

## A model of factors influencing in-service teachers' social network prestige in online peer assessment

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The rise of teacher training in online interactive learning environments has contributed to teachers' professional development and brought new vitality to the informatisation of education. Many researchers have reported that there is a participation gap in online interactive learning environments. Research on the factors influencing this is very important. Social network prestige, which measures the degree to which learners gain peer attention in directed social networks, is one of the important metrics to characterise the participation gap. In this study, we offered an online teacher training course, and 1438 in-service teachers from primary and secondary schools attended. Among them, we selected 457 in-service teachers who participated in the three peer assessment activities as the final participants. To analyse the factors influencing learners' social network prestige in online peer assessment, we first conducted a partial least squares structural equation modelling analysis to construct a model of factors influencing social network prestige. Then, we adopted several semi-structured interviews to investigate learners' perspectives to provide an in-depth analysis of the factors influencing social network prestige. The purpose of this study was to gain insight into the participation gap in online interactions and make effective suggestions on how to improve learning performance in online peer assessment.

*Implications for practice or policy:*

- Course designers could improve the design of the introduction to peer assessment to motivate learners and enhance their acceptance of the activities.
- Course designers could reduce participation gap by assigning work from low-prestige learners to high-prestige learners in a non-mandatory way later in the course.

*Keywords:* online peer assessment, participation gap, social network prestige, participation behaviour, attitude towards participation, motivation to participate

### Introduction

The rapid development of Internet technology has meant that teacher training is no longer limited to face-to-face training. One important training mode is teacher training in an online interactive learning environment, which promotes teacher professional development by significantly enhancing the training effect and improving the quality of teachers (Ma et al., 2020). In an online interactive learning environment, interactions between learners create complex social networks. Some learners in online learning communities can easily attract the attention of other learners and thus gain more benefits, including learning performance and learning emotions, during the process of interaction (Russo & Koesten, 2005). However, some learners have difficulty attracting others' attention, resulting in gaps in learning opportunities and learning outcomes (Mehall, 2020).

The participation gap can describe the phenomenon mentioned above. It is a state of imbalance in the social relations of learners in online learning, characterised by differences in participation opportunities and interactions. For example, Vaquero and Cebrian (2013) have described the participation gap as high-

performing students being more likely to socialise with each other, while low-performing students fail to gain reciprocity in their interactions. The participation gap makes it possible for interactions in the same learning environment to be valued at different levels for each learner, resulting in disparities in learning opportunities and outcomes (Mehall, 2020).

The attention level of a participant in a social network is referred to as their social network prestige (Chen & Huang, 2019). It is a measure of the interactive influence of an individual learner at the micro level and an important factor in facilitating effective learning. Therefore, this study attempted to understand the participation gap in online interactive learning by constructing a model of factors influencing social network prestige, aiming to propose practical ways to reduce the participation gap.

## Literature review

### Teacher training in an online interactive environment

Teacher training in an online interactive environment plays a significant role in promoting teacher professional development. On the one hand, teacher training in an online interactive environment breaks through the constraints of time and space, providing learners with opportunities for independent learning (Koukis & Jimoyiannis, 2019). Different types of training resources with different focuses can be aggregated to maximise the use of learning resources (Boltz et al., 2021; Parsons et al., 2019). On the other hand, an online interactive environment means that learners have more opportunities to communicate, reducing the loneliness of online learning (Crane & Comley, 2021) and, at the same time, integrate individual learning into the group knowledge construction of social networks (Laurillard, 2016).

When it comes to teacher training in online interactive learning environments, researchers have expressed concerns about the participation gap. Although teacher-learners participating in online teacher training have a high level of social interaction (Ma et al., 2022), pre-service teachers who participated in online peer assessment exhibited different levels of participation in their behaviour (Vásquez-Colina et al., 2017). Through a study of online peer-review logs and interview transcripts of in-service teachers engaged in physical education, Sato and Haegele (2018) found that otherwise equivalent teachers had different levels of gains following the interaction. Macia and Garcia (2016) confirmed that the participation gap in Internet-based communities of learners has a significant impact on their emotional support and professional development. Thus, more research focusing on the participation gap in online interactive teacher training is warranted.

### Social network prestige

In an online peer assessment network, the participation gap can be characterised in sociological terms and related metrics, such as social network prestige, prominence (Yen et al., 2022) and the Mathew effect (Perc, 2014). Compared with other metrics, social network prestige exists in directed networks and describes the participation gap on a micro level of social network analysis (Bond & Gaoue, 2020; Ruggiero, 2016). Prestige reflects the characteristics of the number of responses a learner receives in a social network (Zou et al., 2021). In empirical research, prestige could be observed through various network metrics such as network density, in-degree/out-degree and centrality (Aerne, 2020; Barnett, et al., 2010).

*Prestige bias* is an effective mechanism for social learning; learners prefer to ask for advice from people with high prestige because this is a guarantee of effective information in a new environment (Atkisson et al., 2021; Brand et al., 2021). This means that some learners with high prestige have needed to make little effort to gain the attention of the majority of learners while other learners cannot (Hâncean et al., 2021), thus forming different levels of social interaction in the network. However, the quality and intensity of social interactions affects learning performance (Kozuh et al., 2015). Learners with different levels of prestige may meet inequality in learning. Ma et al. (2022) found that prestige has an impact on learners' learning performance, learning behaviour and social network structure. Therefore, it is necessary to explore what factors influence social network prestige to find ways to reduce the participation gap.

