Exploring the formation of collective efficacy in college student learning teams

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Abstract: This study examines the impact of three dimensions of TMS (specialization, task-knowledge coordination and cognition-based trust) on collective efficacy. Ninety-two undergraduates from a northern university in Taiwan participated in an experiment which was employed to collect data. Subjects were randomly assigned to nineteen teams with each consisting of 4-5 persons. Each team was asked to solve a weekly business problem during the 8-week experiment. The study results indicated that: (1) specialization and cognition-based trust had significant positive effects on task-knowledge coordination; (2) task-knowledge coordination had significant positive effects on collective efficacy but specialization and cognition-based trust did not; and (3) collective efficacy significantly influenced team performance. This study found that task-knowledge coordination was the most important dimension of TMS. The study result suggests that effective task-knowledge coordination facilitates the formation of collective efficacy and which, in turn, lead to better team performance.

Keywords: cognition-based trust, collective efficacy, task-knowledge coordination, team performance, transactive memory system (TMS)

Introduction

With the growing use of team to leverage competitive challenges (Cohen & Bailey, 1997), teamwork has become an essential work unit in most organizations (Cohen & Bailey, 1997; Tasa et al., 2007). Tasa et al. (2007) pointed that teamwork behaviors contribute to collective efficacy, which is associated with team performance (Gully et al., 2002). Understanding teamwork behaviors about how team members interact and coordinate with one another and affect group outcomes is an important issue in both academic and practitioner communities.

One theory that can explain the dynamics of teamwork behaviors is TMS. TMS is the metaphor of how individuals employ teammates as external recollection for fulfilling a given task. The notion of TMS is “a shared system for encoding, storing, and retrieving information” (Wenger, Erber, & Raymond, 1991, p.923). Literature on TMS has reported that TMS can be conceptualized to three social-cognition dimensions: specialization, credibility and coordination (Lewis, 2003). Based on the conceptualization of TMS, Kanawattanachai & Yoo (2007) renamed the coordination dimension as task-knowledge coordination. This is to emphasize that coordination among team members can be characterized as alignment between task and knowledge. They also substituted the credibility dimension with cognition-based trust to stress the important role of interpersonal trust during team’s TMS development. Their work on re-conceptualization of TMS suggested that specialization and cognition-based trust affected the formation of task-knowledge coordination among team members and then leveraged virtual team performance when performing a decision-making task (Kanawattanachai & Yoo, 2007).

Prior research indicated that TMS could predict selected outcome variables such as team performance (Yoo & Kanawattanachai, 2001), speed-to-market and team learning (Akgün et al, 2006). Collective efficacy was another variable...
that associated with team performance (Tasa et al., 2007; Gully et al., 2002). Nevertheless, little research discussed the relationships between TMS and collective efficacy or their impacts on team performance. This study investigated how three social-cognition dimensions of TMS (i.e., specialization, coordination and cognition-based trust) impacts on collective efficacy which in turn affects team performance. The following research questions were addressed in this study: (1) The relationship among the three social cognitive dimensions of TMS. (2) How do three social cognitive dimensions of TMS affect collective efficacy? And (3) Do three social cognitive dimensions of TMS transmit their impacts on the formation of team performance via collective efficacy?

This paper contributes to the literature in the followings. First, we follow Lewis’s conceptualization of TMS and empirically investigate the interrelationship among the three social cognitive dimensions. Second, we integrate three social cognitive dimensions of TMS with collective efficacy in a proposed model to study how team performance is antecedents-induced.

Theory background and Hypotheses

Collective efficacy and team performance

Collective efficacy, the extension of self efficacy, is referred as a group’ shared belief in their ability to complete desired results by joint actions (Bandura, 1997). Prior studies have explored the relationship between collective efficacy belief and performance in different contexts, including education (Parker, 1994), sports (Kozub & McDonnell, 2000), and organizations (Gibson, 2000). Given that collective efficacy has been identified as the predictor of team performance and previous studies has revealed that collective efficacy is critical to group performance in various work group settings (e.g., Campion, Medsker, and Higgs, 1993; Jung & Sosik, 1999), we derive our first hypothesis as the follows:

Hypothesis 1: Perceived collective efficacy positively influence on team performance.

