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https://doi.org/10.15017/7343259

出版情報：九州大学心理学研究. 26, pp.1-18, 2025-03-21. 九州大学大学院人間環境学研究院
バージョン：
権利関係：

Kyushu University Psychological Research
2025, Vol.26, 1-18

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This study aimed to examine a path model from social self-efficacy and social value to three modes of motivational regulation (self-, co-, socially shared), three aspects of engagement (cognitive, behavioral, emotional), and performance in collaborative activities, by comparing university students and working adults. Participants comprised 806 university students and 980 working adults, who completed an online questionnaire consisting of psychological measurements. The hypothesized path model had a good enough fit through multi-group structural equation modeling analysis. The positive paths from social self-efficacy and social value to motivational regulation and engagement were significant for both groups. The path from motivational regulation to engagement showed, in part, differences between groups. For recent performance, the positive paths from engagement were statistically significant in both groups. We discussed the possibility of extending self-regulated learning and expectancy–value theory with social dimensions and the necessity of implementing path model-based practices in universities and the workplace.

Key Words: self-regulation, socially shared regulation, intrinsic motivation, social self-efficacy, engagement

Schools and workplaces offer many opportunities for daily, collaborative problem solving. Two related aspects are worth exploring: How do we regulate each other's motivations to be persistent and engaged in collaboration? What are the antecedents of this regulation of motivation and what outcomes (i.e., superior performance) will result from the regulation? Here, we hypothesize a path model of motivational regulation in collaborative activities and aim to elucidate the processes that lead to the generation of successful performance.

Major changes in global society and in diverse workplaces have created a need for individuals with not only specialized skills but also a broader range of personal skills and abilities (Binkley et al., 2012; Organisation for Economic Co-operation and Development, 2019). These are called 21st-century skills and should be cultivated in school education; they include the critical thinking, communication, and collaboration skills that are essential in the workplace (Binkley et al., 2012; Pellegrino & Hilton, 2012) and in ensuring lifelong learning. Diverse individuals are common to both school classrooms and workplaces, so collaborating with them is essential, enabling mutual self-regulation of learning. Elucidating the regulation of collaborative activities and the antecedent factors are necessary for productive engagement in real-life social learning environments (Järvenoja et al., 2020; Volet & Summers, 2013). Specifically, individuals who can self-regulate their learning and collaborate with others can actively engage in intellectual collaborative activities, consequently demonstrating superior workplace performance. Self-regulation involves adapting thought, motivation, emotion, and behavior toward individuals' goals (Schunk & Usher, 2013; Zimmerman, 2013). In modern society and education, the importance of developing sound human relationships is increasing and, more recently, the model of self-regulation has extended to interactive and dynamic situations where collaboration emerges with more social forms of regulation, such as "co-regulation" and "socially shared regulation" being explored (Hadwin et al., 2018; Järvelä & Hadwin, 2013). It is of great academic significance to elucidate not only self-regulation but also "co-regulation," which refers to the process of mutual psychological regulation with others, and "socially shared regulation," which refers to social regulation at the group level. Assessing these concepts can result in practical implications for establishing a variety of learning contexts in schools and workplaces, not only for individual learning but also for collaborative learning.

Although many studies have examined metacognition and cognitive regulation in group situations over time (Malmberg et al., 2017; Molenaar & Chiu, 2014), limited research has clarified how motivational regulation functions in collabora-

tive processes (Bakhtiar & Hadwin, 2020; Järvenoja et al., 2020). While various types of motivation have been considered, it has been demonstrated that intrinsic motivation, which is based on reasons, such as interest and enjoyment, leads to superior performance in both work and educational settings (Ryan & Deci, 2000, 2017). Thus, it is necessary to clarify how the social regulation of intrinsic motivation in a collaborative setting determines active engagement with activities and excellent outcomes in university students and working adults. This will provide important suggestions on how to support the transition of collaborative learning from higher education to the workplace and how to guide lifelong self-regulated learning, through interactions with others, from a motivational-process perspective.

Shared Regulation of Motivation

Self-regulation is the ability of learners to effectively engage in their own learning processes metacognitively, motivationally, and behaviorally (Zimmerman, 1989). Research has shown that self-regulation plays an important role in various learning contexts (Schunk & Greene, 2018; Zimmerman & Schunk, 2001, 2011). While previous studies on self-regulation primarily examined how people cognitively and metacognitively regulate themselves (Pintrich, 1999; Zimmerman, 2000), recent studies have also begun to explore how they self-regulate their motivation (Umemoto, 2015; Wolters, 2011; Wolters & Benzon, 2013).

In group problem-solving and learning situations, regulating oneself, as well as others, through collaboration is important. Järvelä and Hadwin (2013) and Järvelä et al. (2019) have demonstrated that the process of collaborative activities has three modes of regulation. First, learners regulate their learning process, which implies self-regulation. Second, one learner either guides or is supported by another learner in a one-to-one bilateral relationship. This process is called "co-regulation." Third, multiple members in a particular group interdependently regulate the collaborative activities process. They jointly regulate their problem-solving processes through communication. This process is called "socially shared regulation." Researchers are increasingly interested in co-regulation and socially shared regulation, requiring further study (Järvelä et al., 2019; Melzner et al., 2022).

Studies addressing co-regulation and socially shared regulation have also largely focused on regulating cognitive and metacognitive aspects (De Backer et al., 2015; Malmberg et al., 2017). Existing research targeting co-regulation and socially shared regulation of motivation for collaborative activities is scarce (Järvenoja et al., 2020). Research has focused primarily on the regulation of cognitive and metacognitive processes because thinking and understanding are essential for superior learning outcomes. However, motivational regulation is also necessary for deeper and continuous learning, and a comprehensive elucidation of these psychological processes is expected to have profound implications for educational practice. Given that intrinsic motivation is a key factor leading to superior outcomes (Ryan & Deci, 2000, 2017), clarifying the regulation of intrinsic motivation through collaboration is especially required (Ito & Umemoto, 2022a). By relying on the three theories of regulation (self-, co-, and socially shared), it is possible to elucidate the phenomenon of how people continue to persistently engage in collaborative activities by making them enjoyable and meaningful.

