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Exploring the Argumentation Characteristics in SSI Video Discussion Area of Online Video Learning Website

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Abstract—Argumentation is an essential aspect of scientific thinking and plays an important role in the research and practice of science education. In recent years, argumentation in the context of socio-scientific issues (SSI) has attracted extensive attention of educational researchers. The purpose of this study is to explore the argumentation characteristics of SSIs in online video learning website. The content analysis method was used to conduct coding and discourse analysis of 112 argumentation discourses in the discussion area of online video learning websites, and revealed the argumentation characteristics of high-likes comments and the different argumentation performances of high-quality and low-quality arguments. The results showed that in the discussion area, Data and Warrant account for the largest proportion, while Rebuttal and Qualifier account for the least. High-quality arguments have more sufficient Claim, Data and Warrant, can proposed difficult Qualifier as well. Low-quality arguments mainly propose Data, with more Off-topic and Rebuttals, which mostly deviates from the argumentation content and lacks logic and scientificity.

Keywords—argumentation, socio-scientific issues, online video learning website

I. INTRODUCTION

Argumentation is essential for training students' scientific thinking [1]. It shows a great value in both teaching practice and educational research of science education. Due to the diverse and contextual characteristics of socio-scientific issues, students can make corresponding judgments based on their daily life experiences and values to propose their own arguments [2]. Therefore, scientific argumentation in the context of SSI has received widespread attention from educational researchers. Most previous studies have focused on the face-to-face argumentation behaviors [3]. With the development of Internet technology, learners' argumentation places have changed. Writing comments and replies in the online video discussion area has gradually become an important way for online learners to conduct social scientific argumentation [4]. However, at present, few studies have focused on learners' scientific argumentation performance in the discussion area of online video learning websites. The relationship between the

argumentation characteristics and argumentation quality of high-like comments needs to be further explored..

II. LITERATURE REVIEW

A. Scientific Argumentation and Socio-scientific Issues

Kuhn believes that scientific argumentation is a process in which a person cites evidence or data to support oneself or oppose the opinions, claims or conclusions of others [1]. The process of argumentation has been summarized as a pattern. Toulmin's Argument Pattern (TAP) is the most widely used theory in scientific argumentation, which explains the six basic elements of a sound argument: data, claims, warrant, backing, rebuttal and qualifier [5]. In TAP, the three elements of claim, data and warrant can constitute a basic argument, and the claim and data are connected through the warrant. Further, rebuttal and qualifier can be added to make the argumentation more complete. This strategy is usually used to encode students' argumentations [6, 7].

Socio-scientific issues (SSI) refer to ill-structured, open-ended issues involving social and scientific values, such as genetic modification and the construction of nuclear plants. Many researchers have found that it is easier for students to make arguments in socio-scientific issues than scientific phenomena. Using SSIs, students can put themselves in a real circumstance and make corresponding arguments based on their daily life experiences and values [2]. Therefore, many educational researchers pay attention to scientific argumentation in the context of SSIs. Social scientific argumentation goes beyond scientific argumentation and can improve the ability of scientific argumentation, inquiry and moral reasoning [8, 9]. Many empirical results have shown that social scientific argumentation has played a great role in promoting the development of students' scientific literacy and the understanding of scientific knowledge [10]. Therefore, this study focuses on the scientific argumentation under SSIs.

B. Online Video Learning Website

In recent years, online learning has become an important part of the learning and life for network users. Among the various tools of online learning, online video has the advantages of rich expressiveness, intuitiveness, which has become one of the

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most popular and influential media for online education [11]. Online video learning websites such as YouTube and Bilibili contain a large number of educational video resources and have become a significant channel for network users to learn. Comment is an important way of user interaction in online video. Learners can post in the discussion area or directly reply to other comments through an asynchronous non-anonymous interaction, which could improve the learners participation and learning effect [12, 13]. In this context, the traditional way of face-to-face interaction has been gradually subverted. The place where people communicate and discuss is no longer limited to the real environment. The discussion area in online video websites can also become a place for learners to conduct scientific argumentation, in which learners can conduct argumentation feedback and expression through likes, comments, replies and other actions for social interaction [14]. Likes in online video comments are the main interactive way of comments. The number of likes reflects the quality or popularity of comments to a certain extent. However, at present, few study pay attention to learners scientific argumentation behavior in the discussion area. The relationship between high-likes comments and argumentation quality needs to be deeply discussed, and its argumentation performance and characteristics deserve further exploration.