The development of TMS in team

Wenger et al. (1991, p.923) first proposed the concept of TMS to describe how individuals treat their co-workers as external memory aid to complement their insufficient knowledge. TMS was defined as “a shared system for encoding, storing, and retrieving information” (Wenger et al., 1991, p.923). As Moreland and Wenger suggested that TMS is an indexing system which tells team members who knows what (Moreland 1999, Wegner 1995). TMS provides team members with a referencing system and a knowledge map for distributing and retrieving knowledge (Ellis, 2006). The conceptualization of TMS was applied to a new product development project team and its association with team performance was confirmed (Akgün et al, 2005; Akgün et al, 2006). Kanawattanchai & Yoo (2007) classified TMS into three dimensions: expertise location, task-knowledge coordination, and cognition-based trust. They found that both expertise location and cognition-based trust positively influenced task-knowledge coordination and which in turn leads to higher team performance. Thus we proposed the following two hypotheses to address the impact of specialization and cognition-based trust on task-knowledge coordination in the development of TMS:

Hypothesis 2: Perceived specialization in team will positively influence perceived task-knowledge coordination.
Hypothesis 3: Perceived cognition-based trust in team will positively influence perceived task-knowledge Coordination.

The association of TMS with collective efficacy

Previous researches indicated that “task-knowledge” coordination was an important dimension of TMS in explaining team performance (Kanawattanchai & Yoo, 2007). Given that collective efficacy is another precursor of team performance, the relationship between TMS and collective efficacy is worth to be explored. Mannix et al. (2002) explored on the phenomenology of conflict in distributed work teams and proposed that transactive memory is an antecedent of team poteny, which is a synonym of collective efficacy. In other words, TMS may influence on collective efficacy because it can facilitate “the ability of team members to see how each might contribute to accomplish their task” (Fuller, 2007; Mannix et al., 2002). Although TMS might impact on collective efficacy, few researches empirically probed the casual linkage between TMS and collective efficacy. Thus, we proposed the following hypotheses to investigate the impact of TMS on collective efficacy:
Hypothesis 4: Transactive memory system of a team will positively influence perceived collective efficacy.

- H4a: Perceived specialization in team will positively influence perceived collective efficacy.
- H4b: Perceived task-knowledge coordination in team will positively influence perceived collective efficacy.
- H4c: Perceived cognition-based trust in team will positively influence perceived collective efficacy.

Research Methodology

Based on literature review mentioned above, we proposed a research model to explore the relationships among TMS, collective efficacy and team performance. Our goal here is to understand how TMS fosters the formation of collective efficacy and whether collective efficacy affects team performance. This study examines the proposed model using empirical data which was collected from an experiment conducted at a Taiwan university. The experiment procedure and measurement are described as the follows.

Experiment Procedure

The sample was drawn from students enrolled in an undergraduate organizational behavior course at a northern university in Taiwan. The students were asked to join this experiment for course credit. Ninety-two participants were randomly assigned to nineteen teams with each consists of 4-5 team members. Each team was asked to participate in a business simulation game. The web-based simulation game was called Business Operations Simulation System, BOSS 2005.

BOSS 2005 is a popular strategic business game and used as a teaching supplement in business schools in Taiwan. Its simulator contains five functional area of business: finance, executive, marketing, production and operation, and planning and procurement. In this simulation game, each functional manager can share their functional information such as price strategies, manufacturing plans, information systems implementation, and sales forecast with other team members (acting as other functional managers) to help make better strategy decisions.