Social Self-efficacy and Social Value as Antecedent Factors of Motivation

What might be the antecedent factors that predict the success or failure of motivational regulation? The expectancy–value theory is one of the representative theories in motivational research (Eccles & Wigfield, 2002; Wigfield & Eccles, 2000). It emphasizes that the cognitive factors of expectation and value predict motivation, along with past performance in successfully achieving things. When people perceive high expectations of success (i.e., self-efficacy), they are more motivated and actively engage in the activity (Bandura, 1977, 1997). Self-efficacy is a person's belief in their ability to succeed in a particular situation. Similarly, when they perceive high value in an activity, they will be more motivated and actively engage in the activity (Eccles & Wigfield, 2002; Pintrich & De Groot, 1990; Wigfield & Eccles, 2000). Value is the recognition of an activity as meaningful and useful.

Previous studies of motivational regulation have examined how these two antecedent factors determine motivational regulation strategies (Wolters & Rosenthal, 2000; Wolters et al., 2011). For example, Ito and Shinto (2005) demonstrated that self-efficacy positively influenced intrinsic motivational regulation strategies through a longitudinal survey. Intrinsic motivational regulation strategies are methods to regulate the task of studying and learning to create, maintain, and promote personal motivation, such as increasing the enjoyment of and interest in learning itself, and valuing study. Umemoto and Tanaka (2017) revealed that self-efficacy and intrinsic value for a learning task were positively associated with autonomy regulation strategies, which implies enhancing interest and valuing learning. Intrinsic value means that people believe the task is important, useful, and, interesting (Pintrich & De Groot, 1990).

Although previous studies have assessed the self-regulation of motivation by individuals, research has emerged clarifying the self-regulation of motivation in collaborative activities (Umemoto et al., 2018). Umemoto et al. (2018) showed that strategies to regulate intrinsic and identified motivation for cooperative learning were positively associated with self-efficacy and intrinsic value. Ito and Umemoto (2022a) verified the path model and revealed that self-efficacy, utility value, and past performance positively predicted self-regulation, co-regulation, and socially shared regulation of intrinsic motivation in university students and working adults. In this study (Ito & Umemoto, 2022a), utility value comprised the usefulness of activities in everyday life.

Regarding co-regulation and socially shared regulation, accounting for the social aspects of motivational antecedents is necessary. Social efficacy, which corresponds to the belief that one can have positive human relationships with others (Okada, 2014; Patrick et al., 2002), may be an important predictor of social regulation. Social efficacy has been found to be related to enjoyment in the classroom and interest in the subject matter, that is, intrinsic motivation (Okada, 2014; Ryan et al., 2005). To obtain further implications for more realistic collaborative practices, it is necessary to clarify whether social self-efficacy determines co-regulation and social regulation, as well as the self-regulation of intrinsic motivation, in collaborative activities. However, no attempts have been made to conduct such studies. This is probably because the model is complicated, owing to the need to include interpersonal factors. As with social self-efficacy, social aspects of task value can be considered, but no relevant research exists. Here, social value is defined as the belief that collaborative activities are meaningful and useful for the group members, considering the expectancy–value theory (Eccles & Wigfield, 2002; Wigfield & Eccles, 2000). By examining these factors, it is expected that practical suggestions on how to deepen collaborative activities at school and the workplace can be obtained. Expectancy–value theory is a promising theory that explains why people persist in an activity. This theory can reveal the kinds of expectations and values that lead to people's tendencies to make collaborative activities enjoyable and worthwhile.

The Three Modes of Motivational Regulation, Engagement, and Performance

Based on previous studies (Er et al., 2021; Ito & Umemoto, 2022b; Järvelä et al., 2016), the following causal model can be assumed: self-regulation, co-regulation, and socially shared regulation of learning determine engagement, which determines superior performance. These studies suggest, from the analysis of qualitative and quantitative data, that learners who are working with self-regulation, co-regulation, and socially shared regulation are actively engaged in collaborative learning. Furthermore, Ito and Umemoto (2022c) show that the socially shared regulation of learning is positively related to engagement and creative performance in collaborative activities.

In educational psychology, engagement has been demonstrated as a key variable that is a direct predictor of excellent academic performance (Christenson et al., 2012; Robayo-Tamayo et al., 2020; Skinner et al., 2008). Engagement comprises the behavioral intensity and emotional quality of a person's active involvement during a task (Connell & Wellborn, 1991; Reeve et al., 2004); it can be viewed as the motivation itself that is generated through more specific situations and occasions (Kage, 2013; Vallerand, 1997). The more actively people engage in group activities, the more superior outcomes will be produced. Learners' engagement during intellectual activity is an important educational construct that directly and strongly predicts academic achievement (Christenson et al., 2012; Ladd & Dinella, 2009). Previous research (Fredricks et al., 2004; Skinner & Belmont, 1993; Skinner et al., 2009) validated it as a three-component psychological construct, including cognitive, behavioral, and emotional aspects. Cognitive engagement means that students use sophisticated learning strategies instead of superficial learning strategies (Reeve, 2012). Behavioral engagement means that students show a high level of effort, attention, and persistence while participating in the activities (Skinner et al., 2008). Emotional engagement implies that students show a high level of enthusiasm, interest, and enjoyment during the activity (Marks, 2000; Skinner et al., 2008). Prior research has indicated that all three aspects of engagement are positively related to academic performance, but path model testing has clarified that behavioral engagement is the strongest positive predictor of academic performance (Hofverberg et al., 2022; Reeve, 2013; Reeve & Tseng, 2011; Umemoto et al., 2016).

This study also includes working people in the target of the analysis. In psychological research, work engagement is a similar construct to academic engagement. Work engagement is defined as a "positive, fulfilling, work-related state of mind that drives workers actively to involve themselves emotionally, cognitively, and physically in performing their jobs" (Huertas-Valdivia et al., 2018; Schaufeli et al., 2009; Schaufeli et al., 2002). For instance, Yalabik et al. (2013) suggest that work engagement mediates the relationships from affective commitment to job performance. Affective commitment refers to an emotional attachment and identification with the organization held by workers (Meyer et al., 2002). Based on the self-

determination theory (Ryan & Deci, 2000, 2017), Roussillon Soyer et al. (2022) performed an empirical study over three time periods, and found that autonomous motivation was positively associated with job performance through work engagement. By drawing on self-determination theory, it is possible to clarify the process through which a person's propensity to enjoy, find meaning in, and be motivated to work on collaborative activities leads to enthusiastic absorption in the activities and the production of excellent performance.

