

Together We Are Stronger: Examining Virtual Leadership Behavior Towards Knowledge Sharing in Online Programming Communities

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ABSTRACT

Online communities are rapidly growing as an outlet for social support and community building. However, very few succeeded in inspiring members to share their knowledge. The problem of under contribution in online settings has triggered researchers to investigate the role of virtual leadership in promoting knowledge sharing. Using path-goal theory, this study examines the role of supportive, participative, and achievement-oriented leadership towards knowledge sharing in online programming communities. Data were collected from 20 online programming communities and used to empirically test the proposed model. The result from the structural equation modelling suggests that the three leadership behaviors significantly moderate the effect of self-efficacy and outcome expectancy towards members' knowledge sharing in the online programming community. A suitable level of autonomy and recognition of members contributions can motivate members to continuously contribute to online programming communities and help promote sustainability in this platform.

Keywords: Knowledge sharing, virtual leadership, online programming communities, path goal theory, and social cognitive theory.

I INTRODUCTION

Online and offline communities are constantly finding ways to inspire followers to participate and continue enhancing the community (Hashim & Tan, 2015). However, only a few of them have successfully managed to retain and motivate their members to share knowledge despite the drastic increase in the number of emerging online communities (Lai & Chen, 2014). This issue leads to a serious problem of under contribution and inactivity after an extended period of time (Abouzahra & Tan, 2014; Lai & Chen, 2014). Moreover, irregular participation will lead to only a few voices dominating the community which will then affect the resource availability and the health of online communities until it ultimately dies when these few active contributors depart from the communities (Wang & Lantzy, 2011). These problems have sparked more studies in examining

the role of leadership in motivating active contributions. Johnson, Safadi, and Faraj (2015) and Faraj, Kudaravalli, and Wasko (2015) claimed that online community leadership processes and how leaders emerge are not well-studied and there is very minimal research examining the role of leaders in online settings compared to traditional organizations. Hence, to address this gap, this study aims to examine the moderating role of leadership in influencing an individual's efficacy and outcome expectancy towards knowledge sharing in online communities.

II LITERATURE REVIEW

A. Online Programming Communities and Knowledge Sharing

Online programming communities can be defined as a place where a wide group of programmers with a regular interest in programming and development skills interact and share a great number of resources with each other via the Internet (Schwartz & Timbolschi-Preoteasa, 2015). The usage of online programming communities is gradually increasing with the global use by programmers, contributing a big part of their time to consume and generate its content (Thackeray, Neiger, Smith, & Van Wagenen, 2012).

Online programming communities can be understood as one of the knowledge community types through which relationships are built and knowledge is exchanged via computer-mediated communication (Koh & Kim, 2004).

Knowledge sharing is the main constituent component of the online programming community. It refers to the capability to spread a concept or shape a topic discussion on programming and development field. Continuous knowledge sharing is important to help build the learning process of skills required by converting tacit knowledge into explicit knowledge (Al-Husseini, 2014). Online programming community also serves as knowledge repositories for members to gain knowledge and find answers and solution to their enquiries and problems in their fields and other aspects related to their careers.

In spite of the rapid growth and rich diversity of the online community, not much is known about how these communities sustain themselves in a leaderless

organization and how they are structured. It is also often categorized by fluid boundaries, high turnover, expertise-based authority, and emergent roles (Faraj, Jarvenpaa, & Majchrzak, 2011). Because of this fluidity, leadership is important to guide the knowledge sharing process in an online community. The leadership role can engage and shape discussions by stimulating communication on a particular phenomenon or topic. This study takes the lead in examining these three leadership roles in moderating the members' efficacy and outcome expectancy towards knowledge sharing

B. Leadership

Leadership plays an important role in promoting knowledge sharing activities by maintaining active participation and encouraging members to continuously share their knowledge and experience with others (Bradshaw, Chebbi, and Oztel (2015). Hew and Hara (2007) specifically argued leadership as one of the moderating factors that aided knowledge sharing. The leader plays an important role as a sieve that helps keep communication focused on issues related to the communities objectives.