Specifically, this study aims to explore the following three questions:

1. What are the learners' overall scientific argumentation performance in the discussion area of online video learning websites?
2. What are the characteristics of learners' argumentation elements in high-quality arguments and low-quality arguments?
3. What are the characteristics of learners' argumentation discourse in high-quality arguments and low-quality arguments?

III. METHOD

A. Data Resources

The argumentation data of this study are all from Bilibili video website, which is the most popular online video website for the young learners in China. This study selected three high click-through rate videos which were uploaded by uploaders from all over of the country and are open for all the users of Bilibili. The themes of these videos are related to socio-scientific issues, which is genetically modified food(GM food). The video themes are: 1. The development of two kinds of transgenic pigs; 2. Exploration tour of GM food between China and the United States; 3. The essence and truth of GM food. These videos' contents express objective and neutral opinions about GM food. Those who are interested in these videos post comments in the discussion area. Two researchers in this study screened these comments, and selected 45 representative high likes comments in the discussion area based on the number of comments like (between 100-3000) for coding analysis. After preliminary screening, 17 comments irrelevant to the topic of video were excluded and 28 valid comments (112 arguments in total) were obtained.

B. Coding Scheme

The scientific argument coding scheme of this study is shown in Table 1. It is based on Toulmin's Argumentation Pattern [5], and Sadler and Donnelly's argument evaluation criterion [15]. Six elements of Claim, Data, Warrant, Backing, Rebuttal, and Qualifier are included to evaluate learners' argumentation quality.

TABLE I. CODING SCHEME

Category	Argumentation Levels and Definitions		
	Level 1 (0 point)	Level 2 (1 point)	Level 3 (2 points)
Claim (C)	Didn't propose a claim.	Propose a claim.	/
Data (D)	Have no data or data is not related to claim.	Propose a data.	Propose sufficient scientific data.
Warrant (W)	Didn't propose a warrant	Propose a warrant without supportive explanation.	Propose scientific and logical warrant to show the connection between the data and the claim.
Backing (B)	No backing (0 point) Further backing (1 point) Make a new backing (1 point) Rebuttal to counter arguments (1 point)		
Rebuttal (R)	Didn't propose a rebuttal.	Propose a rebuttal, but didn't explain it clearly	Propose a rebuttal with supportive warrant.
Qualifier (Q)	Didn't propose a qualifier	Propose a qualifier	/
Off-topic (O)	Talking irrelevant words or contents.		

C. Data Analysis

To scientifically and effectively explore the learners' scientific argumentation behavior from the comment text, content analysis was conducted in this research. This study obtained the text data of 112 valid popular comments in 3 GM food theme videos. In the process of coding, this study selected two coders and trained them to familiar with the coding rules and standards. The two coders independently completed the coding task and checked it after completion. The Cohen's kappa coefficient of the coding result was 0.75, indicating that the coding result had good reliability.

IV. RESULTS

A. Characteristics of Overall Scientific Argumentation in the Discussion Area of Online Video Learning Website

The descriptive statistical results of the proportion and scores of argumentation elements are shown in Table 2.

TABLE II. OVERALL SCORES AND PROPORTION OF ARGUMENTATION ELEMENTS

Category	C	D	W	B	R	Q	O	Total
Score	0.86	1.11	1.11	0.46	0.25	0.21	0.57	4.57

Category	C	D	W	B	R	Q	O	Total
Proportion(%)	18.8	24.2	24.2	10.2	5.5	4.7	12.5	100.0

It can be seen that the average score and proportion of high-like comments encoded in this study in each argumentation element are different. Among all argumentation elements, the two elements with the highest scores are: Data and Warrant, which are 1.11 points respectively, followed by Claim ($M = 0.86$), while Qualifier and Rebuttal have the lowest scores, only 0.21 and 0.25.