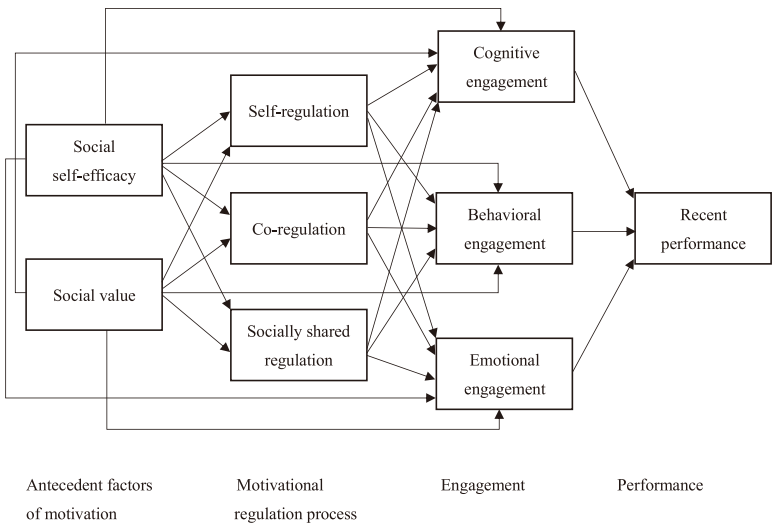
Present Study

This study aimed to empirically clarify the role of self-regulation, co-regulation, and socially shared regulation of intrinsic motivation in collaborative activities for university students and working adults. Based on the presented review's findings, a path model (see Fig.1) can be postulated from social self-efficacy and social value to the three modes of motivational regulation, the three aspects of engagement, and performance in collaborative problem-solving activities. In Fig.1, social self-efficacy and social value are placed on the leftmost side; from there, moving to the right, the factors are placed along the causal flow, represented by a rightward-facing path. From left to right, the first layer is social self-efficacy and value, the second layer represents the three modes of regulation, the third layer is engagement, and the fourth layer is performance, expressed as a causal relationship. The model diagram shows the paths between all the factors that make up each layer. The paths in the model are constructed based on the various theories of motivation and the results of past studies described in the previous sections. The hypotheses of this study are as follows.

Ito and Umemoto (2022a) and Umemoto et al. (2018) show that self-efficacy and value determine self-regulation, co-regulation, and socially shared regulation of motivation; therefore, social self-efficacy (Okada, 2014; Patrick et al., 2002) and social value, which are positioned as antecedent factors, will positively predict the three modes of regulation of intrinsic motivation. General performance based on experience will also be controlled as an antecedent factor (Eccles & Wigfield, 2002; Wigfield & Eccles, 2000). Next, based on previous research findings (Er et al., 2021; Ito & Umemoto, 2022b, 2022c; Järvelä et al., 2016), the three modes of regulation of intrinsic motivation will positively predict cognitive, behavioral, and emotional engagement. Engagement can be viewed as the motivation itself, which is generated through more specific situations and occasions (Kage, 2013; Vallerand, 1997). Therefore, considering the expectancy–value theory (Eccles & Wigfield, 2002; Wigfield & Eccles, 2000), it is assumed that social self-efficacy and social value, which are positioned as antecedent factors, will positively predict the three aspects of engagement. Considering previous studies (Reeve, 2013; Reeve & Tseng, 2011; Umemoto et al., 2016), all three aspects of engagement are positively associated with performance, but behavioral engagement is a significant positive predictor of

Fig.1

Hypothetical structural equation model for social self-efficacy, social values, the three modes of motivational regulation, engagement, and the performance level



performance. According to these path models, we will also examine the differences in the magnitude of the path coefficients between university students and working adults.

Additionally, we will compare the average scores of the motivational antecedent factors, the three modes of regulation of intrinsic motivation, the three aspects of engagement, and the performance level, between university students and adult workers, to obtain suggestions about the transition from higher education to the workplace. Ito and Umemoto's (2022a) results revealed that self-efficacy, utility value, the three modes of motivational regulation, and the previous performance level of university students were significantly higher than those in working adults. We will confirm whether similar results are found here. The abovementioned path models and differences in average scores will be empirically examined to obtain implications for motivational theory and practice in higher education and the workplace.

Method

Participants

In March 2021, 1,786 individuals (806 university students and 980 working adults) in Japan participated in the current study. The students included 571 women and 235 men (first-year 199, second-year 204, third-year 202, fourth-year 201); *M*age = 20.80 years, *SD*age = 2.57 years. Of them, 405 were enrolled in private universities, and 401 were enrolled in national, prefectural, or other public universities. The 980 working adults included 462 women and 518 men (293 aged 23 to 29, 345 aged 30 to 39, and 342 aged 40 to 49 years; *M*age = 35.68 years, *SD*age = 7.75 years), with an average of 8.46 (*SD* = 6.30) years of employment. The occupations of the respondents included full-time employed persons; company owners, executives, and part-time employees were excluded. All participants completed an online questionnaire facilitated by a research firm. After informed consent was obtained, participants answered the questionnaire. This study was approved by the research ethics committee of the Faculty of Human-Environment Studies at Kyushu University (approval number 2020-024). The research was conducted following the human subjects' guidelines.

Measures

Social Self-Efficacy and Social Value of Collaborative Activities. To assess the social self-efficacy and social value of collaborative activities, we developed three items that most directly represented these constructs. First, the first author drafted the items. Subsequently, the two co-authors, who specialize in educational psychology with experience in scale development, independently confirmed the construct validity of the content aspects. An example of the question item on social self-efficacy (Okada, 2014; Patrick et al., 1997) was "In group activities, I feel confident to talk to the members." An example of the question item on social value (Eccles & Wigfield, 2002; Kera & Nakaya, 2016) was "I think group activities are meaningful for everyone in the group." These items were rated on a 1–7 bipolar Likert scale, with responses ranging from "1" for "I don't agree at all" to "7" for "I strongly agree." The scores were used for subsequent analysis. The same was true for all the following measurements.