The experiment of business game lasted for eight weeks. In the first week of the class, the instructor explained to the participants about the experiment procedures and the learning task. Before the business game got started, the participants had two weeks to practice how to use the business simulation software. Such educational training aimed to make sure participants have had enough prior domain knowledge and computer literacy to successfully fulfill their assigned responsibility in the simulation game. During this period, all teams were asked to build a new company in the BOSS 2005 platform and then assigned their team members to six roles of top managerial positions, including general manager, planning manager, marketing manager, production manager, procurement manager, and finance manager. Subjects were instructed to read the system operation manual by themselves and get acquainted with their team members via communication tools.

All six functional managers of each team must made weekly decision according to the updated weekly business information. Weekly news including industry reports, business finance sheet, and functional operation report were updated and posted in web site. Each manager could access all six divisions’ detailed weekly information but could only make his or her decision on his own division. Weekly operation reports such ROE, ROI, corporate finance sheets and team performance ranking were announced via online news and emails. The business game was formally began on week 3 and lasted for eight weeks. After the completion of the eight-week business game experiment, BOSS 2005 produced a final report regarding on the operational report and performance ranking report.

All Questionnaires were administered to ninety-two participants three weeks after the experiment completion.

Measurement

One exogenous variable, TMS, and two endogenous variables, collective efficacy and team performance, were measured in this study. All questions were measured on a five-point Likert scale (from 1 = “strongly disagree” to 5 = “strongly agree”).

Three dimensions of TMS: specialization, task-knowledge coordination and cognition-based trust (Kanawattanachai & Yoo, 2007) were used to capture the dynamics of TMS. Specialization and task-knowledge
coordination comprising four and three items respectively were adapted from Lewis (2003). The scales have been validated in the new product development teams (Akgün et al. 2006) and virtual teams (Kanawattanachai & Yoo, 2007). A sample item for specialization was “Each team member has specialized knowledge of some aspect of our project”. A sample item for task-knowledge coordination was “Our team had very few misunderstandings about what to do”. Cognition-based trust was measured by five items adapted from McAllister (1995). A sample item for cognition-based trust was “Our team member approaches his/her job with professionalism and dedication”.

The measurement of perceived collective efficacy was developed by Salanova et al. (2003). Four questions were adapted from it to probe the individuals’ perceptions regarding the team’s performance capabilities (Kozub and McDonnell, 2000). Given that team performance comprised multidimensional feature (Denison et al., 1996; Gemuenden, 1990; Jung and Avolio, 2000), we adapted five items from Hoegl and Gemuenden’s scale (2001) to measure team efficiency and team effectiveness as measures of team performance. Five questions were refined to measured individuals’ perceived team performance.

Data Analysis

With the insufficient sample size and the innovative theory testing, this study adopted Partial least squares (PLS) approach to examine the proposed research model. Jöreskog and Wold (1982, p 270) pointed “PLS is primarily intended for causal-predictive analysis in situations of high complexity but low theoretical information”. Thus it should be appropriate to employ the SmartPLS 2.0.M3 to estimate our proposed model.

Measurement Model

The measurement model was assessed by examining the values of factor loadings, Cronbach's alphas, composite reliability and average variance extracted (AVE). These parameters were presented in Table 1. All values of factor loading in each construct were greater than the threshold of 0.7. The values of Cronbach's alphas were above the threshold of 0.7 for all of the constructs (Nunnally, 1978). The values of composite reliability were all above the threshold of 0.6 (Fornell and Larcker 1981). Such results indicated that our measurement model had an acceptable internal reliability in each construct.

The AVE values measuring convergent validity were presented in Table 1 which showed all were above the threshold of 0.5 (Fornell and Larcker, 1981). Thus convergent validity of the measurement model was acceptable. The values of squared root of AVE in each construct were presented in the diagonal of Table 1 and all were larger than the values of its corresponding inter-construct correlations. Such result indicated that discriminant validity of the measurement model was also acceptable (Fornell and Larcker, 1981). In sum, the measurement model of our proposed research model was confirmed.