Considering the diverse definitions in the current literature and the characteristics of peer assessment, we regard social network prestige in online peer assessment as the strength of a learner's assignment that can trigger peer commenting behaviour. In other words, the level of a learner's prestige is positively related to

the number of evaluations their assignments have received, and the specific manifestation in the network is the number of directed links received. The analysis of social network prestige helps researchers to analyse and discuss in depth the interaction characteristics and learning impact of social networks from the perspective of individual nodes (Andrews, 2020; Chen & Huang, 2019). Exploring prestige and its related indicators in online peer assessment helps to go beyond counting basic learning behaviours, to uncover the mechanism by which the participation gap influences learning interactions and to suggest ways to reduce the participation gap.

### **Factors influencing social network prestige**

#### *Participation behaviour*

Previous research has attempted to uncover the potential factors that influence social network prestige. In online interactive learning, the most intuitive influence on learners' performance and social network formation is participation behaviour. Therefore, participation behaviours in online interactive learning activities, such as Internet-based discussions and peer assessments, have the potential to become a direct factor influencing social network prestige. Machine learning has been used to identify different participation behaviours and participation states from forum posts in order to examine the relationship between learners' social participation and their prestige in massive open online courses. A study applying machine learning demonstrated that the level of learners' prestige was affected by participating behaviours (Zou et al., 2021). Using social network theory and game theory, Aerne (2020) analysed the causes of social network prestige and concluded that social participation behaviours directly affected the participation gap. Using regression analysis, Chen and Huang (2019) analysed data from discussion boards of online undergraduate courses in the United States of America and found that learners with different levels of prestige did not show differences in post length, post symbol use or post readability, but that there were significant differences in the temporal characteristics of discussion behaviour, with the higher prestige group posting earlier. Zingaro and Oztok (2012) constructed a statistical model based on a comprehensive synthesis of the literature to predict the likelihood of a post receiving a response; their model was based on six quantitative predictors: posting date, participant activity, reading ease, word count, post quality and publisher identity characteristics. Their findings showed that content posted earlier, with higher quality, was more likely to attract responses. This led to the hypothesis that two kinds of participation behaviours, assignment uploading time and assignment quality, may influence learning in teachers' online peer activities.

#### *Attitude towards participation*

Owing to the generative nature of learning, learners need to put in ongoing mental efforts to achieve good learning outcomes. A positive learning attitude towards peer assessment activities might motivate learners to make a sustained effort (Wang et al., 2020). Because of this, many studies (e.g., Podsiad & Havard, 2020; Zou et al., 2017) have explored learners' attitudes towards participation in peer assessment activities.

Ng and Yu (2021) have suggested that attitude towards participation may have an impact on participation behaviour, thereby indirectly affecting social network prestige. Learners who are more active in peer assessment activities are more likely to have higher enthusiasm (Cheng et al., 2014), and are also likely to show higher-quality participation behaviour (Saterbak, 2018). For example, high-prestige learners tend to have a positive attitude towards participation and exhibit positive participation behaviours such as a willingness to communicate (Li & Du, 2014). However, the positive attitude towards participation does not always exist, and some learners may have a negative attitude towards peer assessment activities due to various reasons, such as peer pressure (Panadero & Alqassab, 2019). In this case, a negative attitude towards participation can easily lead to inappropriate participation behaviour, which further damages prestige (Zou et al., 2021).

Based on the literature review above, we hypothesised that learners' attitudes towards participation may play a role in social network prestige by influencing participation behaviour.

#### *Intrinsic and extrinsic motivation to participate*

In addition to attitude towards participation, we also considered that motivation to participate may have a possible impact on prestige. Motivation is considered as a key factor in enhancing learners' engagement and learning performance (Nguyen et al., 2020). In an online environment, motivation is an important factor that may influence participation behaviour (Hoskins & van Hooff, 2005; Rabin et al., 2020). Learners with

high motivation tend to be more actively involved in learning activities (Moore & Wang, 2021). Motivation can be divided into intrinsic motivation and extrinsic motivation (Pinder, 2011). In online peer assessment activities, intrinsic motivation means that learners find participation in online peer assessment activities fun or enjoyable, and extrinsic motivation refers to learners participating in peer assessment activities for a particular purpose, such as meeting course requirements, avoiding negative feedback (Tseng & Tsai, 2010). Learners' orientations of motivation towards participation (intrinsic or extrinsic) have a significant impact on learning outcomes (Peng & Fu, 2021). From the perspective of activity theory, Yu and Lee (2015) argued that learners' participation in peer assessment was driven by learners' own motivation, which affected their participation behaviour in activities, thus affecting their levels of interaction and causing a participation gap. This suggests that learners' motivation to participate may indirectly and positively influence learners' prestige through participation behaviour.

