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Exploring the relationship between individual characteristics and argumentative discourse styles: the role of achievement goals and personality traits

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Abstract

Different argumentative discourse styles will have different effects on science learning. Some researchers proposed that two learners' individual characteristics, including achievement goals and personality traits, could be potential factors that induce different argumentative discourse styles. However, the related empirical evidence revealing how the achievement goals and personality traits are related to discourse styles is limited. Therefore, the current study attempted to fill in this gap by conducting a self-designed collaborative scientific argumentation activity and 40 undergraduates participated. Students were arranged into ten groups with four based on their standpoints of the topic, and each team had two supporters and two opponents. Students' achievement goals and personality traits were obtained through questionnaires, and their argumentative discourse styles were characterized by the actual argumentative moves they made during the collaborative argumentation. Through correlation analysis and stepwise regression analysis, the findings reveal that achievement goals could positively and negatively predict different types of argumentative discourse styles while the personality traits could positively predict three types of argumentative discourse styles. Pedagogical implications and future research are discussed at the end of this paper.

Keywords: Collaborative scientific argumentation, Discourse styles, Achievement goals, Personality traits

Introduction

Scientific argumentation is an essential scientific practice activity advocated by the Next Generation Science Standards (NGSS, 2013; NRC, 2012). A large number of studies have shown that it's a core skill for young people to obtain scientific literacy and develop their critical thinking (Duschl & Osborne, 2002; Driver et al., 2000; Erduran, 2007). Engaging in collaborative argumentation requires students to make a justified claim based on evidence and to critically identify a claim's weaknesses and limitations (Noroozi et al., 2012; Osborne, 2010; Wecker

& Fischer, 2014), which emphasizes social co-construction of scientific knowledge (Evagorou & Osborne, 2013; Walton, 2009). Previous researchers have identified three types of argumentative discourse, namely deliberative argumentation, disputative argumentation, and quick consensus-seeking (Asterhan, 2018), and pointed out that they have different effects on science learning (Asterhan & Babichenko, 2015; Felton et al., 2009; Schwarz & Baker, 2016). For example, deliberative argumentation, enjoying both criticalness and openness, is regarded as an effective form. However, the disputative argumentation lacking cognitive flexibility and openness to alternative viewpoints is less favorable (Schwarz & Baker, 2016; Felton, Crowell, & Liu, 2015). Researchers, therefore, have attempted to identify the factors that may elicit different types of discourse and previous evidence has revealed

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that learners' individual characteristics could be potential factors that induce argumentative discourse styles (Daly & Bippus, 1998; Nussbaum, 2005; Asterhan & Schwarz, 2016).

Achievement goals and personality traits are two individual characteristics that have been mentioned as the potential factors (Darnon, Harackiewicz, et al., 2007; Darnon et al., 2006; Infante & Rancer, 1982; Blickle, 1995; Blickle, 1997; Nussbaum, 2001; Nussbaum & Bendixen, 2003). Achievement goals lead to different kinds of focus (Ames, 1992; Asterhan, 2018) and orient students to use different strategies to discuss and resolve disagreements with peers (Butler, 2000; Darnon, Butera, & Harackiewicz, 2007; Darnon, Harackiewicz, et al., 2007). Specifically, mastery goals orient students to seek challenges, to construe failure as a sign that they need to learn, and to actively seek cooperation with others (Kaplan, 2004; Levy et al., 2004), while performance goals orient students to attribute failure to a lack of abilities and perceive the peers as a threat (Dweck & Leggett, 1988). So different achievement goals may lead to different argumentative discourse styles. In addition, personality characteristics are always viewed as an approved approach to capturing people's behavior (Tehrani & Yamini, 2020). Some investigations have revealed the relationship between personality traits and conflict management behaviors (Amanatullah et al., 2008; Canaan Messarra et al., 2016; Erdenk & Altuntaş, 2017; Park & Antonioni, 2007). For instance, open persons may be more accommodating and less competing, which increases the possibility of pursuing win-win solutions (Neale & Bazerman, 1983; Park & Antonioni, 2007). However, extraverts are sensitive to rewards. Therefore, they tend to use competing strategies rather than accommodation or avoiding strategies (Gray, 1981; Barrick et al., 2002). Arguments between students and peers with different opinions can be considered a cognitive conflict. Therefore, students with different personalities may behave differently when faced with arguments (Blickle, 1995, 1997; Nussbaum & Bendixen, 2003). However, the relationships between the achievement goals, personality traits and argumentative discourse style are not clear yet. Therefore, this study aims to fill the above-mentioned research gaps by exploring the relationships between achievement goals, personality traits, and discourse styles.

Literature review

Collaborative argumentation

Argumentation is an important practice in science education and has received increasing interest because it has been proved to benefit students' science learning (Asterhan & Resnick, 2020; Giri & Paily, 2020; Erduran, 2007). Compared to individual argumentation, collaborative

argumentation takes place in groups of students when they are asked to develop a strong, tenable group conclusion after comparing, evaluating, and synthesizing different opinions (Asterhan & Schwarz, 2009; Evagorou & Osborne, 2013). A high level of oppositional discourse between group members (e.g., challenging, critiquing, and evaluating the ideas of others) could lead to intellectual rigor and constructive criticism, which help students eliminate, revise invalid ideas and contribute to a better group outcome.

Previous research has identified three types of argumentative discourse in collaborative argumentation, namely deliberative argumentation, disputative argumentation, quick consensus-seeking and they have different effects on learning. Deliberative argumentation is regarded as more effective for learning because students not only carefully review, challenge, and compare different ideas but also express and reflect upon their own views, which enjoy both criticalness and openness (Asterhan & Babichenko, 2015; Asterhan & Schwarz, 2016). However, the deliberative argumentation is hard to achieve because students may feel uncomfortable being challenged or having to challenge the ideas of their partners, which may raise uncertainty about their own competence (Butera & Mugny, 1995; Darnon, Harackiewicz, et al., 2007). In order to avoid embarrassment or disharmony, learners may choose to prevent disagreements and seek a quick consensus without further exploring disputes (Keefer et al., 2000; Weinberger & Fischer, 2006). The learner's ultimate goal of seeking consensus may lead to productive discussions but reaching an open consensus does not lead to expected learning outcomes (Howe, 2009; Keefer et al., 2000). Discussing different views may also lead to disputative argumentation, in which discussants defend a viewpoint and convince opponents by undermining alternative viewpoints (Asterhan & Schwarz, 2016; Felton et al., 2009). Though being rich in critical reasoning, disputative argumentation lacks a collaborative construction and can possibly become personal attacks as well as vicious competition (Felton, Crowell, & Liu, 2015; Li et al., 2021; Woods, 2004), which are less favorable for learning (Asterhan & Babichenko, 2015; Asterhan & Hever, 2015). Therefore, to guide students to participate in productive argumentative discourse, it's necessary to explore the factors that promote or constrain constructive argumentative discourse.