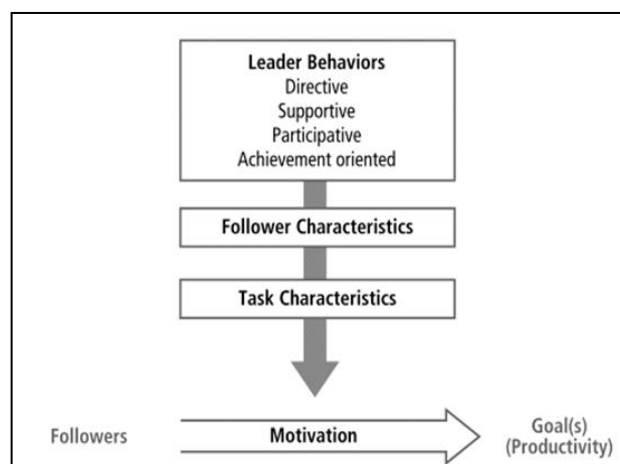
Virtual leadership is also a unique phenomenon. It does not fit neatly into any of Weber's models (Avolio, 2016). It also does not represent traditional forms in which they inherit a position of power nor do they represent legal authority in which they are appointed or elected (Avolio, 2016). Although these leaders informally emerge, they exert influence on the attitudes and behaviors in online spaces they inhabit. Thus, what makes someone a leader online remains an open research question (Johnson et al., 2015; von Krogh, Nonaka, & Rechsteiner, 2012; Yoo & Alavi, 2004).

This study employs path-goal theory to examine the moderating effect of supportive, participative, and achievement-oriented leadership towards knowledge sharing of members from 20 different online programming communities.

III CONCEPTUAL FRAMEWORK

After reviewing the theories related to leadership behavior, path-goal theory was chosen to guide this study. Path-goal theory is a theory that suggests that a leader directs followers' behavior by motivating them to accomplish goals (Northouse, 2015). An effective leader compensates for deficiencies of his/her followers to overcome obstacles toward a goal, which in its turn, increases the followers' intrinsic motivation (House, 1996). Different environments, situations, and tasks dictate leaders which of the three path-goal leadership styles they should select and incorporate to be an effective leader.

Figure 1 illustrates the different components of path-goal theory including leader behaviors, follower characteristics, and task characteristics. Path-goal theory suggests that each type of leader behavior has a different impact on followers. Determining if a particular leader behavior is motivating to followers is contingent on the followers' characteristics and the characteristics of the task. In this study, supportive leadership, participative leadership, and achievement-oriented leadership behavior are selected to study the moderation effect of these leadership behaviors to respectively moderates self-efficacy and outcome expectancy of the followers (members of online programming community) and task shared by the



members of the online programming community.

Figure 1. The Major Components of Path-Goal Theory

The personal characteristics that influence members (followers) of an online community are adopted from social cognitive theory (SCT), namely, self-efficacy (SE) and outcome expectancy (OE). The influence of these two factors on knowledge sharing will be moderated by three types of leadership behavior. These leadership behaviors of a leader are important in an online programming community because it is assumed to boost the motivation of the followers to participate in knowledge sharing.

The following are the justification and suggestion of the hypotheses derived from the conceptual framework in Figure 2.

A. Self-Efficacy and Knowledge sharing

Bandura (1986) defined self-efficacy as the people's perception of what they can do with the skills they possess. Regarded as an intrinsic benefit, self-efficacy is an essential motivator of knowledge-sharing behavior, especially in an online context (Liao, To, & Hsu, 2013). Self-efficacy is enhanced when individuals feel confident about themselves to contribute their valuable knowledge to the community. Researchers have reported a positive

relationship between self-efficacy and knowledge sharing (Liao et al., 2013; Zhang et al., 2017). Therefore, it is assumed that individuals with higher self-efficacy will contribute more and share their knowledge in online programming communities. Thus,

H1: Self-efficacy has a positive effect on knowledge sharing.