By visually presenting the results in Table 1, we got the statistical histogram chart of argument element scores, shown in Fig. 1.

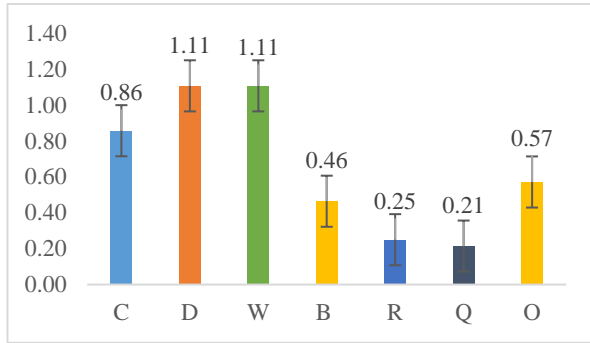


Fig. 1. Overall scores of argumentation elements

It can be seen from Fig. 1 that among all argument elements, Data and Warrant account for the largest proportion, and their proportion reaches 24.2% respectively, which is close to half of the proportion of all argument elements in total. It indicates that when conducting scientific argumentation in the discussion area of the online video learning website, most learners' argumentation is directly stating or just listing data without further processing.

In addition, Qualifiers and Rebuttal account for the least of all elements, 4.7% and 5.5% respectively, which shows that most learners propose and explain their own claims, but rarely give feedback to others' views, especially rarely refute others' views, and also rarely propose Qualifiers of their own claims, indicating that learners are not very interactive in argumentation. Compared with in-depth discussion with others, learners pay more attention to explaining their own views. At the same time, considering the establishment of a friendly atmosphere in the discussion community, they rarely tend to refute others and express opposing opinions.

It is worth noting that among all argument elements, O(off-topic) accounts for 12.5%. This shows that in the process of argumentation, some learners may pay more attention to the funny comments and less focus on the logic and rationality of others' argumentation, which leads to many high-like but irrelevant comments in the discussion area of the video website.

B. Characteristics of learners' argumentation elements in high-quality and low-quality arguments

In order to further analyze the argumentation characteristics of those with high scores, K-means clustering was conducted in

this study by using the scores of arguments as clustering indicators. After excluding the abnormal score (the 28th), learners' arguments were divided into two categories: high-quality arguments and low-quality arguments (High: $M=6.33$, $SD=1.12$; Low: $M=2.43$, $SD=1.03$). The descriptive statistical results about the two groups is shown in the Table 3. The mean value of the high-quality arguments is almost 3 times of the low group.

TABLE III. SCORES AND PROPORTION OF ARGUMENTATION ELEMENTS IN HIGH AND LOW-QUALITY ARGUMENTS

Category		C	D	W	B	R	Q	O	Total
Low	Score	0.57	0.67	0.48	0.38	0.29	0.05	0.48	2.43
	Proportion(%)	23.5	27.5	19.6	15.7	11.8	2.0	19.6	100
High	Score	2.00	2.17	2.17	0.17	0.17	0.67	0.83	6.33
	Proportion(%)	31.65	18.4	34.2	2.6	2.6	10.5	13.2	100.0

