analysis, 1,472 words were extracted from the text data for the face-to-face courses, and 1,248 words were extracted from the online courses. In the face-to-face courses, the most commonly occurring words were “cancer,” followed by “think,” “person,” “live,” and “life,” in the online courses, “cancer” was the most frequently occurring word, and “think,” “person,” “class,” and “life” appeared more frequently, in that order.

The results of the co-occurrence network analysis are shown in **Figure 1**. The texts extracted in the face-to-face and online courses were clustered into three similar themes. Below is a description of each theme and the representative quotations.

Understand the word that is loaded for death (from face-to-face courses)

In the face-to-face courses, 31 words were found to have co-occurring relationships, and “think” and “cancer” had high betweenness centrality (A in **Figure 1**). “Think” co-occurred with “die” and “word” via “live,” suggesting [understand the word that is loaded for death].

“It made me think again about how much the word ‘death’ hurts people.” (Student 5)

“Whenever I made a mistake, I used to think, ‘I want to die,’ but I realized that there are people who want to live but cannot.” (Student 28)

Attitude of appreciation for living (from face-to-face courses)

“Life” co-occurred with “class” and “important,” conveying [attitude of appreciation for living].

“The cancer class made me realize that it is important not to give up on life after cancer but to set goals and enjoy life.” (Student 355)

“We always live our lives casually, but we may die tomorrow, so we should be grateful to be alive today and cherish every day.” (Student 454)

Acquisition of knowledge about cancer (from face-to-face courses)

“Cancer” was co-occurring with “hear,” “know,” “disease,” and “cure” interpreted as [acquisition of knowledge about cancer].

“I learned about the causes of cancer, how to treat it, and that one in two Japanese people will develop cancer.” (Student 181)

“In the class on cancer and life, I learned that cancer may not be curable even with proper treatment.”

Table 1 Characteristics of the study participants

		Learning type	
		Face-to-face	Online courses
		courses (n=873)	(n=628)
		n (%)	n (%)
Gender	Male	455 (52.1)	291 (46.3)
	Female	418 (47.9)	283 (45.1)
	Unknown	0 (0.0)	54 (8.6)
Class size	Each class	141 (16.2)	553 (88.1)
	School assembly	732 (83.8)	75 (11.9)

Table 2 Word occurrence frequency in text data

Face-to-face courses			Online courses		
Rank	Word	Frequency	Rank	Word	Frequency
1	cancer	2,603	1	cancer	1,851
2	think	1,976	2	think	1,340
3	person	886	3	person	689
4	live	857	4	class	623
5	life	755	5	life	541
6	oneself	663	6	oneself	413
7	story	661	7	live	394
8	class	629	8	story	391
9	listen	620	9	important	359
10	important	433	10	listen	359
11	know	363	11	know	277
12	die	334	12	die	220
13	word	325	13	word	217
14	Kamizuru-san	307	14	Kamizuru-san	211
15	disease	281	15	disease	208
16	understand	273	16	understand	197
17	cure	265	17	teach	189
18	consider	262	18	say	170
19	come	227	19	consider	159
20	say	203	20	patient	146
21	teach	183	21	scary	145
22	pass away	183	22	try	139
23	patient	178	23	heart	116
24	heart	177	24	take	115
25	take	173	25	daily life	105
26	scary	169	26	feelings	100
27	energetic	152	27	talk	96
28	image	143	28	feel	95
29	feel	140	29	cure	93
30	middle school	131	30	distressful	91

One thousand four hundred seventy-two words were extracted from the text data for the face-to-face courses, and 1,248 words were extracted from the online courses.

(Student 651)

Understand the word that is loaded for death (from online courses)

Similarly, in the online courses, 28 words were found to have co-occurring relationships, with “think” and “cancer” having high betweenness centrality (B in **Figure 1**). From the word “think,” the co-occurrence with words such as “word” and “say” through the word “die” could be recognized as [understand the word that is loaded for death].

“I reflected on the fact that it is not good to say things like ‘die’ to people when there are people who are fighting hard against their illnesses and want to ‘live’.” (Student 857)

“Life is irreplaceable, and even though I want to die, I think many people want to live but cannot, so I thought I should not say so simply.” (Student 928)

Attitude of appreciation for living (from online courses)

From the co-occurrence with words such as “person,”

“life,” and “story,” it could be interpreted as [attitude of appreciation for living].

“The class on cancer made me realize how important life is. I want to be grateful to the people around me.”
(Student 1,033)

“Even though there will be many difficult, sad, and unhappy times ahead, I am grateful to be alive today, and I want to cherish my limited life.” (Student 1,136)

Acquisition of knowledge about cancer (from online courses)

The word “cancer” was confirmed to co-occur with words such as “class,” “know,” “teach,” and “understand,” and was interpreted as [acquisition of knowledge about

cancer].