Three Modes of Regulation of Intrinsic Motivation in Collaborative Activity. Participants self-reported the extent of intrinsic motivational regulation in collaborative activity via a questionnaire. The questionnaire contained Ito and Umemoto's (2022a) scale, which comprised five items each for self-regulation, co-regulation, and socially shared regulation. These items were presented on a 1–7 bipolar scale. Ito and Umemoto's (2022a) scale was confirmed to have a high reliability coefficient in their study. Additionally, construct validity was examined.

Three Aspects of Engagement in Collaborative Activity. Based on Reeve and Tseng (2011) and Skinner et al. (2009), a questionnaire addressing the three aspects of engagement was developed. Three experts in educational psychology objectively checked the construct validity of the content aspects. Cognitive engagement consisted of four items. Behavioral engagement consisted of five items. Emotional engagement consisted of five items. In the instructional text, we explained that "group activities" are primarily intellectual activities that involve thinking and creating, such as school tasks, workplace, or community projects. These items were presented on a 1–7 bipolar scale.

Considering the COVID-19 situation, we also asked whether the "group activities" for the past three months were mainly face-to-face or online, as well as the content of the activities. Participants described the activities and provided the approximate percentage of time spent on each, with the total being 100%. Subsequently, regarding behavioral, emotional, and cognitive engagement, participants were asked about their feelings and states in the group activities they had experienced within the past three months. The percentage of face-to-face and online activity was positioned as a control variable in the path model.

Self-Assessment of the Two Performance Levels of Collaborative Activity. To assess each individual's general level of performance in collaborative activity, we developed three

items. To assess each individual's specific level of their most recent performance in collaborative activity, we developed three items. Participants self-assessed the specific level of their most recent performance after responding to the content of the group activity and the percentage of online versus face-to-face activity. As before, these items were presented on a 1–7 bipolar scale. General performance was positioned as a control variable, and recent performance was an outcome variable in the path model analysis. All the items used here are summarized in Table 1.

Table 1
Specifics of the items for the scale

Name of scale	Specifics of items
Social self-efficacy	In group activities, I feel confident to talk to the members.
	In group activities, I am able to communicate my thoughts to the members.
	In group activities, I can become friendly with the members.
Social value	I think group activities are meaningful for everyone in the group.
	I think group activities are useful for everyone in the group.
	I think group activities are important for everyone in the group.
Self-regulation	I try to increase my motivation by making the contents of group activities interesting.
	I try to increase my motivation by thinking that the contents of group activities are highly significant.
	I try to increase my motivation by making the contents of group activities as enjoyable as possible.
	I try to increase my motivation by recognizing that there is great value in the activities.
	I try to increase my motivation by linking the contents of group activities with my interests.
Co-regulation	I try to support the motivation of the group member by devising ways to make the member find the contents of group activities interesting.
	I try to support the motivation of the group member by encouraging the member to consider the contents of group activities as highly significant.
	I try to support the motivation of the group member by making the contents of group activities as enjoyable as possible.
	I try to support the motivation of the group member by making the member recognize that there is great value in the activities.
	I try to support the motivation of the group member by linking the contents of group activities with things that the member might be interested in.
Socially shared regulation	I try to support the motivation of the entire group by devising ways to make them find the contents of group activities interesting.
	I try to support the motivation of the entire group by encouraging them to consider the contents of group activities as highly significant.
	I try to support the motivation of the entire group by making the contents of group activities as enjoyable as possible.
	I try to support the motivation of the entire group by making them recognize that there is great value in the activities.
	I try to support the motivation of the entire group by linking the contents of group activities with things that all group members might be interested in.
Cognitive engagement	I worked on group activities, thinking about how we could discuss things better.
	I devised ways to improve the ideas in the discussion through group work.
	I worked on group activities, thinking about how to proceed more efficiently.
	I devised ways to deepen the discussion though group work.
Behavioral engagement	I paid attention in group work.
	I tried very hard to participate in group work.
	I worked on the group activities without giving up, until the end.
	I was very energetic in my group activities.
	I was enthusiastic about the group activities.
Emotional engagement	When we worked on something in group work, I felt interested.
	Group work was fun.
	I felt that I liked the group activities.
	I was excited when I was doing the group activities.
	I enjoyed the group activities.
General performance level	I think I have been hugely successful through various group activities.
	I think I have made many achievements in various group activities.
	I think I have played an important role in leading success in various group activities.
Recent performance level	I think I have been hugely successful through various group activities for the past three months.
	I think I have made many achievements in various group activities for the past three months.
	I think I have played an important role in leading success in various group activities for the past three months.

Results

Confirmatory Factor Analysis

The number of respondents who described their experience of group activities in the past three months was 605 university students and 615 working adults. The percentages of face-to-face group activities were $M = 41.50$, $SD = 41.95$ for university students and $M = 75.41$, $SD = 36.72$ for working adults. The percentages of online group activities were $M = 58.50$, $SD = 41.95$ for university students and $M = 24.59$, $SD = 36.72$ for working adults. As engagement and the recent performance level must be based on the experience of the group activity, for these two variables only, the numerical values of subsequent statistics were calculated for participants who had described the activity. All statistical analyses were done using the statistical software package R version 4.2.0 and lavaan package.