However, some researchers mentioned that the three discourse styles are idealized and, in most contexts, the conversation easily moves from one discourse type to another, which has been called dialectical shift (Walton & Krabbe, 1995; Walton, 2010). Therefore, Gilbert (2013) proposed that to better profile argumentative discourse, it is important to consider discourse styles in terms of

degree “To what degree is this conversation deliberative?” rather than type (“Is this a deliberative dialogue?”). This study follows the previous study and focuses on students’ argumentation tendency rather than directly classifying students’ argumentation into different discourse styles. To distinguish argumentation tendency, one effective way is to observe the argumentative moves students make (van Eemeren, 2019). Asterhan and Schwarz (2009) defined seven different argumentative moves, namely Claims, Requests for claims, Agreements, Supports, Oppositions, Rebuttals, and Concessions and the combination of some certain moves could represent different argumentation tendencies. Supports and Agreements represent the intention to strengthen and verify the epistemic status of an explanation. They usually appear when the participants seriously consider the effective criticism of the partners and adjust their opinions (Asterhan & Schwarz, 2009). Felton et al. (2019) proposed that students in a negotiated state will agree to their partners’ effective criticism (Agreements) and alter their standpoints or arguments accordingly (Supports). Therefore, Supports and Agreements are conducive to the generation of deliberative argumentation (Felton et al., 2019; Nussbaum & Edwards, 2011; Walton, 2010). Rebuttals and Oppositions refer to explicit disputes or criticism about the validity and rationality of others’ views (Asterhan & Schwarz, 2009). Previous studies have proved that groups aiming to win the opponents demonstrated much more rebuttals and oppositions, and also obtained worse learning outcomes (Felton, Garcia-Mila, et al., 2015). The high proportion of Rebuttals and Oppositions in a group may be illustrated that students are more inclined to vie for the right to express and beat opponents rather than showing the openness and acceptance of different viewpoints, which might lead to disputative argumentation (Asterhan, 2013; Felton et al., 2015, 2019). What’s more, Concessions indicate the tendency to simply agree with opposing views without much critical discussion (Asterhan & Schwarz, 2009), representing that the participants intend to obtain a quick consensus and do not explore the differences and disputes deeply. In Felton and Kuhn’s (2001) essential investigation, they found that in the case of quick consensus, Concessions replace the co-constructive argumentative moves and repeatedly occurred.

In order to comprehensively profile students’ argumentative discourse styles, the inclusion of assessment methods that are based on dialogical and pragmatic models of argumentation seems imperative (Baker, 2003). Therefore, this study analyzes students’ actual argumentative moves to identify their argumentation tendencies, more especially, using Supports and Agreements moves to characterize deliberative argumentation tendency, using Rebuttals and Oppositions to characterize the disputative

argumentation tendency and Concession to characterize the quick consensus-seeking tendency.

Achievement goals and discourse styles

Achievement goals have an important impact on students’ learning behavior (Ames, 1992; Asterhan, 2018). There are two types of achievement goals, mastery goals and performance goals (Dweck, 1999; Harackiewicz et al., 1998). When students define success as developing abilities, knowledge, or skills, they pursue mastery goals. On the contrary, when students pursue performance goals, they attribute success or failure to their own capacity. Therefore, they work hard to prove their superior abilities that surpass others (performance-approach goal), or avoid performing inferior ability that is surpassed by others (performance-avoidance goal).

Different goals may lead to different kinds of focus, that is mastery goals favor a focus on the task, whereas performance goals favor a focus on the social comparison (Darnon et al., 2006). Therefore, students with different achievement goals may discuss and resolve disagreements with peers contrarily (Butler, 2000; Darnon, Butera, & Harackiewicz, 2007; Darnon, Harackiewicz, et al., 2007). Students with mastery goals are more willing to cooperate with their peers (Kaplan, 2004; Levy et al., 2004) and to search for information from others (Cheung et al., 1998). They are more likely to have problem-centered deliberative discussions with disagreeing partners (Ames & Archer, 1988; Gabriele & Montecinos, 2001; Harris et al., 2008). However, students with performance goals may perceive the peers as a threat (Ryan & Pintrich, 1997) and intend to avoid deep discussions with others (Karabenick, 2003; Ryan & Pintrich, 1997), which may result in desirable discussion (Grant & Dweck, 2003; Senko & Dawson, 2017). Performance-approach goals orient students to show competence and outperform others in collective argumentation (Hulleman et al., 2010; Grant & Dweck, 2003), which are likely to form disputative discussions (Darnon, Butera, & Harackiewicz, 2007; Darnon, Harackiewicz, et al., 2007). Performance-avoidance goals, on the other hand, are likely to be associated with a tendency towards quick consensus-seeking because it allows students to conceal a lack of competence (Asterhan, 2018). These preliminary findings indicate that achievement goals may lead to different argumentative discourse, but the research exploring the relationships between the achievement goals and different argumentative discourse styles is limited.

There is one notable exception that has explored the relationships between the achievement goals and argumentative discourse styles from Asterhan (2018). He used the self-made PADS self-reported questionnaire to evaluate students’ discourse styles without analyzing

their actual argumentation discourse, and the internal reliability of the questionnaire was reported not high. Asterhan himself also suggested that further empirical research was needed to verify his results. Compared to self-report questionnaires (Asterhan, 2018; Infante & Rancer, 1982; Nussbaum & Bendixen, 2003), analyzing the actual argumentative discourse will be more objective and effective. Therefore, to further verify the relationship between achievement goals and argumentative discourse styles, additional empirical research focusing on actual argumentative discourse and identifying students' argumentative tendencies by analyzing the argumentative moves among students is needed.