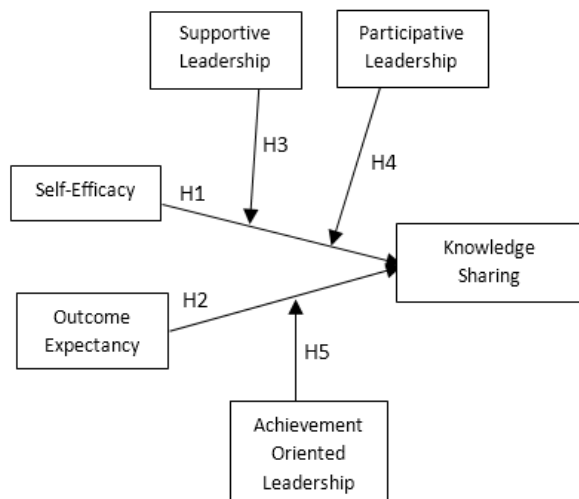


Figure 2. Conceptual Framework

B. Outcome Expectancy and Knowledge Sharing

Outcome expectancy is an individual's belief that carrying out a certain action will lead to the desired outcome (Bandura, 1986). This study argues that outcome expectancy positively affects a given individual's knowledge sharing. Previous studies show that if employees believe they can improve relationships with other employees by offering knowledge, they will be more willing to share what they know with others (Chiu, Hsu, & Wang, 2006; Dong et al., 2016; Wasko & Faraj, 2005).

The willingness of the community members to share their knowledge can happen if they perceive their own knowledge needs and goals (Van den Hooff & de Leeuw van Weenen, 2004) or if they expect reciprocal knowledge sharing from coworkers (Bock, Zmud, Kim, & Lee, 2005). An increasing number of studies have shown that positive expected outcomes of a specific behavior will lead to higher probability to engage in that behavior (Chiu et al., 2006; Hsu, Ju, Yen, & Chang, 2007).

In this study, outcome expectations refer to the judgment of members on outcomes they perceived in joining an online programming community that trigger them to contribute and share knowledge with other members. Therefore, this study proposes that outcome expectancy affect knowledge sharing behavior. The following hypothesis is proposed:

H2: Outcome expectancy has a positive effect on knowledge sharing behavior.

C. Supportive Leadership as a Moderator

The main characteristic of online community members is voluntary behavior. Therefore, it is hard to drive members to share their knowledge without strong motivation (Ipe, 2003). Supportive leadership works on moderating the relationship between self-efficacy and knowledge sharing. A virtual leader can serve to persuade members and empower their efficacy on their self-capability to contribute to the community vision by sharing their knowledge (Kirkpatrick & Locke, 1996; Yukl, 1999).

Moreover, supportive leadership can enhance self-efficacy. By inspiring individuals with their passion, supportive leaders underpin individuals' willingness and ability to work on improving the status quo. The more support received by the leader, the more confident the leader in his or her ability to contribute to the online programming community. Moreover, through supportive leadership, members will have a stronger bond with the leaders, have a better understanding of the vision, and able to anticipate the outcome of the online programming community. Therefore, it is assumed that individuals in the online community supported by the leader will have a high level of self-efficacy towards knowledge sharing in an online programming community. Hence, the following hypothesis is postulated:

H3: Supportive leadership behavior positively moderates the effect of self-efficacy on knowledge sharing.

D. Participative Leadership as a Moderator

According to Northouse (2015), many studies have previously studied other types of leadership such as directive and supportive leadership. However, few studies addressed participative and achievement-oriented leadership. Since most of the online programming communities are on a voluntary platform, participative leadership behavior of a leader can help tremendously in motivating members of online communities to decide their own creative and innovative way of contributing to the online programming communities. According to Sashkin (1976), increasing the degree in which follower participate in decision-making may increase performance through enhanced motivation. This leadership holds strong for the experts in the field who are sharing their expertise and skills that can bring ideas and contribution toward developing and enriching the functionality of the online programming communities. Participative leadership tends to foster the feeling of "psychological ownership" of followers (Sashkin, 1976), increase followers' feelings of self-efficacy and control, and

reduce their sense of powerlessness (Arnold, Arad, Rhoades, & Drasgow, 2000).

Prior research suggests that the participative behavior of a leader plays a vital role in providing followers with the experience of intrinsic motivation, feelings of self-worth, and a sense of self-determination (Deci, Connell, & Ryan, 1989). Similarly, several authors have suggested that participative leadership is likely to induce the feeling of empowerment among followers (Ahearne, Mathieu, & Rapp, 2005; Leach, Wall, & Jackson, 2003). The feeling of psychological empowerment has been conceptualized as a form of intrinsic motivation to perform tasks and is manifested in four cognitive dimensions: meaning, impact, competence, and self-determination (Conger & Kanungo, 1988; Spreitzer, 1995; Thomas & Velthouse, 1990). Hence, giving freedom for members to take part in any project they desire and inducing empowerment and trust toward followers, will enhance members motivation and performance (Huang, Davison, Liu, & Gu, 2009).