Structural Model

The path coefficients of our research model were depicted Figure 1. All paths coefficients were positive significant except one path, which was the path from specialization to collective efficacy. Thus H4a were not supported. Hypothesis 1 examined the effects of collective efficacy on team performance. The path coefficient was positive and significant ($\beta=0.449$, $p<0.01$). The result supported Hypothesis 1.

Hypothesis 2 tested the impacts of team members’ perceived specialization on perceived task-knowledge coordination in team. The path coefficient from specialization to task-knowledge coordination was positive and significant ($\beta=0.191$, $p<0.05$). Thus, Hypotheses 2 was supported. Hypothesis 3 assessed the team members’ perceived cognition-based trust on perceived task-knowledge coordination in team. The path coefficient from cognition-based trust to task-knowledge coordination was positive and significant ($\beta=0.494$, $p<0.01$). Thus, Hypotheses 3 was supported. The confirmations of both Hypothesis 2 and Hypothesis 3 indicated that specialization and cognition-based trust impacted on task-knowledge coordination in the development of TMS.

Hypothesis 4 assessed the impacts of three dimensions of TMS in teams on team members’ perceived collective efficacy. The two path coefficients, from task-knowledge coordination to collective efficacy ($\beta=0.488$, $p<0.01$) and from cognition-based trust to collective efficacy ($\beta=0.231$, $p<0.05$), were all positively significant. On the other hand, the path
coefficient from specialization to collective efficacy indicated that the effects of specialization on collective efficacy was not significant ($\beta=0.163$, $p>0.05$). The aforementioned results indicated that H4b and H4c were supported, but H4a was not supported. We found that task-knowledge coordination and cognition-based trust significantly influenced on collective efficacy, specialization didn’t significantly affect on collective efficacy.

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<tr>
<td>1. Specialization</td>
<td>0.791</td>
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<td>2. Task-knowledge coordination</td>
<td>0.404</td>
<td>0.799</td>
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<td>3. Cognition-based trust</td>
<td>0.430</td>
<td>0.577</td>
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<td>4. Collective efficacy</td>
<td>0.133</td>
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<td>5. Team performance</td>
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Cronbach’s Alpha

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Composite Reliability

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AVE

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**Table 1:** Inter-Constructs Correlation, Average Variance Extracted and Composite Reliability (n=92).

Note: *: $p<$0.05; **: $p<$0.01; Value on the diagonal line is the squared root of AVE.

**Figure 1:** The path coefficients of research model.
(SPE: Specialization; COO: Task-knowledge coordination; CBT: Cognition-based trust; CE: Collective efficacy; TP: Team performance.)

**Findings and Discussion**

The results of hypotheses testing were summarized in Table 2. Hypothesis 1, Hypothesis 2 and Hypothesis 3 were supported, but Hypothesis 4 was partially supported. Our study found that collective efficacy significantly associated with team performance. Such result confirms with the previous work by Gully et al. (2002). H2 and H3 proves that specialization and cognition-based trust significantly affected task-knowledge coordination. Such result implies that the development of TMS may underpin on an inner process and verify the work by Kanawattanachai & Yoo (2007) in virtual team context.

H4 examined the impacts of three dimensions of TMS on collective efficacy. Both H4b ($\beta=0.488$, $p<0.01$), and H4c ($\beta=0.231$, $p<0.05$) were supported. But H4a was not supported. These results indicated that both task-knowledge coordination and cognition-based trust significantly associated with collective efficacy, but specialization didn’t
significantly impact on collective efficacy. Although specialization doesn’t direct influence on collective efficacy, it may indirectly affect collective efficacy via task-knowledge coordination and worthy further study. Comparing with cognition-based trust, task-knowledge coordination had more power in predicting the formation of collective efficacy. Obviously, task-knowledge coordination was the most important dimension in TMS.

