Differences in the effect of online nutrition education through lectures without and with online games on increasing knowledge of Nutrition, Iron, and vitamin C intake of young women

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Abstract. Prevention of anemia in adolescent girls can be done by providing nutrition education to increase knowledge of nutrition and nutrient intake. Online nutrition education with online games media for young women is effective in the era of globalisation and the COVID-19 pandemic. Online games can also attract students so they don't get bored in implementing online nutrition education. This study aimed to analyze the differences in the effect of online nutrition education through online lectures without and with online game on increasing nutritional knowledge and intake of iron and vitamin C in adolescent girls. This was a quasi experiment research with design two-group (online education with game and without game), measured pre and post intervention. Approximately 25 female students aged 15-17 years old in Surakarta were recruited by purposive sampling methods were assigned to intervention and comparison group. Data intake of iron and vitamin C were taken from a recall form 2x24 hour and data nutritional knowledge from a questionnaire that had been tested for validation and reliability. The statistical difference test was performed with Man Whitney U. The results of the test Man Whitney U showed that there was a difference between the two groups after the intervention, namely nutritional knowledge (p = 0.020), iron intake (p = 0.004), and vitamin C intake (p = 0.010). The difference in effect after the intervention was an increase in nutritional knowledge and intake of iron and vitamin C compared to before the intervention. The increase was more than 50%. The greatest increase was in the group with online game. Conclusion: After the intervention, there was an increase in nutritional knowledge and intake of iron and vitamin C compared to before the intervention. The group with online game was the group that experienced the greatest difference in improvement.

1. Introduction
Anemia is the most common nutritional problem worldwide. Young women are one of the vulnerable groups at high risk of anemia. The need for iron increases in adolescent girls due to menstruation. Anemic adolescent girls will reduce the level of health, academic achievement and physical abilities [21]. According to the Indonesian Ministry of Health (2018) anemia in young women was 84.6% in adolescents aged 15-24 years. In Indonesia, the prevalence of anemia in adolescent girls in 2013 in the 15-24-year age group was 18.4% [5]. In 2018 the results of screening for high school students in Surakarta showed that 7.2% of adolescent girls were anemic [10].

Iron deficiency contributes to half of the global burden of anemia [17]. Iron deficiency anemia is anemia that occurs due to iron deficiency so that the formation of red blood cells and other functions in the body is disrupted [1]. Factors that can interfere with the production of red blood cells in addition to lack of iron consumption are less consumption of vitamin C and a less diverse diet [14]. Vitamin C is a nutrient that helps the absorption of iron in the body.
This lack of food intake can be caused by low knowledge. Lack of nutritional knowledge will affect the lack of ability of each individual to apply nutritional information in everyday life. Increasing the knowledge of young women through nutrition education, with an increase in knowledge, it is expected that there will be a change in behavior for better nutrition [21]. Learning media can be created with an atmosphere that is entertaining and fun such as educational games that help in increasing knowledge, cognitive development and skills in a relaxed way [6]. Games are also an active and interactive learning medium that makes students interested in taking part in learning so that it can increase student motivation to gain new knowledge [2].

According to research by Chuang et al [8], it shows that the learning process carried out through educational games can provide fun and eliminate boredom while learning so as to increase children's enthusiasm for learning and the messages conveyed by extension agents are easily absorbed. Other research conducted also states that there is a significant effect of nutrition education through monopoly game simulation techniques on increasing knowledge and behavior of protein consumption in adolescent girls. This is also in line with the research of Viggiano [22] and Soar [20] which state that nutritional education with play media and booklets can improve children's nutritional knowledge and behavior in changing their diet for the better.

In the era of globalization and the COVID 19 pandemic, teenagers more often use cell phones as a learning medium in seeking information, communicating through social media and even playing games [11]. Online media during a pandemic is now a solution that can be done for nutrition education. Therefore, the researcher was interested to examine the differences in the effects of online nutrition education using online media (online games in the form of crossword puzzles) which can be accessed via mobile phones for young women.