Personality traits and discourse styles

Personality refers to the traits and characteristics that make an individual unique (McCrae & Costa Jr., 1997). Each personality type has its own set of strategies and behavior patterns, such as explaining behavior, making requests and apologies, using or avoiding certain words and expressions (Nussbaum & Bendixen, 2003). NEO-Five-Factor model (Costa & McCrae, 1985) classifies personality traits into five dimensions: extraversion (e.g., warmth, gregariousness, assertiveness), openness (e.g., fantasy, aesthetics, feelings), agreeableness (e.g., trust, altruism, compliance), conscientiousness (e.g., competence, order, dutifulness) and neuroticism (e.g., anxiety, angry hostility, depression). Studies have shown that Big Five personality is related to students' dispositions to approach or avoid arguments (Infante, 1987; Blickle, 1995; Nussbaum, 2001, 2003).

People's personalities determine their conscious and mostly subconscious behavior trends in communication. Some investigations have shown the relationship between personality traits and conflict management styles (Amanatullah et al., 2008; Canaan Messarra et al., 2016; Erdenk & Altuntaş, 2017; Park & Antonioni, 2007). More specifically, individuals who are more openness intend to divergence and ideation while those who are lower in openness prefer convergence and idea selection (Mohammed & Angell, 2003). This suggests that openness may be critical to resolving conflicts constructively (Park & Antonioni, 2007). Agreeableness is characterized as a strong motivation to maintain positive relations with others (Wiggins, 1991). Agreeable persons are likely to avoid conflicts (Suls et al., 1998) and to conform to others' demands when involved in conflicts (Johnson & Ostendorf, 1993). However, people high in neuroticism are anxious, emotionally unstable, easily embarrassed, and depressed (Wiggins, 1996). They are less likely to persist in effortful analysis or be emotionally stable when facing interpersonal conflicts (Antonioni, 1998; Moberg, 2001). Therefore, we can see people with different personalities have different

behavior when they face conflict. Conflict is an "interactive process manifested in incompatibility, disagreement, or dissonance within or between social entities" (Rahim, 1992, p. 16). Students who hold different opinions in collaborative argumentation can also be considered conflicting. We can infer that people with different personalities may also behave differently when faced with arguments.

In previous research, Blickle (1995) focused on the relationship between the Big Five personality and the tendency to approach or avoid arguments. The study suggested that the tendency to approach arguments is significantly correlated with openness. Additionally, the score on the tendency to avoid arguments is correlated with the score on neuroticism. Nussbaum and Bendixen (2003) further confirmed that high warmth and low assertiveness in extraversion predicted argument avoidance. However, the scant studies pertaining to personality traits and discourse styles only revealed the relationship between students' personality traits and their tendency to approach or avoid arguing with others. The relationship between students' personality traits and argumentative discourse style is still unclear and worthy of exploring for better implicating argumentation in the authentic classroom.

Therefore, to fill the above-mentioned research gaps, the current study conducts a self-developed collaborative argumentation activity and characterizes students' argumentation tendency by coding their actual argumentative moves. Then, this study explores the relationship between achievement goals, personality traits, and discourse styles. There are two specific questions guiding this research:

1. What is the relationship between achievement goals, personality traits, and argumentative discourse styles?
2. What predictive role do learners' achievement goals and personality traits play on their argumentative discourse styles?

Method

Participants and context

Previous research indicated that students produce a little argumentative discourse in general collaborative learning activities (Isohätälä et al., 2018). Therefore, this study designed a scientific argumentation activity titled "Is the Fast Diet a healthy way to lose weight", which is a wild-concerned topic among undergraduates related to nutrition and human health and is complex enough to provoke group argumentation. This activity's aims are not only to help students better understand the Fast Diet and the healthy way to lose weight but also to enable students

to learn how to make arguments. This study recruited 40 undergraduates (male 10) from a normal university in Beijing, China through schools' online official forum. All participants' age, majors, and their standpoint on the fast diet (Is the Fast Diet a healthy way to lose weight?) were investigated through an online questionnaire. Most students majored in education and literature, and students from nutrition and sports majors were excluded. Participants were divided into ten groups of four students based on their standpoints on the fast diet and each group included two supporters and two opponents of the fast diet. The activity took place in a research space with individual cameras and microphones for each participant. And the activity is self-directed. All student's ethical approvals were obtained.

Argumentation activity

Before the argumentation, participants were asked to answer the Achievement Goal and NEO-FFI questionnaires online (Fig. 1). Then, instructions about the activity and the requirements of drawing the argument diagrams were conducted to students. Argument diagrams have been proved an effective approach to visualize the arguments and support collaborative argumentation (Isohätälä et al., 2018). Additionally, reading materials were distributed to participants, which provide relevant scientific knowledge of nutrition and authoritative scientific research data about the Fast Diet for reference. Participants could quote the provided material or search for additional evidence on the internet to support their claims. Then, students took 15 minutes to draw the first individual argument diagram based on their existing standpoints in which students could get familiar with the learning materials and prepare for collaborative argumentation. Afterward, a 45-minute collaborative argumentation was conducted in which students convinced each other, reached a consensus and finished the group argument diagram (Fig. 2). Three fundamental elements were included in the argument diagram, namely, claim (final claim, supporting claim, counterclaim), evidence (supporting a claim or rebuttal) and rebuttal (refuting a counterclaim but always supporting the final claim). As the task required, the argument diagram includes only one final claim, and those ideas opposing the final claim could be added as counterclaims. Different colors

represent different students, and different shapes represent different elements of the argument.

Data collation

Data for this study came from multiple sources, including audios of collaborative argumentation and two questionnaires. Each group's audio is collected by a voice recorder and used to analyze participants' argumentative discourse. Questionnaires are collected online (<https://www.wjx.cn/jq/101155416.aspx>) and used to measure participants' achievement goals and personality characteristics. Ten groups' audios (8.3 hours) and 40 students' questionnaires were collected. The reliability coefficient to ensure the internal consistency of the questionnaires is as follows:

(1) Achievement Goal Questionnaire

Personal achievement goals were assessed by using the 16-item Chinese version of the Achievement Goal Questionnaire (Elliot & Church, 1997), which has been shown to have reliability in Chinese samples (e.g., Zong et al., 2017). Students rated their agreement with predefined statements on a Likert scale, ranging from 1 (not true for me) to 5 (very true for me). The survey included five mastery goal items (e.g., "It is important for me to understand the content of this course", $\alpha = .792$), six performance-approach goal items (e.g., "It is important for me to perform better than the other students", $\alpha = .854$), and five performance-avoidance goal items (e.g., "I often worry about the possibility of getting a bad grade in this class", $\alpha = .748$).