Due to the aforementioned argument and the limited studies focusing on this leadership, it is hypothesized that participative leadership is vital for motivating online community members toward sharing their knowledge. Thus, the following hypothesis is proposed:

H4: Participative leadership positively moderates the effect of self-efficacy on knowledge sharing.

E. Achievement Oriented Leadership as a Moderator

Achievement-oriented leadership is characterized by a leader who constantly challenges followers to perform at the highest level possible. This leader establishes a high standard of excellence for followers and seeks continuous improvement. In addition to expecting a lot from followers, achievement-oriented leaders show a high degree of confidence that followers are capable of establishing and accomplishing challenging goals (Northouse, 2015).

Achievement-oriented cultures built by leaders might also shed some light on the direction of knowledge within the online programming community as well as the assignment of specific roles within the communities for followers. According to Ardichvili, Maurer, Li, Wentling, and Stuedemann (2006), in offline organizations, achievement-oriented cultures such as in the United States, status is derived from past achievements or how others relate to his or her position in the community. One usually becomes a full member of a community from earning his or her status through

a history of achievements and contribution (Hildreth, Kimble, & Wright, 2000).

Achievement-oriented leadership is also important in online programming communities since it boosts the motivation of the followers to attain specific goals that lead to external and internal rewards. External rewards include gaining status in online programming community such as gaining higher position (i.e beginner, intermediate, advanced, top contributor, and expert) or gaining more stars and followers. This exists in many types of online communities such as in Linux and gaming communities (Ducheneaut, Moore, & Nickell, 2007). In addition to a better set of skills gained to use for career, a new network of a good team to work with and so on are also attained. Internally, achievement can also be perceived by followers through successfully accomplishing a challenging task, expanding knowledge and network, and successfully guiding others to accomplishing a task. Hence, an achievement-oriented environment built by leadership in online programming community will create value internally and externally for followers and will motivate them to contribute to reach goals and achieve online programming community target as well expanding the community empire. Therefore, the following hypothesis is formulated:

H5: Achievement-oriented leadership behavior of virtual leader positively moderates the effect of outcome expectancy on knowledge sharing.

IV RESEARCH METHODOLOGY

A. Target Population and Sampling Design

The target population for the study is online programming communities. The respondents were selected from the top 20 programming languages listed in TIOBE (The Coding Standard Company). This site provides statistics on the popularity and position of the programming languages for the first twenty programming languages from August 2016 to August 2017.

Purposive sampling was used as this is one of the most cost-effective and time-effective sampling methods available. Invitation threads are posted on the online programming community lounge. A total of 322 useful responses were obtained. Respondents were briefed about the scope of the research and how their honest responses could be useful in assessing the phenomenon and were assured of their confidentiality. In return, each respondent stood a chance to win \$10 Amazon gift card and six will be awarded the cards. Data processing and analysis were performed by using SmartPLS 3.0 with IBM SPSS Statistics version 21.

Questionnaire Design

The online survey questionnaire items were adapted from several sources (Chiu et al., 2006; Compeau, Higgins, & Huff, 1999; Davenport & Prusak, 1998; Kankanhalli, Tan, & Wei, 2005; Wang & Fesenmaier, 2003). Bipolar scale from 1 to 5 will be used whereby 1 = Strongly Disagree and 5 = Strongly Agree.

B. Demographic Profiles of Respondents

A total of 85% of the respondents were male and 71.6% are from the age of between 13 and 40 years old. The statistics also show that almost half of the participants hold a bachelor degree. In terms of experience in using online programming communities, 43.4% of the respondent revealed to have joined between 1 and 3 years. In terms of the role in online programming communities, 29% regarded themselves as beginner level, 38% as the intermediate level, and the rest are categorized into advanced level, expert level, and moderator/community manager level.

C. Analysis and Results

The reliability results of testing measurement model are shown in Table 1 and Table 2. The results in Table 1 indicate that the measures are robust in terms of their internal consistency reliabilities as indexed by their composite reliabilities. The composite reliabilities of different measures in the model range from 0.803 to 0.899 which exceed the recommended threshold value of 0.70 (Nunnally & Bernstein, 1978). The average variance extracted (AVE) for each measure exceeds 0.50, thus, consistent with the recommendation of Fornell and Larcker (1981). Table 2 also demonstrates the discriminant validity of the measured scales. The bolded elements in the matrix diagonals represent the square roots of the AVEs which are identified to be are greater in all cases than the off-diagonal elements in their corresponding row and column. This result supports the discriminant validity of the scales.