2. Methodology

The research was conducted at SMAN 8 Surakarta and SMAS Batik 1 Surakarta. The nutrition intervention provided is online nutrition education related to anemia, given once a week for 30 minutes in 1 month through the zoom application. This study used research type quasi experimental with design two group (online education with game and without game), measured pre and post intervention. The research subjects were divided into two groups, namely the group who received nutrition education through online lectures via zoom and the other group received nutrition education through online lectures via zoom and a crossword puzzle game designed online. The sample selection in this study used purposive sampling with the criteria of young girls aged 15-17 years who attend school, are not sick during the study, and can operate and have a mobile phone. Subjects in this study were 50 students for 2 groups where each group consisted of 25 students. The division of groups was done randomly.

Retrieval of data before the study with questionnaire pre-test and after the study with a questionnaire posttest. The questionnaire includes data on nutritional knowledge that has been tested for validation and reliability, while the intake of nutrients (iron and vitamin C) is through a recall form 2x24 hour. In the online game group, each nutrition education session was given so that a total of 4x online games were given. Online game in research are in the form of crossword puzzles made in google. The online game technique starts from the researcher making questions that are adjusted to the given material, the researcher creates an online game account in the form of a crossword puzzle and designs a game model in Google, then the researcher distributes the game link to the subject group after each nutritional education. In this online game, researchers can find out the answers of all subjects and the time to complete the game, so that researchers can rank based on the highest number of correct answers and the fastest time. Subjects with ranks 1 to 3 will get a reward at the end of the game.

Data analysis in the study used the test Mann Whitney U because the data were not normally distributed. This research has passed ethics from the Health Research Ethics Commission (KEPK) Sebelas Maret University with No.036 / UN27.06.6.1 / KEPK / EC / 2020.
3. Result and Discussion
This study provides online nutrition education interventions for high school students in Surakarta with 25 female respondents per group. The research group was divided into 2 groups, namely the group that was given nutrition education through online lectures only and the second group was given nutrition education through online lectures and online games as well. Data on the distribution of the characteristics of the respondents for each group can be seen in Table 1 below.

| Table 1. Distribution of respondent characteristics based on treatment groups |
|---------------------------------|---------------------------------|
| **Group**                      | Nutrition education with online lectures | Nutrition education with lectures and online game |
| Age                            |                                  |
| 15                             | 0 (0%)                           | 1 (4%)                          |
| 16                             | 15 (60%)                         | 19 (76%)                        |
| 17                             | 10 (40%)                         | 5 (20%)                         |
| Total                          | 25 (100%)                        | 25 (100%)                       |
| Nutritional Status             |                                  |
| Underweight                    | 9 (36%)                          | 7 (28%)                         |
| Normal                         | 14 (56%)                         | 14 (56%)                        |
| Overweight                     | 2 (8%)                           | 3 (12%)                         |
| Obesity                        | 0 (0%)                           | 1 (4%)                          |
| Total                          | 25 (100%)                        | 25 (100%)                       |
| Allowance                      |                                  |
| < Rp. 10,000                   | 2 (8%)                           | 0 (0%)                          |
| Rp. 10,000 – Rp. 20,000        | 23 (92%)                         | 19 (76%)                        |
| > Rp. 20,000                   | 0 (0%)                           | 6 (24%)                         |
| Total                          | 25 (100%)                        | 25 (100%)                       |
| Family Support                 |                                  |
| Positive                       | 8 (32%)                          | 11 (44%)                        |
| Negative                       | 17 (68%)                         | 14 (56%)                        |
| Total                          | 25 (100%)                        | 25 (100%)                       |

Table 1 shows the age of the research subjects in the two majority groups aged 16 years. This is because the research subjects used female adolescent girls in class XI SMA. Most of the nutritional status of the research subjects in the two groups were normal, namely 14 students (56%), but the nutritional status with underweight was more in the online lecture group compared to the online game group. that is, as many as 9 students (36%). Respondents with overweight or obese nutritional status in the study were lower than normal nutritional status and underweight. Nutritional status does not have a significant relationship with the incidence of anemia (Y Excepti et al, 2019). This means that anemia can occur in all young women.