For social self-efficacy, social value, self-regulation, co-regulation, socially shared regulation, engagement, and the two performance levels, one factor structure was confirmed through multi-group structural equation modeling (SEM). Using the data of both groups, we tested the scalar invariance model in which factor loadings and intercepts were constrained equivalently for each group. The analysis results showed good model fits: social self-efficacy ($\chi^2(4) = 24.059$, $p = .000$, $\chi^2/df = 6.015$, comparative fit index; CFI = .993, standardized root mean squared residual; SRMR = .031); social value ($\chi^2(4) = 7.122$, $p = .130$, $\chi^2/df = 1.781$, CFI = .999, SRMR = .017); self-regulation ($\chi^2(18) = 539.552$, $p = .000$, $\chi^2/df = 29.975$, CFI = .916, SRMR = .046); co-regulation ($\chi^2(18) = 500.883$, $p = .000$, $\chi^2/df = 27.827$, CFI = .934, SRMR = .038); socially shared regulation ($\chi^2(18) = 237.137$, $p = .000$, $\chi^2/df = 13.174$, CFI = .970, SRMR = .025); engagement ($\chi^2(170) = 786.797$, $p = .000$, $\chi^2/df = 4.628$, CFI = .956, SRMR = .047); general performance level ($\chi^2(4) = 15.880$, $p = .003$, $\chi^2/df = 3.970$, CFI = .998, SRMR = .018); and recent performance level ($\chi^2(4) = 5.757$, $p = .218$, $\chi^2/df = 1.439$, CFI = 1.000, SRMR = .012). All these indicators for each scale had satisfactory values. All factor loadings showed a high value of more than .706, indicating contribution to the factors.

Reliability and Descriptive Statistics

Reliability coefficients were calculated for all the scales. These results are presented in Table 2. Notably, all values were high. As in previous studies, the mean values of the items were calculated for each scale, and the scale scores were used in the following analyses. Table 2 shows the mean score, standard deviation, and reliability coefficient in each group.

Comparison of Average Scores Between University Students and Working Adults

To examine the mean differences of variables between both groups, a *t*-test was conducted (Table 2). These tests were found to be statistically significant, although the effect sizes were small or medium. Simultaneously, we tested the above model with the mean structure using multi-group SEM. The analysis results showed that the difference in means was similarly significant: general performance level ($z = 3.542$, $p < .001$); social self-efficacy ($z = 2.638$, $p = .008$); social value ($z = 7.361$, $p < .001$); self-regulation ($z = 4.502$, $p < .001$); co-regulation ($z = 2.107$, $p = .035$); socially shared regulation ($z = 2.311$, $p = .021$); cognitive engagement ($z = 1.789$, $p = .074$); behavioral engagement ($z = 4.580$, $p < .001$); and emotional engagement ($z = 3.749$, $p < .001$). The analysis results revealed that social self-efficacy, social value, the three modes of motivational regulation, and behavioral and emotional en-

Table 2

Means, standard deviations, and reliability coefficients of social self-efficacy, social value, the three modes of motivational regulation, engagement, and the performance level for each group and results of the *t*-test

	Entire group		University students				Working adults				*t-value*	*Cohen's d*
	Mean	*SD*	*Mean*	*SD*	α	ω	*Mean*	*SD*	α	ω		
General performance level	4.03	1.57	4.19	1.49	.93	.93	3.90	1.62	.95	.95	3.87 ***	.18
Social self-efficacy	4.55	1.42	4.65	1.42	.87	.87	4.46	1.43	.90	.90	2.87 **	.14
Social value	4.66	1.34	4.91	1.31	.91	.92	4.45	1.33	.93	.93	7.43 ***	.35
Self-regulation	4.54	1.29	4.69	1.24	.89	.92	4.41	1.32	.93	.95	4.48 ***	.21
Co-regulation	4.45	1.30	4.51	1.30	.92	.94	4.39	1.31	.94	.95	2.04 *	.10
Socially shared regulation	4.38	1.33	4.47	1.30	.92	.94	4.32	1.35	.94	.96	2.34 *	.11
Cognitive engagement	4.77	1.08	4.83	1.07	.85	.86	4.72	1.09	.87	.88	1.79	.10
Behavioral engagement	5.06	1.14	5.21	1.11	.92	.93	4.90	1.14	.92	.94	4.81 ***	.28
Emotional engagement	4.42	1.33	4.57	1.32	.92	.93	4.28	1.33	.93	.94	3.75 ***	.21
Recent performance level	4.46	1.40	4.51	1.42	.95	.95	4.42	1.38	.94	.94	1.17	.07

Note. * $p<.05$, ** $p<.01$, *** $p<.001$.

gagement in university students were significantly higher than those in working adults. Although cognitive engagement was marginally significant, the average score of university students was higher than that for working adults.

Correlation Analysis Results

The results of calculating the correlation coefficients between social self-efficacy, social value, self-regulation, co-regulation, socially shared regulation, engagement, and the two performance levels are presented in Tables 3 and 4. There were statistically significant positive correlations between all variables for both groups. All values of the correlation coefficients were moderate or strong. There was almost no correlation between the percentage of face-to-face and online group activities and all these variables. The range of correlation coefficients for university students was *rs* = -.06–.06, and *rs* = -.13–.13 for working adults.

Path Model Analysis

We hypothesized a path model in which social self-efficacy and social value are antecedents, first determining the three modes of motivational regulation, then the three aspects of engagement, and finally, the most recent performance level. Additionally, social self-efficacy and social value were assumed to directly determine the three aspects of engagement. Covariance was assumed between the errors in social self-efficacy and social value, and between the errors in each of the three modes of motivational regulation. General performance and percentage of face-to-face group activity were incorporated into the model as control variables. This hypothesized model was verified by multi-group SEM. The goodness of fit index of the model was satisfactory with $\chi^2(10) = 18.119$, $p = .053$, $\chi^2/df = 1.812$, root mean square error of approximation; RMSEA = .037, 90% confidence interval; CI [.000, .063], SRMR = .005, CFI = .999, and Tucker-Lewis index; TLI = .991. The analysis results are presented in Table 5 and Fig.2.

Following the path flow, the following paths were statistically significant in the order of causality: First, the positive paths from social self-efficacy, social value, and general performance to the three modes of motivational regulation were

Table 3

The correlation analysis results between social self-efficacy, social value, the three modes of motivational regulation, engagement, and the two performance levels in university students.