(2) NEO Five-Factor Inventory

We use the 60-item adult form of the NEO Five-Factor Inventory (NEO-FFI, Costa Jr. & McCrae, 1992) to measure personality traits, which was translated to Chinese and verified by Yao and Liang (2010). Students rated their agreement with predefined statements on a Likert scale, ranging from 1 (not true for me) to 5 (very true for me). The survey includes five dimensions, each of which has 12 items: extraversion ($\alpha = .78$), openness ($\alpha = .79$), agreeableness ($\alpha = .72$), conscientiousness ($\alpha = .74$) and neuroticism ($\alpha = .77$).

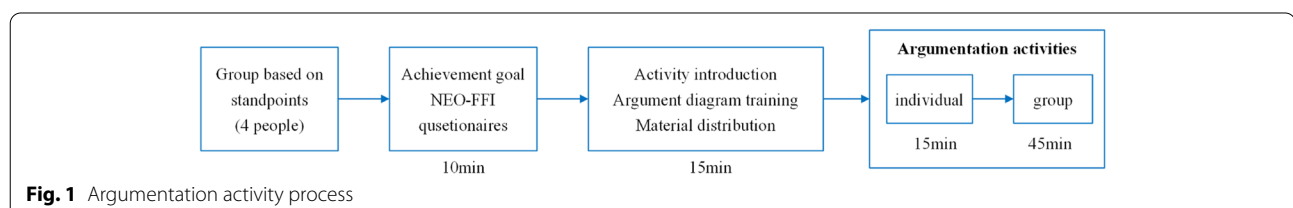
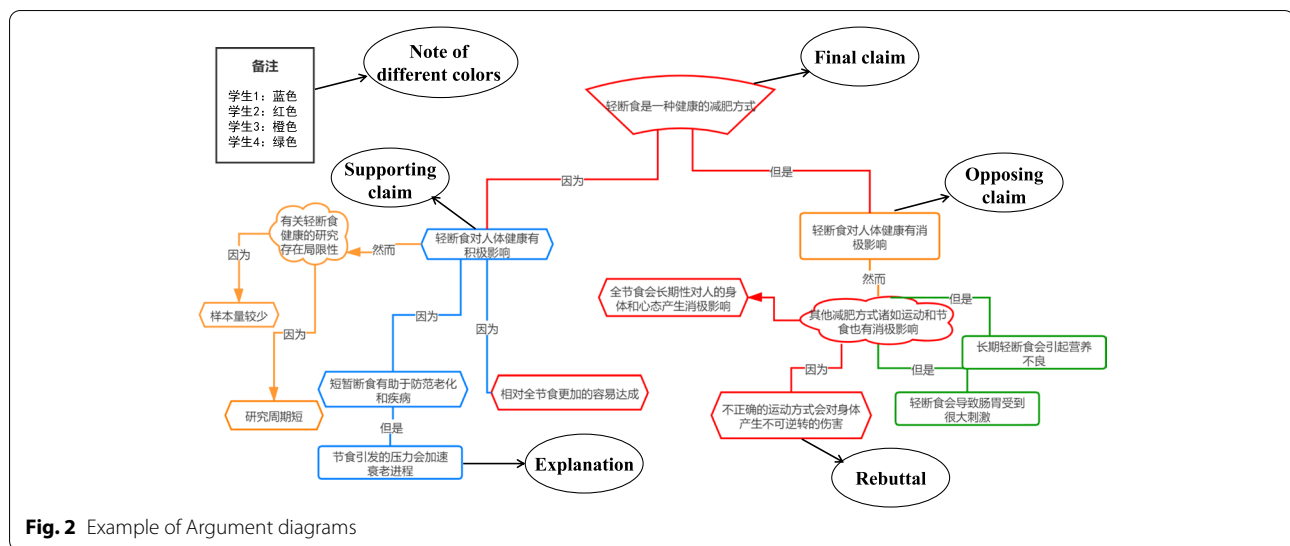


Fig. 1 Argumentation activity process



Data analysis

In order to identify students' argumentation tendency, this study adopted the coding scheme developed by Asterhan and Schwarz (2009) (Table 7 in Appendix presents definitions of each category together with an example from the data) in which seven different argumentative moves are defined: claims, request for claims, simple agreements, supports, simple oppositions, rebuttals, and concessions. All students' discourse was coded by two independent coders who received training in applying the coding schemes. The inter-rater reliability was satisfactory (Cohen's Kappa = .79). After the independent coding, the two coders also discussed all of the discrepancies face-to-face until a consensus coding was achieved.

Ten audios of participants' collaborative argumentation were analyzed. First, we transcribed the audio of collaborative argumentation into text. Following the coding approach of previous research (see Iiskala et al., 2011), the unit of analysis in this study was at the episodic level. The episodes consisted of several utterances that reflected a specific argumentative move (Asterhan & Schwarz, 2009). The analysis concentrated on the argumentative moves between the speaker with the two opponents. In order to visualize the process of argumentation, we use the flowchart (Fig. 3) to present the argumentative moves (see similar research, e.g., Isohätälä et al., 2018). The numbers represent the discourse rounds, and the letters represent the four participants. After that, we identified the types and numbers of each participant's argumentation moves in the collaborative argumentation.

In our research, we defined three types of argumentation tendency: deliberative argumentation tendency

(Agreement, Support), disputative argumentation tendency (Opposition, Rebuttal), and quick seek consensus tendency (Concession) (Asterhan & Schwarz, 2009; Felton & Kuhn, 2001; Felton, Crowell, & Liu, 2015; Felton et al., 2019). We sum all argumentative moves which represent the same argumentation tendency and divide this number by the sum of all the argumentative moves produced by each student. This proportion was used to represent each student's tendency of three argumentative discourse styles (for example, see Table 1).