<table>
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<th>Hypothesis</th>
<th>Test result</th>
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<tr>
<td><strong>H1</strong>: Collective efficacy positively influence on team performance.</td>
<td>Supported</td>
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<tr>
<td><strong>H2</strong>: Specialization in team will positively influence Perceived task-knowledge coordination.</td>
<td>Supported</td>
</tr>
<tr>
<td><strong>H3</strong>: Cognition-based trust in team will positively influence task-knowledge coordination</td>
<td>Supported</td>
</tr>
<tr>
<td><strong>H4</strong>: TMS of a team will positively influence collective efficacy.</td>
<td>Partially supported</td>
</tr>
<tr>
<td><strong>H4a</strong>: Specialization in team will positively influence collective efficacy.</td>
<td>Supported</td>
</tr>
<tr>
<td><strong>H4b</strong>: Task-knowledge coordination in team will positively influence collective efficacy.</td>
<td>Not supported</td>
</tr>
<tr>
<td><strong>H4c</strong>: Perceived Cognition-based trust in team will positively influence collective efficacy.</td>
<td>Supported</td>
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Table 2: Summary of Hypotheses Tests Results.

**Conclusion**

**Academic and Managerial implication**

This study provides some implications for Academics. Firstly, we proved that in the development of TMS, specialization and cognition-based trust impacts on task-knowledge coordination. Such results confirmed the evidence that the development of TMS may reveal an inner process. The dynamics of TMS during team operation should gain more attention. Given that TMS is related to team learning (Akgün et al., 2006), one situation should be considered that team learning may facilitate knowledge sharing and knowledge transfer among team members which would lead to ambiguous labor division. In other words, the boundary of specialization among team members may be torn down after individuals having established boundary spanning capability. As a result, the impact of specialization on task-knowledge may disappear. Thus, the inner process of TMS should be carefully investigated by conducting a longitudinal study. Secondly, this study investigated the impacts of three dimensions of TMS on collective efficacy. We found that two dimensions of TMS, task-knowledge coordination and cognition-based trust, had significant influences on collective efficacy. For better understating on the formation of TMS, the relationships among three dimensions of TMS and their antecedents should be explored. Thirdly, compared with cognition-based trust, task-knowledge coordination had more power on explaining collective efficacy. Future research on TMS may explore whether both specialization and cognition-based trust would transmit their effects on other selected outcome variables, such as collective mind (Akgün et al., 2006, Yoo & Kanawattanachai, 2001), via task-knowledge coordination.

Our research contributes some managerial implications as follows. Firstly, the result indicated that cognition-based trust and affect-based trust related to task-knowledge coordination (Akgün et al., 2005; Kanawattanachai & Yoo, 2007), managers should take managerial actions such as using rewards (Ferrin & Dirks, 2003) or fostering transformational leadership style (Jung & Avolio, 2000) to enhance trust among team members. In addition, managers should consider the specialty of team members when composing work teams so that team members can easily backup one another to accomplish the given mission.

**Limitations and Future Research**

This study provides a plausible framework to investigate the role of TMS theory in forming collective efficacy. There exist limitations in the present study. First, nineteen teams consisted by ninety two samples are not enough to perform team level data analysis, thus we used 92 samples to perform individual level data analysis instead. Although we added a paragraph in the questionnaire: “The following questions aim to understand your perception regarding teamwork behavior”, to capture the individual’s perceived TMS, collective efficacy and team performance, the individual level of perception may bias the results. Future study may seek for a larger sample size to meet the requirement of team level
analysis. Secondly, future research may use alternative indicators to measure team performance to increase the internal validity. Thirdly, TMS may already exist before the experiment because all team members may have known one another already. Future study may incorporate antecedents of TMS into research model. Lastly, future study may test the proposed model in a real organizational setting or take a longitudinal research to increase its generalizability.

Reference