### Research questions

Learners' participation in online interactive learning is multifaceted and related to many factors. Previous studies on the factors influencing prestige have recognised the important role of participation behaviour (including assignment uploading time and assignment quality) and also speculated about possible indirect effects of motivation to participate and attitude towards participation on participation behaviour. However, most previous studies were conducted with school students, and the context of research was mostly limited to online forums or discussion boards; very few explored the factors that shape the social network prestige of teacher-learners, who constitute an important and specific group of learners. In this study, we employed partial least squares structural equation modelling (PLS-SEM) analysis to construct and evaluate the structural relationship of factors influencing social network prestige in online peer assessment and interviewed six participants to gain an in-depth understanding of the factors influencing social network prestige.

## Methodology

### Model construction

Based on a literature review of social network research, we calculated prestige of each learner by using the following formula (Knoke & Yang, 2008; Tsvetovat, 2011):

$$prestige = \frac{\sum_{j=1}^n x_{ji}}{n - 1}$$

where  $n$  is the total number of nodes in the social network formed by teachers' online peer assessment, and  $j$  and  $i$  are the row and column values in the social network matrix respectively. With this formula, the prestige value of each learner can be derived. The higher the calculated value, the higher level the prestige of the learner. Learners with relatively high prestige values in the group are called high-prestige learners, while those with low prestige values are called low-prestige learners.

Based on the literature and the characteristics of the variables, we selected participation behaviour as the formative indicator, and attitude towards participation, intrinsic motivation to participate and extrinsic motivation to participate as the reflective indicators. Among them, attitude towards participation refers to learners' acceptance of participation in online peer assessment activities, that is, whether they hold positive or negative attitudes toward peer assessment activities. Motivation to participate refers to learners' motivation to participate in online peer assessment activities and is divided into intrinsic and extrinsic motivation to participate. Participation behaviour is learning behaviour that occurs when learners participate in peer assessment; we used assignment uploading time and assignment quality to reflect participation behaviour indicators in this study. The descriptions of each indicator are shown in Table 1.

Table 1  
Variables and their calculation methods

Latent variables	Observed variables	Abbreviation	Calculation method of the variables in this study
Social network prestige	Social network prestige	Prestige	Prestige is calculated from the formula.
Intrinsic motivation to participate	Intrinsic motivation to participate	InMot	Questions 1–7 (InMot1- InMot7) of the Motivation of Online Peer Assessment Questionnaire (Tseng & Tsai, 2010).
Extrinsic motivation to participate	Extrinsic motivation to participate	ExMot	Questions 8–12 (ExMot1- ExMot5) of the Motivation of Online Peer Assessment Questionnaire (Tseng & Tsai, 2010).
Attitude towards participation	Attitude towards participation	PreAtt	Questions 1–4 (PreAtt1- PreAtt4) of the Attitude towards Online Peer Assessment Questionnaire (Wen & Tsai, 2006).
Participation behaviour	Assignment uploading time	PostTime	The number of days between the submission date and the deadline of the assignment.
	Assignment quality	PostQua	The average score of a learner’s three assignments.

We constructed a theoretical model of factors influencing social network prestige in online peer assessment, as shown in Figure 1. The research hypotheses in the model were:

- H1: Learners’ participation behaviour has a positive effect on their social network prestige.
- H2: Learners’ attitudes towards participation have a positive influence on their participation behaviour.
- H3: Learners’ intrinsic motivation to participate has a positive effect on their participation behaviour.
- H4: Learners’ extrinsic motivation to participate has a positive effect on their participation behaviour.



Figure 1. Theoretical model of factors influencing social network prestige in online peer assessment

**Participants**

We designed and opened up a course titled Project-Based Learning Under Blended Concepts aimed at in-service teachers of primary and secondary in various disciplines across China. A total of 1438 participants attended through a voluntary online application process. They had clear learning goals and willingness to learn. We then selected 457 teachers who participated in three peer assessment activities and had complete data as participants. The basic information about the learners is shown in Table 2. Most of them were general teachers in primary and secondary schools, and their ages were concentrated between 25 and 35. Most of the participants had bachelor’s or master’s degrees. Furthermore, all participants had experience with online learning and were able to use information technology skilfully.

Table 2  
Demographics

Variables	Value	Frequency	Percentage (%)
Gender	Male	52	11.38%
	Female	405	88.62%
Age	20–25	70	15.32%
	26–30	300	65.65%
	31–35	82	17.94%
	>35	5	1.09%
Identity in education	Elementary school teachers	234	51.20%
	Secondary school teachers	191	41.79%
	Middle management cadres and above	32	7.00%
Degree program	Less than bachelor	7	1.53%
	Bachelor	277	60.61%
	Master or doctoral	173	37.86%
Online learning experiences	Inexperienced	0	.00%
	Less than 1 year	16	3.50%
	1–3 years	372	81.40%
	Over 3 years	69	15.10%

### Experimental procedure

We developed an online teacher training course titled Project-Based Learning Under Blended Concepts for teacher professional development and offered it on an online interactive learning platform, the Learning Cell System (<http://lcell.cn/>). It was based on exploring the integration of information technology and subject teaching for teachers in the new era; designing, developing and implementing project-based learning based on the blended learning concept to improve teachers’ professionalism and skills. The content structure of the course drew on social constructivism theory and adult learning theory and aimed to address the needs of learners on how to undertake project-based learning. Starting from practice, this course focused on five aspects of project-based learning: selection of learning topic; scenario setting and learning plan; information retrieval and application; determination of results; evaluation of work presentation. The whole course lasted for 5 weeks. To ensure the effective implementation of peer assessment, the first 2 weeks of the course were mainly dedicated to teaching basic knowledge, and the peer assessment was carried out over the last 3 weeks. The experimental procedure of this study is shown in Figure 2. Figure 3 shows a combination of some course screenshots.