After that, to obtain the score of each dimension of the Achievement Goal and NEO-FFI questionnaires, we calculated the average score of all the items in each dimension. Then, we obtained a set of data on each student's discourse styles, achievement goals, and personality traits (for example, see Table 2).

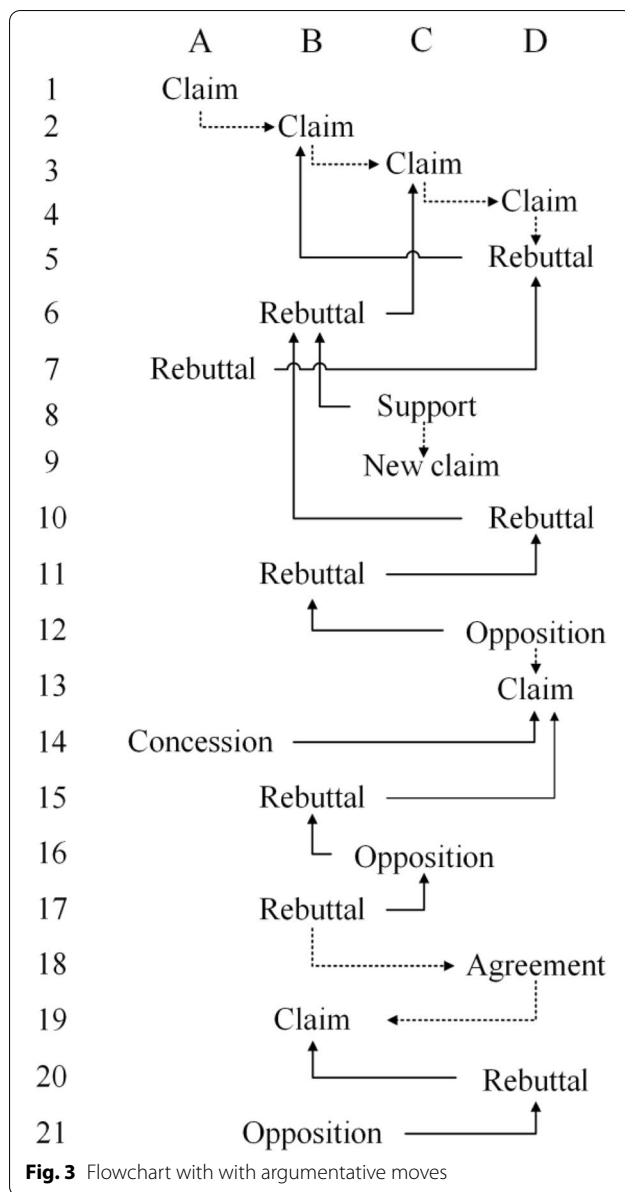
Based on this, two Pearson correlation analyses were adopted to analyze the relationship between the Achievement Goal and the argumentative discourse style, NEO-FFI dimensions and the argumentative discourse style. Then, regression analyses between the dimensions of the two instruments and the discourse style were implemented. In our research, we regarded the Achievement Goal and NEO-FFI factors as predictor variables and three argumentative discourse styles as the outcome variable. Therefore, a total of 6 regression equations were conducted.

Results

Achievement goals and discourse styles

Correlation between the achievement goal and discourse style

Before the correlation analysis, we performed descriptive statistics on discourse styles and achievement goals. The



charts below present the minimum, maximum, mean, and standard deviation of each dimension of students' argumentative discourse styles (Fig. 4) and achievement goals (Fig. 5).

In order to understand the association between the participants' argumentative discourse styles and their achievement goals, Pearson correlation analysis was performed. Table 3 shows the correlation values among all the factors.

First, it shows that mastery goal is positively correlated to deliberative argumentation, and the correlation coefficient value is relatively high. The Performance-approach goal is negatively correlated to deliberative argumentation. Second, the performance-approach goal has a relatively closer relation with the disputative argumentation than the performance-approach goal, which means that the participants who pursue the performance-approach goal tend to engage in disputative argumentation. Third, the performance-avoidance goal is significantly correlated to quick consensus-seeking, which indicates that the students who pursue performance-avoidance goals tend to quickly seek consensus.

Stepwise regression analysis of predicting argumentative discourse style based on achievement goal

Then this study conducted the regression analysis to further evaluate the predictive power of the achievement goal for the argumentative discourse style. We constructed three regression equations with deliberative argumentation, disputative argumentation, and quick consensus-seeking as the outcome variables, and three dimensions of achievement goals as the predictor variables. Results from the regression analyses are presented in Table 4.

Mastery goal strongly predicts deliberative argumentation ($\beta=0.612$), whereas performance-approach goal does not. It indicates that mastery goal plays an important role in deliberative argumentation. In other words,

Table 1 Argumentation tendency of four in a group

Student in same group	Argumentative moves (f)				Discourse tendency (%)			
	A	B	C	D	A	B	C	D
Deliberative argumentation								
Agreement	2	2	1	2	31%	38%	25%	40%
Support	5	3	1	4				
Disputative argumentation								
Opposition	1	2	2	2	36%	30%	25%	33%
Rebuttal	7	2	0	3				
Quick seek consensus								
Concession	3	2	3	3	17%	18%	37%	20%

Table 2 discourse styles, achievement goals, and personality traits of four in a group

	Student A	Student B	Student C	Student D
Discourse style				
Deliberative argumentation	31%	38%	25%	40%
Disputative argumentation	36%	30%	25%	33%
Quick seek consensus	17%	18%	37%	20%
Achievement goal				
Mastery goal	2.33	4.17	4.17	3.33
Performance-approach goal	4.80	1.60	3.40	3.00
Performance-avoidance goal	4.40	1.20	4.20	3.80
Big five personality				
Extraversion	4.75	3.58	4.58	3.25
Openness	2.33	3.92	3.58	3.67
Agreeableness	3.17	4.17	4.00	3.83
Conscientiousness	3.67	4.00	2.50	3.08
Neuroticism	2.25	2.47	4.42	2.67

the participants who pursue mastery goals will be more likely to form deliberative argumentation. In addition, performance-approach goal strongly predicts disputative argumentation ($\beta=0.57$). That is, the students whose score is high in performance-approach goals tend to participate in disputative argumentation. Let's take student A

as example, who has high score in performance-approach goals (Extract 1):

Extract 1

Student A: I don't understand what you mean (with high scores of performance-approach goals).