Table 1. Reliability Assessment of the Measurement Model

	AVE	Composite Reliability	R Square	Cronbachs Alpha
AOB	0.68	0.863	0.000	0.777
DB	0.715	0.882	0.456	0.8
KS	0.52	0.86	0.000	0.799
OE	0.51	0.803	0.000	0.674
PB	0.662	0.887	0.000	0.831
SE	0.578	0.871	0.000	0.816
SB	0.64	0.899	0.000	0.86

Note: (KS: Knowledge Sharing, SE: Self-efficacy, OE: Outcome Expectancy, M-SB: Moderator-Supportive

Leadership, M-PB: Moderator-Participative Leadership, M-AOB: Moderator-Achievement Oriented Leadership).

Some recent criticisms of the Fornell and Larcker (1981) criteria suggest they do not reliably detect the lack of discriminant validity in common research situations (Henseler, Ringle, & Sarstedt, 2015). An alternative approach was suggested to assess discriminant validity: the heterotrait-monotrait (HTMT) ratio of correlations based on the multitrait-multimethod matrix (Henseler et al., 2015). Discriminant validity was tested using this new method and results are shown in Table 3. For the first criterion, if the HTMT value is greater than HTMT.85 value of 0.85 (Kline, 2011), then discriminant validity is a problem. As shown in Table 3, all values surpassed HTMT.85.

**Table 2. Reliability Assessment of the Measurement Model
Fornell-Larcker Criterion**

	AOB	DB	KS	OE	PB	SE	SB
AOB	0.825						
DB	0.600	0.846					
KS	0.301	0.328	0.721				
OE	0.489	0.416	0.384	0.714			
PB	0.601	0.48	0.451	0.49	0.814		
SE	0.115	0.18	0.576	0.235	0.241	0.76	
SB	0.623	0.615	0.301	0.561	0.657	0.119	0.8

Table 3. Heterotrait-monotrait (HTMT).

	AOB	DB	KS	OE	PB	SE	SB
AOB							
DB	0.771						
KS	0.386	0.428					
OE	0.664	0.567	0.557				
PB	0.735	0.601	0.553	0.624			
SE	0.136	0.223	0.665	0.348	0.273		
SB	0.751	0.749	0.389	0.723	0.779	0.15	

Convergent validity is tested with SmartPLS by extracting the factor loadings and cross-loadings of all indicator items to their respective latent construct more highly than on any other construct. The results show that all the items are loaded on their respective construct from lower bound of 0.581 to an upper bound of 0.89. Throughout the process of exploratory factor analysis, items that do not load properly on a particular factor (<0.40) or have cross-loadings should be deleted (Steven, 1992). However, all items had loadings greater than 0.40, thus, none were deleted.

The measurement models have reported how the constructs measures used in this study are reliable and valid. The next step in PLS-SEM is an evaluation of the structural model. Before that, it is

important to examine the level of collinearity in the structural model (Hair, Ringle, & Sarstedt, 2011).

Table 4 shows the estimated path coefficients. The test of significance of all paths was performed using the bootstrapping technique.

The results of the PLS model via bootstrapping technique indicated in Table 4 shows the T-value of direct paths of SE -> KS is 9.368, OE -> KS is 2.888. T-value revealed that the structural model for both direct relationships is statistically significant. The coefficients of direct and indirect paths of moderating effect of supportive leadership and achievement oriented leadership are also tested. The moderating effect of supportive leadership and participative leadership on self-efficacy were revealed to be = 2.289 and =2.219 respectively. The moderating effect of outcome expectancy and achievement-oriented leadership was revealed as = 2.471. Respectively, both relationships indicate a positive significant relationship by using the critical values for the significance level of 5% ($\alpha=0.05$) and the probability of error is 1.96 (two-tailed test).