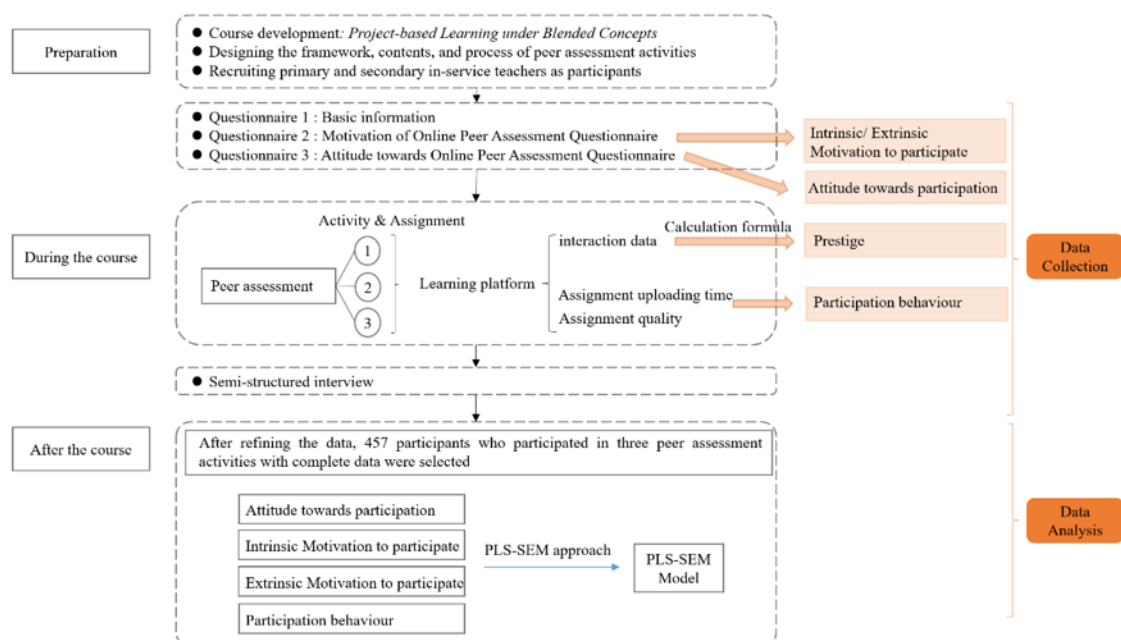


Figure 2. Experimental procedure





In this course, learners could first study the learning materials in the form of video and text in the platform, complete the corresponding assignments and submit them according to the requirements (as shown in Figure 5). Then, in the peer assessment, they could select other learners' work from the assignment display, score it according to the evaluation scale and give comments (as shown in Figure 6). Each learner was free to choose the work they wanted to evaluate, and all participants were advised in the course guide to evaluate approximately 10 assignments. The evaluated learner could view the learning feedback, including scores and comments given by other learners.



Figure 5. Interface for submitting assignments



Figure 6. Interface for assignment display

## Instruments

### PLS-SEM

PLS-SEM enables the modelling and estimation of complex causal models. Compared with the general structural equation model, PLS-SEM is more suitable for dealing with non-normally distributed data while allowing the measures to be either formative or reflective indicators, which facilitates the acquisition of more explanatory results. Among them, formative indicators means that all question items are one-way directional indicators and deleting a certain item will not exert a helping influence on the indicators; reflective indicators mean that individual items constitute indicators, and deleting an item will change the



definition of the indicator. In addition, PLS-SEM can effectively address the covariance among the observed variables, eliminating the interference in the regression and giving the model better robustness (Manfrin et al., 2019). Therefore, PLS-SEM is highly predictive and is an empirical research method suitable for theoretical and causal model verification. Based on the fact that this study used data from a sample of 457 learners, some of the indicators did not conform to a normal distribution; these indicators consisted of three reflective indicators (intrinsic motivation to participate, extrinsic motivation to participate and attitude towards participation) and a formative indicator (participation behaviour). PLS-SEM was used to investigate the causes of learners' prestige in online peer assessment.

#### *Motivation of Online Peer Assessment Questionnaire*

In order to assess learners' motivation to participate in online peer assessment, the Motivation of Online Peer Assessment Questionnaire, a 5-point Likert scale that divides learners' motivation into intrinsic motivation (seven items) and extrinsic motivation (five items) developed by Tseng and Tsai (2010), was used prior to the three peer assessment activities. The Cronbach's alpha coefficient for the items was .78, indicating a high degree of reliability.