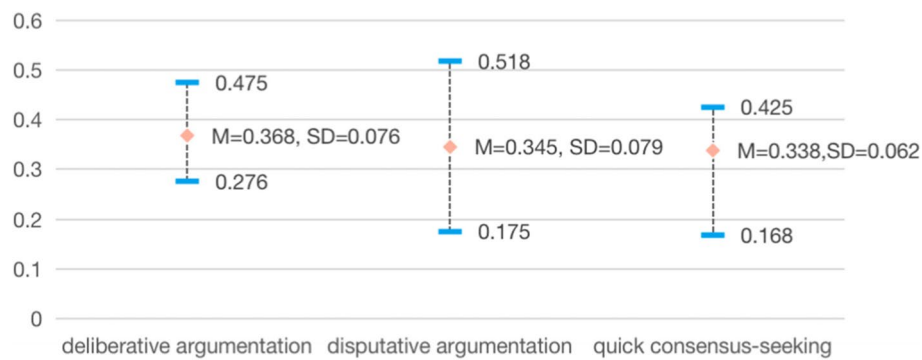
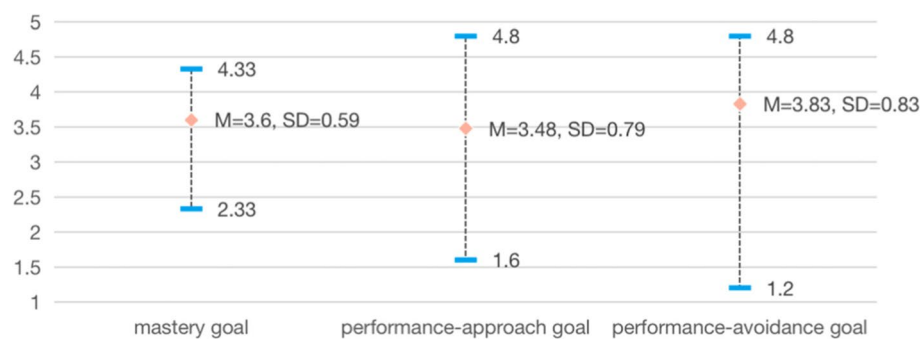
**Fig. 4** Descriptive statistics for three types of argumentative discourse styles**Fig. 5** Descriptive statistics for three types of achievement goals

Table 3 Correlation between the achievement goal and discourse style

	Deliberative argumentation	Disputative argumentation	Quick consensus-seeking
Mastery goal	.730**	-.147	-.239
Performance-approach goal	-.404*	.611**	-.215
Performance-avoidance goal	.032	.156*	.627**

* $p < .05$; ** $p < .01$

Student B: We can see from this study that.... [Not finished yet, interrupted by student 1]

Student A: Wait a minute, we're not talking about the same thing. You are talking about your own experience. Why you think you are right? (Rebuttal- disputative argumentation tendency)

Student B: I'm giving my opinion.

Student A: Your point of view is not sufficient (Opposition-disputative argumentation tendency). How can you prove it's harmful?

Student B: How can you prove it's healthy?

Student A: What I've said before is proving that Fast Diet is healthy. (Rebuttal- disputative argumentation tendency). Obviously my point is correct.

Interestingly, the performance-avoidance goal is also found to have negative predictions for disputative argumentation ($\beta = 0.149$). Besides, of the three achievement goals, only the performance-avoidance goal is a significant positive predictor of quick consensus-seeking ($\beta = 0.256$). This result indicates that the performance-avoidance goal plays a role in the form of quick consensus-seeking. In sum, the regression results suggest that the achievement goals play a powerful role in predicting three argumentative discourse styles.

Table 4 Stepwise regression model for predicting students' discourse style

	Beta	t	R ²
Deliberative argumentation			
Mastery goal	0.612	5.908***	0.33
Disputative argumentation			
Performance-approach goal	0.57	5.32***	0.27
Performance-avoidance goal	-0.149	-1.378*	
Quick consensus-seeking			
Performance-avoidance goal	0.256	2.21**	0.48

* $p < .05$; ** $p < .01$; *** $p < .001$

Big Five personality and discourse styles

Correlation between the Big Five personality and discourse style

We first performed descriptive statistics on Big Five personalities. Figure 6 presents the minimum, maximum, mean, and standard deviation of each dimension of students' Big Five personalities.

Then, we conducted the Pearson correlation to test the association between the argumentative discourse styles and big five personalities. Table 5 shows the correlation values among all the factors.

Statistically significant positive correlations are found between openness, agreeableness, and deliberative argumentation. And openness has a relatively closer relation with deliberative argumentation than agreeableness, which indicates that open students tend to participate in the deliberative argumentation. Besides, among the five factors of Big Five personality, only the extraversion is significantly correlated to disputative argumentation. It means that the participants who score high on extraversion tend to form disputative argumentation. In addition, openness, agreeableness, neuroticism are positively correlated with quick consensus-seeking. The correlation coefficient value between neuroticism and quick consensus-seeking is relatively high. This finding echoes the viewpoint that neurotic students tend to avoid arguments (Blickle, 1997).

Stepwise regression analysis of predicting argumentative discourse style based on Big Five personality

In order to further evaluate the predictive power of the Big Five personalities for the argumentative discourse styles, we conducted the stepwise regression analysis. We constructed three regression equations with deliberative argumentation, disputative argumentation, and quick consensus-seeking as the outcome variables, and five dimensions of personality traits as the predictor variables. Results are presented in Table 6.