Judging from the distribution of pocket money, most of the two groups amounted to Rp. 10,000 to Rp. 20,000, but in the online game group, students who get an allowance of more than Rp. 20,000 more than the online lecture group of 6 students (24%). The distribution of family support is mostly negative in both groups. According to Gultom's research [12], it shows that there is a relationship between pocket money and the incidence of anemia. The higher the allowance, the more you can afford to buy food or snacks so that it can affect your diet. A high allowance does not mean that the nutritional status is good, it depends on children's awareness and support from the surrounding environment to buy healthy snacks.

Likewise, family support can also be associated with anemia. According to research conducted by Azzahro and Rozalia [3], it is stated that the better the family support provided to children, the lower the incidence of anemia. Family support can motivate children to change their eating habits for the better. In addition, family support in the form of preparing a balanced breakfast and food every day can shape children's diets for the better. Results of research for data knowledge of nutrition, the intake
of iron and vitamin C before and after the online nutrition education in the two groups can be seen in table 2 below.

**Table 2. Distribution of nutritional knowledge, iron and vitamin C intake before and after online nutrition education**

| Variable          | Before | After |
|-------------------|--------|-------|
|                   | n      | %     | n      | %     |
| Nutritional Knowledge |       |       |       |       |
| Good              | 5      | 20    | 4      | 16    |
| Poor              | 20     | 80    | 21     | 84    |
| Good              | 14     | 56    | 16     | 64    |
| Poor              | 11     | 44    | 9      | 36    |
| Iron Intake       |        |       |        |       |
| Good              | 1      | 4     | 4      | 16    |
| Poor              | 24     | 96    | 21     | 84    |
| Good              | 6      | 24    | 11     | 44    |
| Poor              | 19     | 76    | 14     | 56    |
| Vitamin C Intake  |        |       |        |       |
| Good              | 3      | 12    | 7      | 28    |
| Poor              | 22     | 88    | 18     | 72    |
| Good              | 9      | 36    | 13     | 52    |
| Poor              | 16     | 64    | 12     | 48    |

In Table 2 it can be seen that an increase in knowledge of nutrition, the intake of iron and vitamin C after given online nutrition education to both groups. Although not all respondents experienced an increase, the increase in the three variables in the two groups was quite large, namely more than 50%. It can be said that online nutrition education is one of the efforts to prevent anemia in adolescent girls because it can increase nutritional knowledge and intake of iron and vitamin C which can affect hemoglobin levels.

According to research conducted by Chau et al [7] states that nutrition education carried out with online media can increase nutritional knowledge and provide positive results at every treatment because online media is an attractive medium in carrying out nutrition education for adolescents. The online media in this study uses a time-based zoom application and online games which are made via a web page so that they can be accessed on any cell phone or laptop. In other research, such as that conducted by Chung & Fon [9], online nutrition education through E-Learning can improve nutritional knowledge and nutritional behavior for each individual. Current technological developments can create opportunities for innovation in health education such as nutrition education.

The results of this study indicate that the largest increase in nutritional knowledge, iron and vitamin C intake is in the online nutrition education group through lectures and online game, so that online gaming media is one of the most effective media in nutrition education. Statistical tests conducted to determine the effect of differences in nutrition education between groups can be seen in table 3 below.

**Table 3. Differences in the value of nutritional knowledge and intake of iron and vitamin C in the two treatment groups**

| Variable          | Pre Nutrition Education | Post Nutrition Education |
|-------------------|-------------------------|--------------------------|
|                   | Nutrition education with online lectures | Nutrition education with online lectures | p-value | Nutrition education with online lectures | Nutrition education with online lectures | p-value |
| Minimum           | 25,00                   | 15,00                    | 0,199 | 40,00 | 45,00 | 0,020 |
| Maximum           | 65,00                   | 95,00                    | 1,99  | 85,00 | 95,00 | 0,020 |
| Mean              | 48,60                   | 53,40                    |       | 62,40 | 74,20 |       |
Iron Intake

|       | Minimum | Maximum | Mean  |
|-------|---------|---------|-------|
|       | 2.20    | 13.70   | 6.42  |
|       | 3.30    | 14.70   | 7.96  |
|       | 3.50    | 1.145   | 8.10  |
|       | 4.30    | 13.10   | 10.82 |