#### *Attitude towards Online Peer Assessment Questionnaire*

In order to assess learners' attitudes towards participation, the Attitude towards Online Peer Assessment Questionnaire, developed by Wen and Tsai (2006), was used prior to the three peer assessment activities. The questionnaire consists of five items that ask learners about their acceptance of online peer assessment activities in terms of technology, fairness and interactivity. An average attitude score of more than 3.5 was considered to represent a high degree of satisfaction with the course. The Cronbach's alpha coefficient for the items was .86, indicating a high degree of reliability.

## Model measurement

All latent and measured variables passed the single dimensional tests. Confirmatory factor analysis allowed those items with factor loadings greater than .05 to be retained; in this study, confirmatory factor analysis was passed. Then, using the SmartPLS version 3.0 software, PLS-SEM was used to model the factors influencing learners' social network prestige in online peer assessment. The statistical significance of the PLS-SEM results was calculated by combining the bootstrapping method with the estimated nonparametric confidence interval set to the corrective acceleration (BCa) bootstrap, and the subsample size drawn was 2,000. All indicators were less than .001; thus, the indicators were retained, and the model was derived.

### Measurement model assessment

#### *Reliability and convergent validity test*

PLS-SEM requires testing the reliability and validity of the constructed model by verifying Cronbach's alpha ( $\alpha$ ), composite reliability (CR) and average variance extracted (AVE). As shown in Table 3,  $\alpha$  and CR of all the reflective indicators were greater than .7, indicating good reliability of the model. The AVE values were greater than .5, indicating good convergent validity of the measurement model (Thurasamy et al., 2016; Urbach & Ahlemann, 2010).

Table 3  
 *$\alpha$ , CR and AVE*

Latent variables	$\alpha$	CR	AVE
Intrinsic motivation to participate	.877	.904	.575
Extrinsic motivation to participate	.731	.731	.515
Attitude towards participation	.826	.877	.588
Social network prestige	1	1	1

#### *Discriminant validity test*

The Fornell-Larcker method was employed to calculate the correlation coefficients of the model, which involves constructing a matrix of correlation coefficients among the latent variables. The diagonal of the matrix is the square root value of the AVE of the latent variables, and the values below the diagonal are the correlation coefficients among the latent variables respectively (Manfrin et al., 2019). As shown in Table 4, the correlation coefficients of all latent variables were smaller than the AVEs; thus, the discriminant validity was appropriate (Barrett et al., 2021; Saeed & Al-Emran, 2018).

Table 4  
Fornell-Larcker discriminant validity test

	<b>Intrinsic motivation to participate</b>	<b>Extrinsic motivation to participate</b>	<b>Attitude towards participation</b>	<b>Participation behaviour</b>	<b>Prestige</b>
Intrinsic motivation to participate	<b>.758</b>				
Extrinsic motivation to participate	.465	.704			
Attitude towards participation	.433	.475	<b>.767</b>		
Participation behaviour	.457	.614	.484	.855	
Prestige	.412	.616	.434	.882	<b>1</b>

Recent studies (e.g., Alshurideh et al., 2020; Saeed & Al-Emran, 2018) have recommended the heterotrait-monotrait (HTMT) criterion instead of the Fornell–Larcker traditional metric for correlation coefficient tests. In this study, for the exact correlation coefficient test, we obtained the inferred HTMT results at the 95% confidence level by performing a complete bootstrapping procedure for all samples. The HTMT values for all latent variables in the model were less than 1, which was acceptable (Barrett et al., 2021). In addition, we measured the factor loadings and cross loadings of the model and found that all reflective indicators were > .6, indicating that the validity of the model was good.

*Predictive ability test*

The coefficient of determination ( $R^2$ ) is a measure of a model’s in-sample predictive power, while the Stone-Geisser’s  $Q^2$  is used to determine a model’s out-of-sample predictive relevance. As shown in Table 5,  $R^2$  of social network prestige was .778, indicating a high level of predictive ability for the social network prestige model, and the  $R^2$  of participation behaviour was .440, indicating a moderate level of predictive ability. The Stone-Geisser’s  $Q^2$  of social network prestige calculated by the Blindfolding algorithm was .774, which indicated a high level of predictive accuracy for the social network prestige model, and participation behaviour had a  $Q^2$  of .414, indicating a moderate level of predictive accuracy (Hair et al., 2019).

Table 5  
Predictive ability test of the model

	<b>R<sup>2</sup></b>	<b>Q<sup>2</sup></b>
Social network prestige	.778	.774
Participation behaviour	.440	.414

*Stability test*

To test the stability of the model, we calculated the variance inflation factors (VIF) of the reflective and formative indicators. The results are shown in Table 6. The values of all indicators were less than the critical value of 5, indicating that there was no multicollinearity in the model; and therefore, the model results had high stability (Thurasamy et al., 2016).