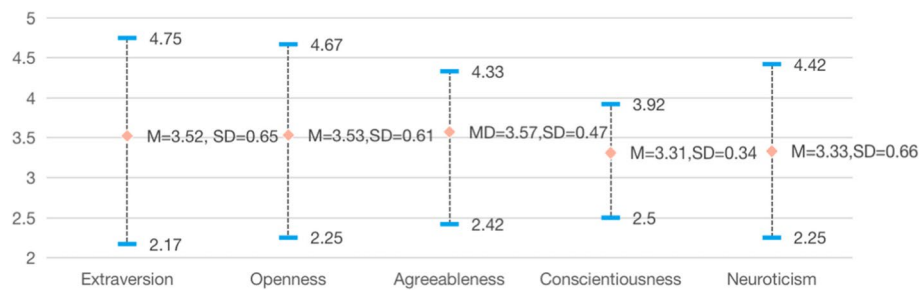


Fig. 6 Descriptive statistics for Big Five personality

We can find that openness strongly predicts the discourse styles of deliberative argumentation ($\beta = 0.612$). Moreover, agreeableness is also found to have positive predictions ($\beta = 0.392$). This result indicates that openness and agreeableness play an important role in deliberative argumentation. In addition, only the extraversion can positively predict the disputative argumentation ($\beta = 0.72$). The participants who score high on extraversion would be more likely to form disputative argumentation. Besides, neuroticism strongly predicts quick consensus-seeking ($\beta = 0.509$). That is, the students with a higher score of neuroticism tend to quickly seek consensus. To illustrate this finding, we present the responses of student D with high neuroticism scores to arguments as an example (Extract 2):

Extract 2

Student C: I think Fast Diet isn't a healthy way to lose weight.

Student D: Yeah. It may be an effective way to lose weight, but not healthy (with high neuroticism scores).

Student E: But for obese people, obesity can also lead to many diseases. So Fast Diet is a healthy way for them to lose weight. How about you?

Student D: Ok, you may be right. I have no opinion (Concession-quick seek consensus tendency).

Student C: I still don't agree with your point of view.

Student E: I don't think we can reach a consensus.

Student D: Stop arguing, can we just pick a point of view whatever? (Concession-quick seek consensus tendency).

Surprisingly, agreeableness can positively predict quick consensus-seeking ($\beta = 0.473$). In a word, we think that the Big Five personality can effectively predict students' argumentative discourse styles.

Discussion

This study explored the relationship between achievement goals, personality traits, and discourse styles of collaborative scientific argumentation. We characterized students' discourse style based on the argumentative moves. Then, correlation and stepwise regression analyses disclosed the intricate relationship between the achievement goals, personality traits, and argumentative discourse style.

Predictive roles of achievement goals on argumentative discourse styles

At present, some research on achievement goals in individual settings has shown that they lead to different

Table 5 Correlation between the Big Five personality and discourse style

	Deliberative argumentation	Disputative argumentation	Quick consensus-seeking
Extraversion	.183	.796**	-.165
Openness	.761**	-.042	.417*
Agreeableness	.650**	-.294	.503**
Conscientiousness	-.101	.299	-.299
Neuroticism	-.054	-.335	.525**

* $p < .05$; ** $p < .01$

Table 6 Stepwise regression model for predicting students' discourse style

	Beta	t	R ²
Deliberative argumentation			
Openness	0.612	4.565***	0.69
Agreeableness	0.392	2.831**	
Disputative argumentation			
Extraversion	0.72	5.908***	0.56
Quick consensus-seeking			
Neuroticism	0.509	3.176**	0.45
Agreeableness	0.473	2.347*	

* $p < .05$; ** $p < .01$; *** $p < .001$

responses when students meet with challenges and difficulties (Butler, 2000; Midgley et al., 2001). The present results confirm that students' intentions to engage in three argumentative discourse styles (deliberative argumentation, disputative argumentation, and quick consensus-seeking) were associated with individuals' achievement goals.

The first finding of regression analysis reveals that mastery goal is a significant predictor of deliberative argumentation. Mastery goal has been shown to favor the search for information from others (Cheung et al., 1998) and is willing to cooperate with others (Kaplan, 2004; Levy et al., 2004). Students who pursue mastery goals tend to carefully review, challenge, and compare different ideas, and engage in a critical, yet constructive discussion with a disagreeing peer. Our study further verified the results of Asterhan (2018). However, in his study, a weak association between performance-avoidance goal and deliberative argumentation was found, which was not replicated in our study. The reason for this difference may be that the correlation is not strong, and more research is still needed to explore the relationship between the performance-avoidance goal and deliberative argumentation.

This study also finds that performance-approach goal and performance-avoidance goal are two major predictors of disputative argumentation. It suggests that students who endorsed performance-approach goals show more willingness to engage in disputative discourse, which aligns with previous work (Darnon et al., 2006; Sommet et al., 2015). When students pursue the performance-approach goals, they attribute their success or failure to their own ability and strive to prove their excellent ability to others (Nicholls, 1984; Elliot & McGregor, 2001). Therefore, performance goals usually lead students to react to a conflict by trying to show that they are right and others are wrong (Darnon et al., 2006), which possibly leads to disputative argumentation. Additionally, it is worth noting that we find performance-avoidance goal has a negative predictive effect on disputative argumentation. Even though this predictive effect is small, the finding could be explained that when students pursue performance-avoidance goals, they try to avoid themselves performing worse than others (Harackiewicz et al., 1998). This could also be explained from the cultural perspective. For Chinese students, they were influenced by face culture. Most of them are afraid of losing face, so they tend to hide their honest opinions in order to expose their shortcomings (Liu et al., 2018; Zheng et al., 2018; Zhan, 2019). In this situation,

students will avoid too many disputes and are unwilling to participate in disputative argumentation. Finally, performance-avoidance goal is also found to be associated with quick consensus-seeking. When students strive to avoid the demonstration of inferior performance (high performance-avoidance goals), they are more likely to let the peer lead and decide. In this situation, they tend to seek a quick consensus without further exploration of differences (Asterhan, 2018).

Predictive roles of Big Five personality on argumentative discourse styles

The results of the recent studies have shown that learners' personality traits (Big Five Personality Traits) are related to their tendency to approach or avoid arguing with others (Babakhani, 2014; O'Connor & Paunonen, 2007; Feyter et al., 2012). The current study further reveals that the different personality traits could lead to different argumentative discourse styles.