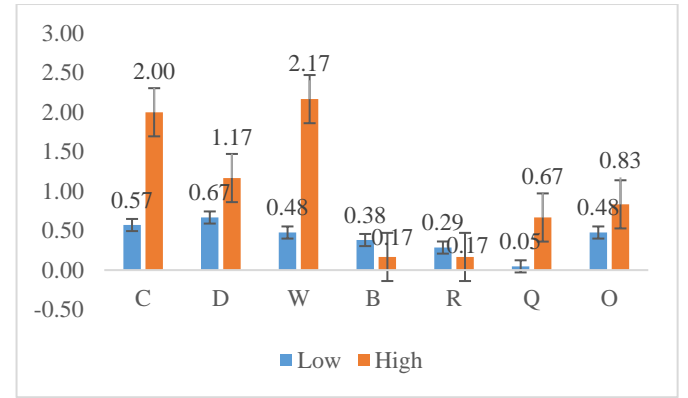


Fig. 2. Scores of argumentation elements in high and low-quality arguments

It can be seen from the Fig. 2 that the score of almost every item in the high-quality arguments is higher than that of the low-quality arguments, especially the high group (C: $M=2.00$, D: $M=1.17$, W: $M=2.17$) has higher Claim, Data, and Warrant scores than the low group, even reaching 3-4 times than that of the low group (C: $M=0.57$, D: $M=0.67$, W: $M=0.48$). From the perspective of the proportion of argumentation elements (Fig. 3), learners with high-argumentation level have more Claim, Warrant and Qualifier, (High: C: 31.65%, W: 34.2%, Q: 10.5%; Low: C: 23.5%, W: 19.6%, Q: 2.0%). It is worth noting that the argumentation process of the higher scorers can propose more Qualifiers. In addition, the off-topic content (O) of the high-quality arguments is higher than that of the low-quality arguments, showing that learner with high level of argumentation skills not only have more statements on the three elements of Claim, Data, and Warrant, but also have more irrelevant arguments.

While the low-quality arguments get a lower score on all other elements except O(Off-topic), especially on Qualifier, which reflects the low quality of their argumentation. From the perspective of the proportion, the low-quality arguments group has more Data than the high group (High: D: 18.4%, Low: D: 27.5%), indicating that the learners with low argumentation

skills are mostly listing data, but there is no connection between their data and claim, leading to less scientific Warrants. It is worth noting that the learners in low-quality group propose more rebuttals than the high-quality group (High: R: 2.6%, Low: R: 15.7%), which indicates that individuals in the low-quality group may prefer to refute others' views and ignore use sufficient evidence and reasons to support their own claims. Finally, O(Off-topic) accounts for a relatively large proportion in low-quality groups, 19.6%, almost take up the same proportions as Claim, Data, and Warrant. This shows that the argumentation process of the learners with low argumentation skills mostly deviates from the argumentation content, discusses irrelevant discourse, and lacks logic.

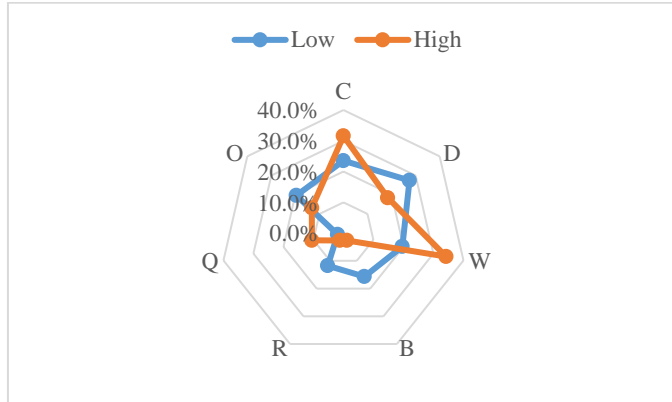


Fig. 3. Proportion of argumentation elements in high and low-quality arguments

C. Characteristics of Learners' Argumentation Discourse in High-quality and Low-quality Arguments

The above statistical results revealed learners' argumentation characteristics of the two group, which is learners in high-quality group can propose sufficient Claim, Data, Warrant and Qualifier, while learners in low-quality group mainly propose Data, with more Off-topic and Rebuttals. The following two examples show the comments of the high-quality arguments and the low-quality arguments.

Comment 1(High-quality arguments, Leaner 1): "From a few points of view, first of all, human DNA is similar to plant DNA... [Data2] For example, humans and other higher organisms can express the protein components of organelles and the proteins on the membrane are the same. So the DNA of humans and plants are similar[Warrant2] So what is the difference between plant and human DNA? That is the order of the base pairs in the DNA sequence, ..., it appears to be different species and individuals! [Backing]So here comes the problem. Transgenic technology is artificial means to rewrite DNA, base pair arrangement sequence.Just extract this base pair sequence and restore it in the gene sequence of crops that need insect resistance to achieve the same effect that the crop can produce the same insect-resistant substances. This is the general explanation of transgenic technology. [Data + Backing]

Then after the plant is genetically modified,...the human body does not absorb the DNA in the food [Warrant2]. DNA is broken down into nucleotides in the small intestine, [Data2]...that is, the DNA sequence of the food does not directly affect the DNA sequence of the human. But it does not mean

that genetically modified foods will not affect people. [Qualifier]For example, the chemical substances produced by different functional proteins produced by different base pair arrangements will definitely affect the human.