		1	2	3	4	5	6	7	8	9
1	General performance level									
2	Social self-efficacy	.66 ***								
3	Social value	.51 ***	.62 ***							
4	Self-regulation	.56 ***	.62 ***	.60 ***						
5	Co-regulation	.64 ***	.66 ***	.56 ***	.75 ***					
6	Socially shared regulation	.68 ***	.67 ***	.55 ***	.74 ***	.88 ***				
7	Cognitive engagement	.59 ***	.62 ***	.60 ***	.64 ***	.66 ***	.67 ***			
8	Behavioral engagement	.49 ***	.54 ***	.58 ***	.54 ***	.52 ***	.50 ***	.76 ***		
9	Emotional engagement	.55 ***	.58 ***	.57 ***	.53 ***	.55 ***	.57 ***	.68 ***	.66 ***	
10	Recent performance level	.62 ***	.58 ***	.46 ***	.49 ***	.53 ***	.54 ***	.67 ***	.66 ***	.65 ***

Note. *** $p<.001$.

Table 4

The correlation analysis results between social self-efficacy, social value, the three modes of motivational regulation, engagement, and the two performance levels in working adults.

		1	2	3	4	5	6	7	8	9
1	General performance level									
2	Social self-efficacy	.64 ***								
3	Social value	.58 ***	.69 ***							
4	Self-regulation	.63 ***	.68 ***	.70 ***						
5	Co-regulation	.63 ***	.68 ***	.66 ***	.84 ***					
6	Socially shared regulation	.70 ***	.68 ***	.68 ***	.84 ***	.88 ***				
7	Cognitive engagement	.53 ***	.58 ***	.61 ***	.63 ***	.60 ***	.64 ***			
8	Behavioral engagement	.50 ***	.60 ***	.62 ***	.64 ***	.59 ***	.62 ***	.82 ***		
9	Emotional engagement	.52 ***	.56 ***	.60 ***	.57 ***	.52 ***	.55 ***	.68 ***	.73 ***	
10	Recent performance level	.60 ***	.58 ***	.57 ***	.57 ***	.57 ***	.59 ***	.74 ***	.72 ***	.74 ***

Note. *** $p<.001$.

Table 5

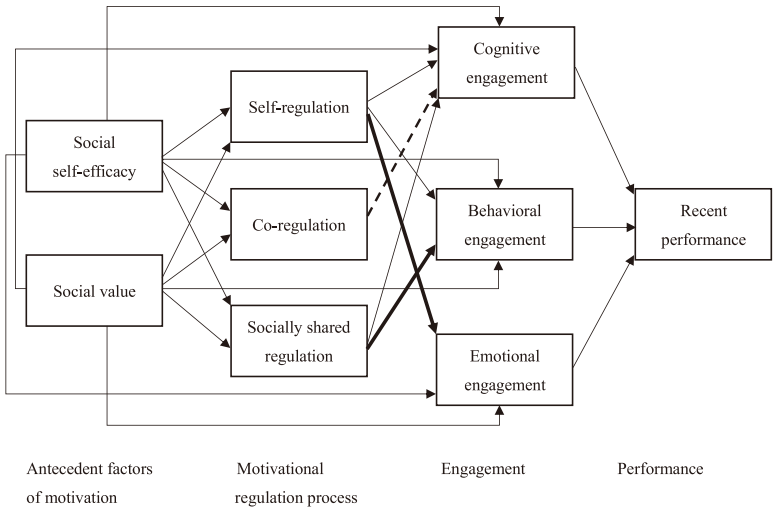
Result of multi-group structural equation modeling analysis on the path model for social self-efficacy, social values, the three modes of motivational regulation, engagement, and the performance level

Criterion	University students				Working adults			
Predictor	*B*	95%CI	*SE*	*β*	*B*	95%CI	*SE*	*β*
Self-regulation								
Social self-efficacy	.23	[.15, .30]	.04	.26 ***	.18	[.11, .25]	.04	.20 ***
Social value	.30	[.23, .38]	.04	.31 ***	.33	[.26, .40]	.04	.34 ***
General performance	.18	[.11, .24]	.03	.21 ***	.22	[.17, .28]	.03	.30 ***
Group activities	.00	[.00, .00]	.00	-.01	.00	[.00, .00]	.00	.02
R^2	.53				.55			
Co-regulation								
Social self-efficacy	.28	[.20, .35]	.04	.31 ***	.21	[.14, .28]	.04	.24 ***
Social value	.23	[.16, .31]	.04	.22 ***	.29	[.22, .36]	.04	.30 ***
General performance	.25	[.19, .32]	.03	.29 ***	.22	[.16, .27]	.03	.29 ***
Group activities	.00	[.00, .00]	.00	-.04	.00	[.00, .00]	.00	.00
R^2	.49				.49			
Socially shared regulation								
Social self-efficacy	.28	[.21, .35]	.04	.31 ***	.19	[.13, .26]	.03	.21 ***
Social value	.19	[.12, .26]	.04	.18 ***	.25	[.19, .32]	.03	.26 ***
General performance	.32	[.25, .38]	.03	.36 ***	.30	[.25, .36]	.03	.40 ***
Group activities	.00	[.00, .00]	.00	-.02	.00	[.00, .00]	.00	-.02
R^2	.53				.55			
Cognitive engagement								
Self-regulation	.17	[.09, .24]	.04	.18 ***	.19	[.10, .29]	.05	.21 ***
Co-regulation	.11	[.02, .21]	.05	.13 *	.00	[-.10, .11]	.06	.00
Socially shared regulation	.10	[.00, .20]	.05	.12 *	.17	[.06, .29]	.06	.19 **
Social self-efficacy	.10	[.04, .16]	.03	.13 **	.14	[.08, .21]	.03	.17 ***
Social value	.19	[.13, .25]	.03	.21 ***	.22	[.15, .29]	.04	.24 ***
General performance	.12	[.06, .17]	.03	.15 ***	.03	[-.02, .09]	.03	.04
Group activities	.00	[.00, .00]	.00	.01	.00	[.00, .00]	.00	-.02
R^2	.58				.52			
Behavioral engagement								
Self-regulation	.17	[.08, .26]	.05	.18 ***	.23	[.14, .33]	.05	.24 ***
Co-regulation	.11	[-.01, .22]	.06	.12 +	-.02	[-.13, .09]	.06	-.02
Socially shared regulation	-.09	[-.21, .03]	.06	-.10	.15	[.03, .27]	.06	.16 *
Social self-efficacy	.11	[.04, .19]	.04	.14 **	.20	[.14, .27]	.03	.23 ***
Social value	.28	[.21, .36]	.04	.31 ***	.25	[.18, .32]	.04	.27 ***
General performance	.12	[.05, .19]	.03	.15 ***	.00	[-.06, .05]	.03	.00
Group activities	.00	[.00, .00]	.00	.03	.00	[.00, .00]	.00	.01
R^2	.44				.54			
Emotional engagement								
Self-regulation	.09	[-.01, .19]	.05	.08 +	.20	[.09, .32]	.06	.18 ***
Co-regulation	.07	[-.06, .21]	.07	.07	-.05	[-.19, .09]	.07	-.04
Socially shared regulation	.09	[-.05, .23]	.07	.09	.09	[-.06, .23]	.07	.08
Social self-efficacy	.15	[.06, .23]	.04	.15 ***	.19	[.11, .27]	.04	.19 ***
Social value	.29	[.20, .37]	.04	.26 ***	.33	[.24, .42]	.04	.30 ***
General performance	.17	[.10, .25]	.04	.19 ***	.10	[.03, .17]	.04	.12 **
Group activities	.00	[.00, .00]	.00	.08 *	.00	[.00, .00]	.00	-.02
R^2	.47				.47			
Recent performance								
Cognitive engagement	.21	[.09, .32]	.06	.16 ***	.41	[.30, .51]	.05	.32 ***
Behavioral engagement	.34	[.23, .44]	.05	.26 ***	.12	[.02, .23]	.05	.10 *
Emotional engagement	.24	[.16, .32]	.04	.22 ***	.35	[.28, .42]	.04	.33 ***
General performance	.29	[.22, .35]	.03	.29 ***	.19	[.14, .24]	.03	.22 ***
Group activities	.00	[.00, .00]	.00	.03	.00	[.00, .00]	.00	.04 +
R^2	.60				.69			