The first finding of regression analysis reveals that openness and agreeableness are two significant predictors for deliberative argumentation. It suggested that open students tend to comprehensively consider their own and opposing ideas when facing disputes (Komaraju et al., 2011; Lounsbury et al., 2003), thus easily forming deliberative argumentation. Blickle (1997) found that scores on openness to experience correlated significantly with those on the tendency to approach arguments. Our study not only confirms this correlation but also further proves that openness can predict deliberative argumentation. In addition, agreeableness can also significantly predict deliberative argumentation. This could be explained by cultural differences that most Chinese students are influenced by collectivism (Hofstede, 1980). Collectivist cultures attach more value to interpersonal harmony and common group goals (Inglehart, 2006). Under the influence of collectivism, Chinese students are more likely to have a high agreeableness score. Agreeable students tend to be trusting, cooperative and may be receptive to different views (De Raad & Shouwenburg, 1996; Vermetten et al., 2001). And the groups with a higher average agreeableness score tended to report fewer conflicts and maintain a harmonious atmosphere (Yu, 2021). These are all key factors of deliberative argumentation. Additionally, extraversion significantly predicts disputative argumentation. Similar results could be found in Nussbaum's (2001) study. In an in-depth observational study, he found a greater tendency of extroverts to engage in argumentative behaviors. Our study further verifies these results and could be explained by that the

personality trait of extraversion usually reflects how outgoing and assertive individuals are in social situations (Nussbaum & Bendixen, 2003). The extroverts are much more confident in their ideas and interpersonal skills (Nussbaum, 2001; Matthews & Zeidner, 2004), so they are more likely to occupy a dominant position in the argumentation, which may lead to the disputative argumentation.

Additionally, this study also indicates the significance of neuroticism and agreeableness for predicting quick consensus-seeking. Neuroticism is likely to focus on superficial features of the studied material instead of achieving a deeper, meaningful understanding of it (Entwistle & Waterston, 1988). Moreover, they have difficulties in coping with academic challenges and dealing with disputes (Elliot & McGregor, 2001). Blickle (1997) pointed out that the scores on neuroticism correlated significantly with the tendency to avoid argument. The present study further suggests that neurotic students are more likely to give up quickly in argumentation and form a consensus with others. In particular, agreeableness also presents such a pattern. Agreeableness involves compliance and cooperativeness, making the agreeable individuals more likely to adjust their original views in response to external demands (Slaats et al., 1997; Vermetten et al., 2001). Even though agreeableness has a less predictive effect on quick consensus-seeking, the results still reveal that agreeable students tend to maintain a harmonious discussion atmosphere (Chamorro-Premuzic & Furnham, 2003), so it's easy to compromise in intense discussions and quickly seek consensus.

Conclusion and implications

In this study, we refined the analysis approach of argumentative discourse by focusing on the actual argumentative moves rather than using questionnaires and therefore, profiled students' argumentative discourse styles more comprehensively. In addition, this study initially provided a deeper insight into the relationships between students' achievement goals, personality traits, and argumentative discourse styles. Results unpack the significant role of achievement goals and Big Five personality to predict argumentative discourse styles. These findings could provide important implications for applying argumentation in the authentic classroom and promoting students' learning gained from argumentation by fostering different discourse styles.

On the one hand, this study's results can better help teachers understand students' behavior in collaborative argumentation activities. For example, students' frequent rapid consensus-seeking argumentative moves may be influenced by neurotic personality. On the other hand, according to our results, teachers could lead students to conduct deliberative argumentation, which is more beneficial for their conceptual understanding and conceptual transformation (Asterhan et al., 2010; Asterhan & Babichenko, 2015; Schwarz & Baker, 2016). To maximize the learning outcomes from argumentation, teachers could consider orchestrating instructional designs to guide students' goals towards co-construct knowledge and more important, deep understanding, and to avoid guiding towards beating or winning the debate. For example, by guiding them to focus on problem-solving together rather than personal competition, through which students are more likely to conduct efficient deliberative argumentation. In addition, teachers can better understand the argumentative tendency of students with different personalities and consider whether and how the argumentation activity can be applied to the class. For instance, facing neurotic students, teachers should put them in groups with agreeable peers, which appear to be able to moderate the tension.

Limitations and future studies

There are several limitations of this study. The sample size is related small and the participants came from only one university, which could limit the generalizability of the findings. Besides, our participants all resided in mainland China, and the findings might be affected by the Chinese socio-cultural context. In the future, the number of research samples and duration of the activity should be expanded. Replications in other cultural contexts and topics could also be considered to verify the results.

In addition, this study only explored the predictive effect of achievement goals and personality traits on argumentative discourse styles, ignored the potential interaction effect between these two factors. Stepwise regression analyses may be limited in revealing the potential structural relationships. And this research did not include other relevant variables that may lead to differences in discourse style preferences. Future research can dig out more influencing factors of argumentative discourse style, and take into account the potential overlap between various factors and determine the unique contribution of each.

Appendix

Table 7

Table 7 Categories of the argumentative moves

Category	Description and examples
Claim	A proposed explanations (or part of it) to the phenomena. Only the first turn involved in the proposition of the explanation is considered a claim. Example: I think Fast Diet is a healthy way to lose weight.
Req.claim	Request for a solution/explanation, request for an evaluation of a proposed explanation (or part of it), or request for a stance toward an explanation that has been proposed. Example: What do you think are the criteria for judging whether it is a healthy way to lose weight?
Agreement	Overt verbal utterances of unreasoned agreement, a simple reconfirmation of the correctness of (part of) a certain explanation. Example: Yeah, I think so too.
Support	Any verbal, reasoned utterance that is intended to strengthen the epistemic status of an explanations. Example: Fast Diet can play a role in regular detoxification of the human body, which can trigger long-term changes in the body that help protect against aging and disease.
Opposition	Overt verbal utterances of disagreement, simple opposition to (part of) a certain solutions without providing any further justifications/ reasons of why they think so. Example: I don't think Fast Diet is a healthy way to lose weight.
Rebuttal	Any verbal, reasoned utterance intended to weaken the epistemic status of a solution. Example: Fast Diet is not necessarily a good way, it will bring bad psychological effects on people. Some studies have shown that Fast Diet may make people often dizzy and cold.
Concession	Any overt verbal, unreasoned expression of agreement in a critical constellation, that is: when the content the discussant agrees to was previously opposed by that same person. Example: A: Fast Diet is a healthy way to lose weight. B: I think so. C: But some studies show that weight loss due to Fast Diet can be easily rebounded by the stress it causes, which has no effect in the long run. So Fast Diet is not a healthy way to lose weight. B: You are right.

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Authors' contributions

CYS led the research project, analyzed the data and wrote the manuscript. LXR conducted the data collection and analysis. LYY supervised the research and revised the manuscript. All authors read and approved the final manuscript.

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Availability of data and materials

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Competing interests

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