“I was taught about cancer and realized that cancer is a common disease that anyone can get, as I learned that there is a high chance of a cure if one undergoes periodic cancer screening and early treatment.”
(Student 909)

“I learned that there are three treatment options for cancer: radiation therapy, drug therapy, and surgery, and that each patient can choose the appropriate method depending on their individual needs.” (Student 1,113)

Furthermore, the co-occurrence relationship between “family” and “friend” was observed in both face-to-face

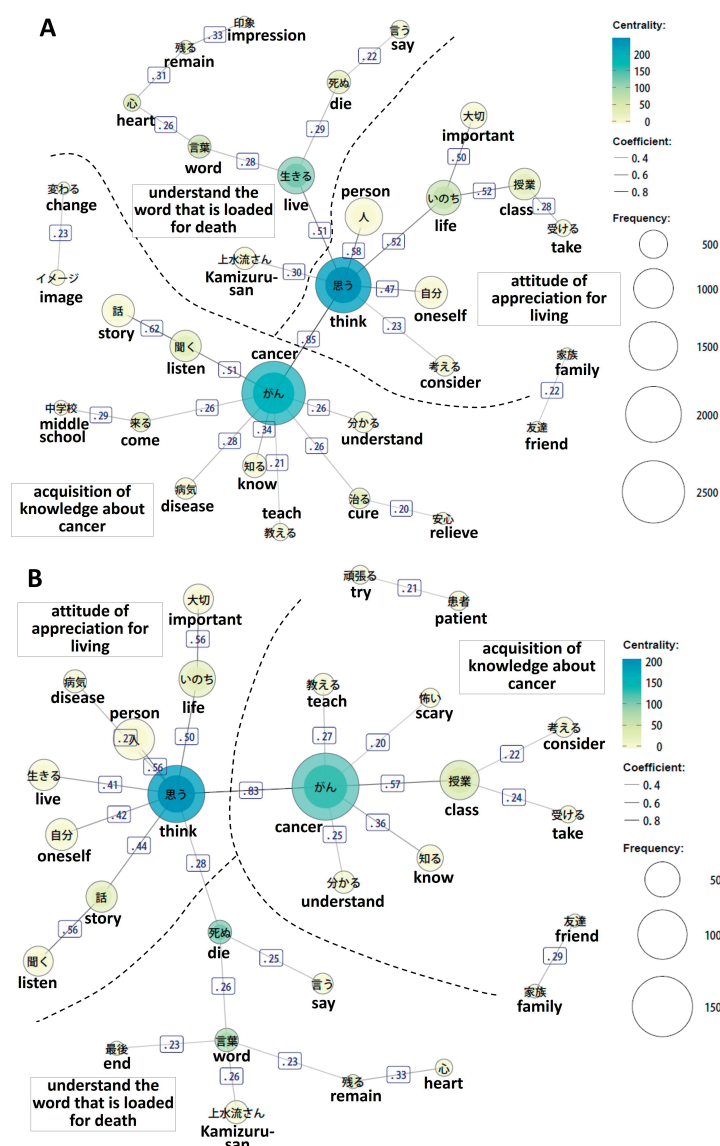


Figure 1 Co-occurrence network of high-frequency words in text data (A: face-to-face courses, B: online courses)

and online classes.

Figure 2 shows the results of the correspondence analysis. In face-to-face courses, words such as “say” and “distressful” were used as the characteristic words for each class. In contrast, “impression” and “relieve” were characteristic words for school assembly (A in **Figure 2**). Typical examples of sentences containing each characteristic word are listed below. Words highlighted as characteristic words in the correspondence analysis are underlined for each example sentence.

Sentences representing face-to-face courses conducted as each class

“I may have said “die,” even though I did not realize it, so from now on, I will try not to say things that hurt people.” (Student 38)

“I sometimes feel distressed but think better after taking this class. Whenever I have a distressed or sad time, I will remember the life education and do my best.” (Student 123)

Sentences representing face-to-face courses conducted as a school assembly

“I had a strong impression that cancer was a disease of death. Still, after taking the life education that there are people who are doing their best even though they have cancer, I feel that my impression of cancer has improved a little.” (Student 317)

“I was relieved that if the cancer is found and treated when small, it can be cured.” (Student 472)

In online courses, words such as “learn” and “try” were used as characteristic words for each class, while words such as “end” and “live” were used as characteristic words for school assembly (B in **Figure 2**). Typical examples of sentences containing characteristic words are described below.