It can be seen that learner 1 proposed a rational warrant when explaining his claim, and used enough data to support his reason, establishing a connection between data and claim. For example, his claim is "The DNA sequence of food and will not directly affect the DNA sequence of human". The warrant to support his claim is "Human DNA and plant DNA are similar, but there are also differences". Next he used a lot of scientific data to support his claim. After that, he further proposed backing "The human body does not absorb DNA in food", finally he proposed a qualifier "but it does not mean that GM food will not affect people." In short, learners who can make high-quality arguments, just like learner 1, can make clear warrants to connect scientific data and claim, and can further propose backing, and finally put forward qualifier, forming a complete logical chain of scientific argumentation..

Comment 2(Low-quality arguments, Leaner 2):The reality is so magical. I'm Anti-GM but I still have GM food. My roommate and classmate turned to Cui but he refused to have GM food. This is true .Hahahahaha [Off-topic]. Here are some news. CCTV News: London: Research suggests that Monsanto's GM corn may cause cancer[web link] [Data]

From the comment 2, it can be seen that learners who propose low-quality arguments do not have a systematic argumentation process, and most of them are expressing their own thoughts on the topic, or just list data randomly, lacking scientific data sources. However, data cannot directly explain the claim, because scientific argumentation needs to establish a connection between claim and warrant through data, so as to complete a reasoning process to persuade others. At the same time, there are some learners with low-quality argumentation skills only made comments on irrelevant topics. Although their argumentation scores are low, they can also get a higher number of likes because of their interesting words. This shows that high-like comments don't mean high-quality arguments.

V. CONCLUSION AND DISCUSSION

Through the coding and content analysis of the argumentation discourse in the SSI video discussion area of the online video learning website, this study revealed the overall argumentation performance of learners in the discussion area, and found the argumentation characteristics of high-quality and low-quality arguments through the descriptive statistics of argumentation elements and the content analysis of argumentation discourse.

First of all, in the discussion area, Data and Warrant account for the largest proportion, while Rebuttal and Qualifier account for the least. Data and Warrant, as the largest proportion elements, reflected that most learners can reach the primary stage of argumentation, that is, presenting data and explaining warrants. There are fewer Rebuttal and Qualifier, which indirectly showed that learners are not interactive in the process of argumentation. Learners seem to pay more attention to the proposing and explanation of personal claims, less refute others, and less consider the restrictive conditions for their claims.

Secondly, the high-quality arguments have more sufficient Claim, Data and Warrant, have difficult Qualifier as well, which is very important to propose a complete and scientific argumentation. In addition, the irrelevant content (O) of high-quality argumentation process are much more, this could be due to learners with high-argumentation level have more divergent thoughts, experiences and ideas, and can produce more discourse [16]. The low-quality argumentation mainly proposed Data, with more Off-topic and Rebuttal, and proposed very few Qualifier, which is consistent with the research of Lin [17], that is, Qualifier is the most difficult part in the argumentation. It is worth noting that the Rebuttal of low group is more than that of high group, indicating that individuals in low group tend to refute other people's views and ignore supporting their claims with sufficient evidence and reasons.

Finally, learners with high-quality argumentation skills can make full use of data to support their warrants, and their warrant can connect data and claim, then further propose backing, and finally put forward Qualifier, which forming a complete logical chain of scientific argumentation. While learners in low-quality group do not have a systematic argumentation process, and Off-topic content accounts more, which shows that the argumentation process of low score learners mostly deviates from the argumentation content and lacks logic and scientificity.

To sum up, this study reveals the characteristics of social scientific argumentation in the discussion area of online video learning website, and provides a foundation for further understanding learners' scientific argumentation in the online learning environment, which means to promote the generation of high-quality scientific argumentation.

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