Table 6  
Multicollinearity test for reflective and formative indicators

	<b>InMot1</b>	<b>InMot2</b>	<b>InMot3</b>	<b>InMot4</b>	<b>InMot5</b>	<b>InMot6</b>	<b>InMot7</b>
VIF	2.004	1.878	1.786	2.019	1.843	1.946	2.521
	ExMot1	ExMot2	ExMot3	ExMot4	PreAtt1	PreAtt2	PreAtt3
VIF	1.192	1.081	1.088	1.225	1.856	2.915	1.289
	PreAtt4	PreAtt5	Prestige	AveScore	PostTime		
VIF	2.095	1.836	1	1.286	1.218		

### PLS-SEM model assessment

The statistics of the path coefficients for each latent variable are shown in Table 7; these coefficients represented the relational effects within the model. The path coefficient of participation behaviour → social network prestige showed a positive effect on a significant level with a high degree of influence ( $\beta = .882$ ,  $p < .001$ ), confirming H1. The path coefficient of attitude towards participation → participation behaviour had a significant level but a low degree of influence ( $\beta = .204$ ,  $p < .001$ ), verifying H2. The path coefficient of intrinsic motivation to participate → participation behaviour had a moderate and significant effect ( $\beta = .442$ ,  $p < .001$ ); therefore, H3 was accepted. The path coefficient of extrinsic motivation to participate → participation behaviour had a low but statistically significant effect ( $\beta = .163$ ,  $p < .01$ ); therefore, H4 was accepted.

Table 7  
*Descriptive statistics and t-test results of path coefficients*

Path	$\beta$	M	SD	t	p
Participation behaviour → social network prestige	.882	.882	.009	79.096	.000**
Attitude towards participation → participation behaviour	.204	.204	.038	5.326	.000**
Intrinsic motivation to participate → participation behaviour	.442	.443	.037	11.974	.000**
Extrinsic motivation to participate → participation behaviour	.163	.164	.037	4.351	.002*

Note: \* $p < .05$ , \*\* $p < .001$

As shown in Table 8, the external weights statistics of the formative indicators revealed that both assignment quality and assignment uploading time showed significant levels of influence on participation behaviour.

Table 8  
*Statistics of external weights of formative indicators*

Path	$\beta$	M	SD	t	p
AveScore → participation behaviour	.484	.484	.013	35.907	.000**
PostTime → participation behaviour	.676	.676	.019	35.866	.000**

Note: \* $p < .05$ , \*\* $p < .001$

To determine the type of mediating role of intrinsic motivation to participate, extrinsic motivation to participate and attitude towards participation, we analysed the indirect effects of each indicator; the results are shown in Table 9, showing that all indirect effects are significant. Combined with the path coefficient statistics, intrinsic motivation to participate, extrinsic motivation to participate and attitude towards participation had a partially mediating role on social network prestige via participation behaviour (Thurasamy et al., 2016).

Table 9  
Results of indirect effect analysis

	$\beta$	M	SD	t	p
Intrinsic motivation to participate → participation behaviour → social network prestige	.18	.18	.034	5.291	.000**
Extrinsic motivation to participate → participation behaviour → social network prestige	.144	.145	.033	4.348	.002*
Attitude towards participation → participation behaviour → social network prestige	.39	.391	.033	11.781	.000**

Note: \* $p < .05$ , \*\* $p < .001$

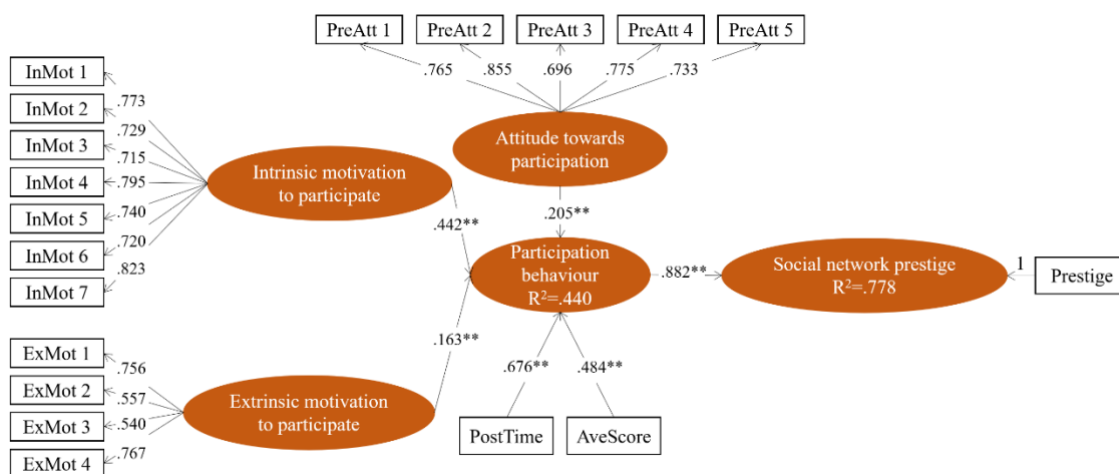


Figure 7. The model of factors influencing learners' social network prestige in online peer assessment

The final model is shown in Figure 7. Participation behaviour had a direct positive effect on learners' prestige in online peer assessment; intrinsic motivation to participate, extrinsic motivation to participate and attitude towards participation on social network prestige were partially mediated by participation behaviour. In addition, extrinsic motivation to participate had a small effect on participation behaviour of .163, while intrinsic motivation to participate and attitude towards participation had a moderate influence on participation behaviour, with weights of .442 and .205 respectively. Participation behaviour had a dominant influence on social network prestige, with a weight of .882. The weight coefficients of the two indicators, assignment quality and assignment uploading time, were .484 and .676 respectively, indicating that among the participation behaviours, assignment uploading time had the greatest influence on social network prestige.