Note. + $p<.10$, * $p<.05$, ** $p<.01$, *** $p<.001$.

Fig.2

Result of structural equation modeling analysis on the path model for social self-efficacy, social values, the three modes of motivational regulation, engagement, and the performance level.



Note. The bold arrows indicate that the path coefficient was significant for working adults only. The dashed arrow indicates that the path coefficient was significant for university students only. All other arrows indicate that the path coefficients for both groups were significant.

significant for both groups. The positive paths from social self-efficacy and social value to the three aspects of engagement were significant for both groups. Second, positive paths from general performance and the three modes of motivational regulation to cognitive engagement were significant for university students. The positive paths from self-regulation and socially shared regulation to cognitive engagement were significant for working adults. Third, the positive paths from general performance and self-regulation to behavioral engagement were significant for university students. The positive path from co-regulation to behavioral engagement was marginally significant for university students. The positive paths from self-regulation and socially shared regulation to behavioral engagement were significant for working adults. Fourth, the positive paths from general performance and face-to-face group activity to emotional engagement were significant for university students. The positive path from self-regulation to emotional engagement was marginally significant for university students. The positive paths from general performance and self-regulation to emotional engagement were significant for working adults. Fifth, for recent performance, the positive paths from the three aspects of engagement and general performance were statistically significant in both groups. All the standardized partial regression coefficients were low or moderate, as presented in Table 5. These coefficients of determination (R^2) showed values from .44 to .69.

The results for significant differences in path coefficient values between both groups are as follows; The value of the path from socially shared regulation to behavioral engagement was higher for working adults than for university students (z = 2.782, p < .01). The values of the paths from general performance to cognitive and behavioral engagement were higher for university students than for working adults (z = 2.147, p < .05; z = 2.730, p < .01, respectively). The values of the paths from cognitive and emotional engagement to recent performance were higher for working adults than for university students (z = 2.543, p < .05; z = 1.979, p < .05, respectively). The value of the paths from behavioral engagement and general performance to recent performance was higher for university students than for working adults (z = 2.842, p < .01; z = 2.271, p < .05, respectively).

Discussion

This study examined a path model from social self-efficacy and social value to three modes of motivational regulation, three aspects of engagement, and performance in collaborative activities, by comparing university students and working adults. Additionally, this study aimed to identify differences in the average scores of the two groups for these variables.

Differences Between University Students and Working Adults

The analysis results of differences in average scores revealed that the general performance level, social self-efficacy, social value, the three modes of motivational regulation, and behavioral and emotional engagement in university students were significantly higher than those in working adults. Although cognitive engagement was marginally significant, the average score of university students was higher than that for working adults. Ito and Umemoto (2022a) indicated that self-efficacy, utility value, the three modes of motivational regulation, and the previous performance level in university students were significantly higher than those in working adults. Similar results were obtained in the current study. One of the new findings was that self-efficacy and value were conceptualized and measured in terms of social aspects. This may be particularly important in collaborative problem solving. The difference in engagement was also a new finding of this analysis. In the real modern workplace, job-related problem solving needs to be more creative in the VUCA (volatility, uncertainty, complexity, and ambiguity) aspects (Iba, 2019; Organisation for Economic Co-operation and Development, 2019; Shliakhovchuk, 2021), so a higher level of performance will tend to be demanded. The self-assessment of the general performance level in university students was more positive. This finding implies that university students evaluate themselves optimistically, as they recognize themselves as more capable for collaborative activity. Conversely, working adults probably have sufficient experience working with diverse others in the real world. Therefore, their self-evaluation may have become more objective and self-critical, similar to what Ito and Umemoto (2022a) suggested. Both university educators and workplace employers need to understand the self-evaluation tendencies of the people they teach and support. Practical interventions that promote psychological factors while considering the self-evaluation tendencies of each supported individual are required.

The Relationships Between Social Self-Efficacy, Social Value, the Three Modes of Motivational Regulation, the Three Aspects of Engagement, and the Two Performance Levels

All values of the correlation coefficients were moderate or strong and significantly positive for both groups. These correlation analyses supported the previously stated hypotheses about relationships between variables. The COVID-19 pandemic may have offered more opportunities for collaborative activities to be conducted online (Nagai, 2021; UNESCO, 2020). However, as almost no correlation existed between the percentage of face-to-face and online group activities and all variables, it is assumed that whether the collaborative activity was face-to-face or online had little effect on these psychological variables.