Table 4. Result of Moderating Effects

Hypotheses	Beta	T	P	Decision
		Statistics	Values	
SE -> KSB	0.457	9.368	0.000	Supported
OE -> KSB	0.172	2.888	0.002	Supported
M-SB-> KSB	0.132	2.289	0.011	Supported
M-PB-> KSB	0.121	2.219	0.013	Supported
M-AOB-> KSB	0.087	2.471	0.007	Supported

The beta values of path coefficient indicate the direct influences of predictor upon the predicted latent constructs. According to the results, outcome expectancy and self-efficacy showed a positive influence on knowledge sharing. This result supported the hypotheses (H1) and (H2). The results also indicated that supportive leadership and participative leadership behavior respectively moderates the relationship between self-efficacy and knowledge sharing behavior supporting hypothesis (H3) and (H4). In addition, achievement-oriented behavior also positively moderates the relationship between outcome expectancy and knowledge sharing which satisfied the hypothesis (H5).

V DISCUSSION

The main objective of this research is to uncover the intermediate mechanism of three types of leadership behavior; supportive, participative, and achievement-oriented leadership.

This study extends the literature in knowledge sharing and leadership in online communities by

using path-goal theory. Firstly, our results show supportive leadership behavior can increase online community members' self-efficacy toward knowledge sharing in an online programming community. This indicates that when a leader supports members by nurturing an acquired belief in members abilities (cognitively and/or emotionally), this will lead to an individual's motivating behavior. According to Kerfoot (2001), people feel the fire of passion when they are inspired by their leader who drives them intrinsically to achieve the right way. The followers will also feel enthusiastic and passionate about the purpose and values of their work (Bandura, 1986). This type of leadership behavior, if cultivated by a virtual leader, will foster the feeling of appreciation within the members towards their perceived leaders and to their community as Wellman and Gulia (1999) argue that the stronger your attachment to virtual community is, you are more likely to participate in that community and will eventually support other members as well because one commonality is that being supported by others will make you support others as well (Wasko & Faraj, 2000).

Secondly, our results demonstrate that participative leadership behavior can increase members' self-efficacy towards knowledge sharing in an online programming community. This indicates that when members perceived that they have the abilities to contribute, their knowledge sharing behavior will be amplified when they are included by the leader to participate in the decision-making process through deciding their own creative and innovative way of contributing. This moderating role of participative leadership holds this for the professional workers who share their expertise and programming skills that can bring ideas and contribution toward developing and enriching the functionality of the online programming communities. This type of leadership behavior, if cultivated by a virtual leader, will foster the members "psychological ownership" (Sashkin, 1976).

Practically, community managers and moderators can nurture the motivation of their members by providing their members a sense of ownership in the online community. Additionally, the members can be empowered by being included in decisions and allowed to determine the direction.

Thirdly, achievement-oriented leadership is also essential in moderating outcome expectancy towards knowledge sharing in online programming communities. This shows that having leaders who can boost and strengthen members' capabilities on accomplishing challenging goals will increase the members' contribution towards online programming community.

In terms of practical contribution, the community manager or moderator should focus on providing and cultivating achievement-oriented environment by providing internal and external rewards for their members. In comparison with the traditional physical organization, achievement leadership is focused on promotion and appraisals for the staff, yet, the achievement is somewhat similar for an achievement-oriented leadership in an online community. In online communities, achievement leadership can motivate members' contributions through assigning a position rank to their members (e.g. beginners, intermediate, advanced) as it exists in Linux and gaming communities (Ducheneaut et al., 2007). In addition, assigning contribution point towards project valued by other members can also be applied. However, unlike traditional organization, there is no monetary reward associated with the promotion to higher ranks in the online programming setting.

Another approach for leaders to recognise achievement of the members is through challenging members to add a new functionality in system development. Monitoring the time and progress of their programming skills, they may be given project after passing the assessment. This will help online programming community to receive more members who intend to improve themselves by participating and sharing their knowledge with each other and decrease lurking. Therefore, leaders who cultivate these types of leadership will decrease the dropout rate among members demonstrated by previous studies and also ensure the sustainability of the online programming community.

VI CONCLUSION

The data for this study were collected from 20 online programming communities. This findings from this study contributed to the existing body of knowledge by demonstrating the significant dual role of leadership moderating knowledge sharing behavior. The finding implied that although online communities are informal in nature and that an appropriate type of leadership can boost the members' efficacy and outcome expectancy to participate in knowledge sharing. Ideally, with the appropriate level of autonomy and recognition of members contributions, members are motivated to continuously contribute and promote sustainability in online programming communities.

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