### Results of interviews

To further understand the model and explore the learners' perceptions, we conducted semi-structured interviews through the Internet. This section describes the perceptions of the six participants who were interviewed after the end of the course. In terms of gender, two of the six participants were male and four were female; in terms of education, they all had a bachelor's degree or higher: four bachelor's degrees and two master's degrees.

After explaining the meaning of the participation gap and prestige to the interviewees, we mainly asked the following questions relevant to this study:

- (1) Do you think there is a participation gap in online peer assessment? That is, some learners can easily get the attention of others with less effort, while some learners cannot. Do you think participation gaps affect learning outcomes?
- (2) Could you please describe your general behaviour when participating in peer assessment?
- (3) What is your motivation to participate in online peer assessment?
- (4) How do you feel about peer assessment activities?

In summary, first of all, all the interviewees expressed their concern about the participation gap, believing that such unfair participation would affect their learning enthusiasm and learning outcomes.

With regard to participation behaviour, the data from the interviews further explained the importance of participation behaviours to the model, such as assignment uploading time and assignment quality. All interviewees thought they would pay attention to learners who published their work early and were more likely to interact with them:

The assignments on the first page of the display area are easier to see.  
Before writing homework, I will refer to the work that others have submitted.

Most interviewees indicated that they tended to interact with peers who wrote high-quality assignments:

I want to comment on assignments that look good, and I think it will lead to more reflection.  
It's easier to interact with well-formed assignments.  
Some homework is written in a mess and I don't know how to score them according to the scale.

Regarding motivation to participate, some interviewees mentioned that:

I hope to get a certificate at the end of the course, so I will write high-quality homework carefully and strive to make more people willing to score me.  
I care what people think of me, so I want my homework to get a high score and be discussed by more peers.  
I want to understand how project-based learning unfolds and improves teachers' skills, so I will hand in my homework earlier, which I think will allow them to appear in the display earlier and get suggestions from teachers and classmates.

This confirms that motivation to participate contributes to the emergence of high-prestige learners by influencing participation behaviour. However, some interviewees also mentioned that:

I had hoped to master the method of project-based learning, but then work commitments put the latter two assignments on hold and the quality of the assessments was not so high.

Therefore, the inconsistency of intrinsic motivation may be responsible for its lower weight in the model than extrinsic motivation.

Regarding attitude towards participation, most of the interviewees mentioned that if they thought peer assessment would be helpful to them, they would be more willing to participate in it:

I think that participating in peer assessment activities helps me understand the course content better, so I am increasingly participating in peer assessment activities and find myself receiving more and more responses.

Conversely, one of the interviewees who felt that participating in peer assessment activities is bit of waste of time then exhibited negative participation behaviours, which in turn led to low prestige. This confirms that attitude towards participation can affect prestige by influencing participation behaviour.

## Discussion and conclusions

### Discussion of the model

Based on previous literature, we examined the factors influencing the level of learners' prestige through a PLS-SEM analysis of 457 learners who participated in online peer assessment. The results of the model explicitly demonstrated the role of participation behaviours, attitude towards participation and motivation on social network prestige and the interrelationship among each factor. This approach provided insight into the participation gap in online interactive teacher training. Three main findings were drawn as follows:

- First, participation behaviour had the greatest positive influence on prestige. The results of the PLS-SEM showed that the influence of participation behaviour on social network prestige was dominant with a high weight of .882, which was consistent with Zou et al. (2021). Meanwhile, the data further revealed that the weight of the two indicators of participation behaviour, assignment quality and assignment uploading time, were .484 ( $t = 35.907$ ,  $p = .00 < .001$ ) and .676 ( $t = 35.866$ ,  $p = .00 < .001$ ) respectively, indicating that among the participation behaviours, assignment uploading time had a greater impact on social network prestige.
- Second, the weight of the influence of attitude towards participation on participation behaviour was .204 ( $t = 5.326$ ,  $p = .00 < .001$ ), which had a moderate influence. The indirect effect of attitude towards participation on prestige was .39 ( $t = 11.781$ ,  $p = .00 < .001$ ). Therefore, we believed that the effect of attitude towards participation on prestige was partially mediated by participation behaviour.
- Finally, as for the extrinsic and intrinsic motivation on participation behaviour, their effects on participation behaviour were .163 ( $t = 4.351$ ,  $p = .002 < .05$ ) and .442 ( $t = 11.974$ ,  $p = .00 < .001$ ), and their indirect effects on prestige were .144 ( $t = 4.348$ ,  $p = .002 < .05$ ) and .18 ( $t = 5.291$ ,  $p = .00 < .01$ ) respectively. This implied that the effect of motivation to participate on social network prestige was partially mediated by participation behaviour.