Sentences representing online courses conducted as each class

“I will always remember what I learned today, and I want to talk about it with my family and think about the importance of life.” (Student 952)

“My grandfather is currently suffering from cancer, and to be honest, I was very anxious. But after learning that people who are trying to fight cancer are doing their best, I became more determined to support my grandfather.” (Student 957)

Sentences representing online courses conducted as a school assembly

“I want to cherish the “life” I have been given and

enjoy life until my end.” (Student 1,365)

“I have decided that from now on, I will live my life to the fullest for those who want to live but cannot.” (Student 1,349)

IV. Discussion

This study aimed to determine the learning content acquired by middle school students through cancer education provided by cancer survivors according to different types of learning. The study found that 41.8% of students took online courses in cancer education. Previous studies have reported the benefits of visiting lecturers in schools to provide face-to-face lectures on cancer education¹⁸⁾¹⁹⁾. The widespread use of online education in schools during the COVID-19 pandemic may have reduced the time and cost of visiting schools and accessibility of visiting lecturers for cancer education²⁰⁾.

Frequent word extraction and co-occurrence network analysis results for each face-to-face or online course revealed three common themes. It was found that even if cancer education was provided online, it might help students develop respect for their own and others' lives and gain knowledge about cancer. The theme of [acquisition of knowledge about cancer], derived from the word “cancer,” students confirmed that they learned about cancer as a potentially curable disease by studying the cancer treatment process experienced by cancer survivors. Despite significant advances in cancer treatment that have improved patient survival rates, cancer is frequently associated with stigma on the impossibility of recovery and stereotype²⁸⁾²⁹⁾. A survey of middle school students across Japan regarding their attitudes toward cancer revealed that 66.3% expressed fear about cancer, 12.1% believed that cancer could not be cured through treatment, and 55.8% were uncertain about its curability with treatment³⁰⁾. Building on previous studies that have highlighted the greater impact of narratives delivered by cancer survivors³¹⁾³²⁾, this study also demonstrated that narratives about cancer treatment and recovery from actual cancer survivors may have helped reduce students' negative bias toward them.

At the same time, the students' reports in this study confirmed their recognition that cancer is a disease that may remain incurable even with appropriate treatment. Although visiting lecturers must avoid giving students an undue sense of fear, it is also important to teach them about living and dying through cancer education, given that one in four to six people in Japan die from cancer¹⁾¹⁴⁾.

a more interactive and in-depth learning experience in a small group learning-type setting. A previous UK study that qualitatively examined the optimal learning type for human papillomavirus education suggests that a short, interactive, small-group class format is effective in capturing students' interest³⁶). While large-group learning types, such as school assemblies, can efficiently disseminate information to a broad audience, they may also hinder individualized learning, decrease student engagement, and restrict interactive discussions, all of which are crucial for effective education³⁷). Findings from previous studies and this study emphasized the importance of avoiding a lecture-style approach and instead making the sessions concise and interactive to enhance students' attention and interest. This study suggests that classroom-based education may be particularly effective in enhancing cancer knowledge, perceptions, and the ability to apply the learned concepts to real-life situations.

The strength of this study is that the characteristics of learning content were confirmed in various types of learning in cancer education according to the schools' diverse curriculum. Nevertheless, this study has some limitations. First, in this study, which utilized KH Coder for text mining, low-frequency words were excluded from the analysis. As a result, important analytical insights may have been overlooked in these low-frequency words. Second, given the study design in which sample sizes varied among groups depending on the learning type, concerns regarding the reliability and validity of the results remain. However, to mitigate these issues as much as possible, we employed quantitative text analysis and implemented measures to enhance reliability and validity, such as triangulation, where multiple researchers examined the study from different perspectives. Third, since the focus was on cancer education by cancer survivors with extensive experience in educating students, it cannot be ruled out that the results may be dependent on the educational skills of cancer survivors. Furthermore, since the focus is on cancer education among middle schools in the two prefectures, careful attention should be paid to applying the results of this study to other municipalities. Finally, as this study analyzed only the essays written by the students after the class and focused on examining the characteristics of the learning content, future research employing a pre-post comparative design is required to assess the effectiveness of cancer education delivered by cancer survivors.

V. Conclusion

This study revealed that cancer education provided by cancer survivors, whether in person or online, might help students develop respect for their own and others' lives and gain knowledge of cancer. Particularly, students who participated in cancer education in each class were more likely to describe their attempts to connect what they learned to actual actions.

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Competing Interests

The authors declare that they have no competing interests.

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Main Works:

- Hosokawa Y, Yako-Suketomo H, Ishii K et al.: Factors promoting collaboration between community sports leaders and guardians in urban areas of Japan: A cross-sectional study. *Frontiers in Public Health* 10:940580, 2022
- Hosokawa Y, Ishii K, Shibata A et al.: Social role of the 'Bow-Wow Patrol' in urban areas of Japan: A qualitative study. *Scientific Reports* 14:13119, 2024

Membership in Learned Societies:

- Japanese Society of Public Health
 - Japanese Society of Health Education and Promotion
 - Japanese Association of Exercise Epidemiology
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