Vitamin C Intake

|       | Minimum | Maximum | Mean  |
|-------|---------|---------|-------|
|       | 0.00    | 282.00  | 33.51 |
|       | 2.00    | 200.00  | 50.03 |
|       | 0.021   | 0.00    | 43.61 |
|       | 15.40   | 134.00  | 76.57 |

In table 3, it is known that the results of this study are that there are differences in nutritional knowledge related to anemia in the group that was only given nutrition education through online lectures only with nutrition education that was given online game. This can be seen from the statistical difference test results using the test, Man Whitney U the p-value after being given online nutrition education is 0.020 (<0.05) which means that H0 is accepted and there is a difference between the two groups, while the statistical difference test results before nutrition education was carried out, there was no difference between the two groups, which means that H0 was rejected because the p-value was 0.199 (> 0.05).

This result is also the same, there is a difference between the two groups after nutrition education on iron and vitamin C intake, namely p-value 0.004 and 0.010, which means <0.05 and H0, whereas before online nutrition education there was no variable intake of iron and vitamin C. The difference between the two groups, which means p-value > 0.05, is equal to 1.145 and 0.021. The most effective improvement was found in the nutrition education group with lectures and online game. This can be seen from the average score of nutritional knowledge (74.2), iron intake (10.82) and vitamin C (76.57) after the intervention in the group with online games media was greater than the online lecture media only. This can happen because in the provision of nutrition education it will be more interesting if it is done with the media of game, so that students will be more motivated and enthusiastic in participating in nutrition education.

This research is in line with research conducted by Bellan et al [6] which states that nutrition education through educational game media can have a positive effect on a person's nutritional knowledge. Nutrition education will run well if it is supported by the right media and methods of delivering material [18]. Learning media can be created with an atmosphere that is entertaining and fun such as educational game that help in increasing knowledge, cognitive development and skills in a relaxed way [6].

Games are also an active and interactive learning medium that makes students interested in taking part in learning so that it can increase student motivation to gain new knowledge [2]. In this study, online nutrition education with online game media using crossword puzzle games made on the web. The crossword puzzle game can be used for all levels, whether for beginners, intermediate or advanced, as well as materials that can be selected according to the learning objectives [15]. According to Haryono [13] the advantages of crossword puzzle game media are that it can motivate students to take part in nutrition education, media that is interesting and not boring in the process of nutrition education taking place because it can cause curiosity and challenges in completing the game.

Another research that is in line with this research is research conducted by Viggiano [22] and Soares [20] which states that nutrition education with game media and booklets containing crossword puzzles can improve children's nutritional knowledge and behavior in changing their diet to be more good. According to research by Chuang et all [8], it shows that the learning process carried out through interactive puzzle games can provide fun and eliminate boredom while learning so as to increase children's enthusiasm for learning and the messages conveyed by the instructors are easily absorbed.

In a study conducted by Khadijah [16], nutrition education carried out with peer discussions and role-exchanging games can improve attitudes towards iron intake better than the control group and before the intervention was carried out. Increased intake of nutrients (iron and vitamin C) can be caused because individuals have received information related to nutrition in the incidence of anemia so
that their nutritional knowledge increases and individuals can adjust their diet by choosing a balanced diet and measuring the right portion of food [9]. In addition, the delivery of material in the implementation of online nutrition education is carried out using language that is easy to understand, concise and clear so that participants do not get bored and easily understand the material provided [19].

Although the results showed that there was a positive effect after being given online nutrition education to the online games group, but in the variable intake of iron and vitamin C, almost half of the respondents had iron and vitamin C intake below the RDA. This can be due to the fact that in addition to nutrition education there are also other factors that affect nutritional intake. One of these factors is environmental factors which can be in the form of family support, peers and support from the school [11]. This study has limitations, namely not intervening nutrition education that includes the environment at home such as family members, so that the results of the study cannot be said to be maximally successful in changing the intake of nutrients, especially iron and vitamin C which are associated with anemia.

4. Conclusion
The results in this study indicate that there is a difference in the effect of online nutrition education through lectures without and with online games on increasing nutritional knowledge and intake of iron and vitamin C in young girls. This can be seen from the results of differences before and after online nutrition education. After the intervention, there was an increase in nutritional knowledge and intake of iron and vitamin C compared to before the intervention. The group with online game was the group that experienced the greatest difference in improvement.

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