In summary, participation behaviour had the greatest weight of positive influence on prestige, and the influences of attitude towards participation and motivation to participate on social network prestige were partially mediated by participation behaviour. This indicated that attitude towards participation, participation behaviour and motivation to participate were effective indicators for discovering high-prestige learners. Those who were more positive towards peer assessment activities, submitted assignments earlier and with higher assignment quality, and they also tended to gain high prestige in peer assessment.

### Implications for research

Some studies have identified the potential influence of motivation, attitude towards participation and learning behaviours on the participation gap. Building on these findings, we performed a PLS-SEM analysis and semi-structured interviews.

First, participation behaviour had a significant positive effect on prestige. The interviews revealed that the assignment quality made a significant contribution to prestige. High-quality assignments that received more peer recognition generally followed a better-structured writing paradigm, and they were therefore more likely to trigger evaluation behaviours from learners. This was consistent with Liu et al. (2018), who found assignment quality was an important factor in the formation of high-prestige learners. Among the participation behaviours, assignment uploading time contributed the most to prestige. We found that the earlier the learners posted their assignments, the more likely they were to gain high prestige in peer assessment activities. This validated the previous findings, using regression analysis (Chen & Huang, 2019; Zingaro & Oztok, 2012), that assignment uploading time had a high predictive power on social network prestige. The interviews also confirmed that uploading and presenting the assignments earlier in peer assessment tended to obtain more views. Accordingly, they were more likely to be evaluated. This also confirmed Koszalka et al.'s (2021) finding that the earlier the interaction begins, the more likely it is to provoke longer and richer analysis and reflection.

Second, the measure selected for attitude towards participation was learners' acceptance of peer assessment activities. The recognition of peer assessment was an important prerequisite for learners to be able to



complete peer assessments seriously (Liu & Li, 2014). Learners also indicated that they would develop a deeper understanding of the activity and act accordingly if they recognised its value. Against this background, these learners understood better how to achieve positive interaction.

Finally, learners' motivation to learn drove them to be more willing to invest their energy and effort in activities and affected learning behaviour during the process of participation (Simonova et al., 2021; Yu & Lee, 2015). It should be noted that the participants in this study were teachers. According to adult learning theory (McCray, 2016), teacher-learners, as adult-learners with heavy workloads as well as insufficient time and energy (Zhao & Song, 2021), are more result-oriented in learning and adequate motivation contributes to their better learning behaviours. The interview demonstrated that both extrinsic motivation to learn and intrinsic motivation contributed to high-prestige learners by influencing participation behaviours. Extrinsic motivations encouraged learners to emphasise the quality of their work while intrinsic motivations allowed them to engage in peer assessment spontaneously and consciously and submit their assignments earlier.

However, unlike Tseng et al.'s (2010) finding, the weight of the influence of extrinsic motivation was relatively low, probably because extrinsic motivation did not awaken learners' enthusiasm for learning in the long term and would fade in the absence of intervention to promote and reinforce it, narrowing the influence on participation behaviours in peer assessment.

### **Implications for education and practice**

In the design of the introduction to peer assessment activity, since motivation to participate and attitude towards participation have significant positive effects on learners' social network prestige and indirectly affect their participation behaviour, the successful implementation of learning activities relies on learners' expectations and understanding of the activities (Koszalka et al., 2021). Therefore, course designers can improve the design of the introduction to peer assessment activities, as a way of motivating learners and enhancing their understanding of peer assessment, thereby narrowing the participation gap. For example, the introduction should explain the necessity and meaning of peer assessment as well as the proper use of the assessment scale, so that the learners understand the specific requirements for assessment and know how to evaluate the performance of their peers and themselves.

In the selection rules for the review of learners' work, it is possible to consider adding a mandatory assignment selection method, or to combine the mode of learners' arbitrary choice of assignment and the mode of the system to automatically push assignments. In the current online peer assessment, there are mainly two selection rules for the review of learners' work: one is that learners choose the work to review according to their own preferences, and the other is assignment assigned by the system (Anaya et al., 2019). Since participation behaviour positively and significantly affects learners' social network prestige, combined with directional research in social network characteristics, it can be inferred that learners who submit assignments late and with poor quality have difficulty getting more feedback to help them reflect, especially from a high-prestige group. Therefore, we propose a combination of the above two approaches, allowing learners to freely choose the work to be assessed at the beginning of the peer assessment, and pushing the work of low-prestige learners to high-prestige learners in a non-mandatory way later in the peer assessment process. In this way, low prestige learners would be provided with additional opportunities to gain interaction, and the damage caused by the participation gap may be reduced.

### **Limitations and recommendations**

First, studies have extensively investigated how to improve the frequency of learners' online interactions through the design of tools and strategies, but research on the participation gap of learners involved in the interactions is relatively weak. Future researchers are advised to devote more attention to the participation gap. Second, we conducted a 5-week online teacher training course and constructed a model of the factors influencing in-service teachers' social network prestige. Future studies may consider extending the course duration to explore how the model changes under the influence of time. Finally, in order to improve the precision, a more typical online peer assessment interactive paradigm was selected as the background of the research. Subsequent studies could consider expanding the selection scope of interactive activities on the basis of this study.

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