The Path Model for Social Self-Efficacy, Social Value, the Three Modes of Motivational Regulation, the Three Aspects of Engagement, and the Performance Level

The hypothesized path model was found to have a good enough fit by multi-group SEM. Following the causal flow of the path model, we will discuss the paths that were statistically significant.

First, the positive paths from social self-efficacy, social value, and general performance to all three modes of motivational regulation were significant for both groups. Based on the expectancy–value theory (Eccles & Wigfield, 2002; Wigfield & Eccles, 2000), it has been demonstrated that self-efficacy and value positively predict motivational regulation (Ito & Shinto, 2005; Ito & Umemoto, 2022a; Umemoto & Tanaka, 2017; Umemoto et al., 2018; Wolters et al., 2011). The present study verified that social self-efficacy (Okada, 2014; Patrick et al., 2002) and social value predicted three modes of regulation of intrinsic motivation in collaborative activities. Individuals who not only have confidence in their ability to perform on a task and value the task itself but also have confidence in group relationships and value group activities as useful, effectively regulate their intrinsic motivation from both the self and social aspects in collaborative problem-solving activity. This is universally true for both groups. Additionally, social self-efficacy and social value positively predicted the three aspects of engagement for both groups. These results supported the hypothesis based on the expectancy–value theory (Eccles & Wigfield, 2002; Wigfield & Eccles, 2000). Both university students and working adults who have a high level of confidence in communicating with members in collaborative activities, and who think that collaborative activities are meaningful for everyone in the group, are better able to regulate their own, others', and the group's intrinsic motivation, and furthermore, are cognitively, behaviorally, and emotionally engaged in collaborative activities. It would be significant for university educators and workplace employers to encourage these antecedents as a starting point in any effective practical intervention.

Second, for university students, all three modes of motivational regulation were positively associated with cognitive engagement, whereas for working adults, self-regulation and socially shared regulation were positively associated with cognitive engagement, but co-regulation was not. In higher

education, the task and activities may be structured and the strategies to be applied may be clear. In university classes, pair work is often incorporated, so it may be easier to co-regulate each other's intrinsic motivation. Problem solving and interpersonal relationships in the workplace are much more complex (Colligan & Higgins, 2006; Reich & Hershcovis, 2011), and there may not be the same opportunities for pair work as those set up in the classroom under the care of university teachers. For working adults, the path from general performance was not significant either, and the difference in path coefficients between both groups was significant. Job-related problems change rapidly, depending on the situation; thus, solving problems in the workplace may pose greater challenges than doing so in the more supported learning environment at the university. Therefore, experience may not be easily applied cognitively.

Third, for university students, the positive paths from general performance and self-regulation to behavioral engagement were significant and positive, and the path from co-regulation to behavioral engagement was marginally significant. The positive paths from self-regulation and socially shared regulation to behavioral engagement were significant for working adults. In collaborative activities, it is especially important for both groups to self-regulate their intrinsic motivation; self-regulation leads to effort, attention, and persistence in activities, which in turn enables superior performance. The result that socially shared regulation was not significant is consistent with previous studies (Ito & Umemoto, 2022a, 2022d). A meta-analysis (Kodama, 2021) showed that Japanese university students became less cooperative and more individual-oriented over the past decade. For working adults, co-regulation was not significant. It is probably more important to pay attention to and consider all members of the company organization as a team (Nawata et al., 2015; Rousseau et al., 2006), rather than just working in pairs. Conversely, socially shared regulation was significant in working adults and differences in the path coefficients between both groups were significant. Therefore, to be absorbed and behaviorally involved in collaborative activities, it may be required to maintain or increase the motivation of the organization's members as a member of a team. For working adults, the path from general performance was not significant, and differences in path coefficients between both groups was significant. In the workplace, workers may need to manage multiple tasks simultaneously (De Bruin & Barber, 2019), and it may not be easy for them to initiate or focus their attention on a particular activity over time. Employers in the workplace need to understand the mentality of these working adults and aim to create a desirable working environment.

Fourth, for university students, the positive paths from general performance and face-to-face group activity to emotional engagement were significant, and the positive path from self-regulation to emotional engagement was marginally significant. The positive paths from general performance and self-regulation to emotional engagement were significant for working adults. For both groups, this result suggests that the self-regulation of intrinsic motivation may be important for emotional engagement, as well as behavioral engagement, even though the result for university students was marginally significant. For both groups, co-regulation and socially sheared regulation were not significant, but one of the reasons for these results may involve emotional engagement being context-dependent and an unstable factor (Kage, 2013; Park et al., 2012). Even if an individual can effectively regulate the intrinsic motivation of others and the group, whether they enjoy or are interested in collaborative activities is a different matter. Only university students were found to be more emotionally engaged when the percentage of face-to-face activities was higher. During the COVID-19 pandemic, there were more opportunities for university courses to be taught online (Nagai, 2021; UNESCO, 2020). Educators should be mindful of the potential for increased emotional engagement of students by ensuring face-to-face opportunities for collaborative activities. In the post COVID-19 period, this is an aspect of practice that we would like to see realized in the design of university classes.

Fifth, for recent performance, the positive paths from the three aspects of engagement and general performance were statistically significant in both groups. The values of the path coefficients were the largest among the three aspects of engagement, especially the path from behavioral engagement for university students. It was predicted that behavioral engagement is a significant positive predictor of performance (Hofverberg et al., 2022; Reeve, 2013; Reeve & Tseng, 2011; Umemoto et al., 2016), which was supported. The differences in all these path coefficients between both groups were significant. Path coefficients from behavioral engagement and general performance were significantly greater for university students than for working adults. Relatively considered, in university students, focused and devoted efforts and past experiences may tend to determine a high level of performance in the present. Path coefficients from cognitive and emotional engagement were significantly greater for working adults than for university students. Relatively considered, in working adults, the use of sophisticated strategies and working collaboratively with a sense of fun and interest may determine the

current high level of performance. Compared to the university, maintaining a high level of cognitive and emotional engagement may not be easier, but may be more important for success at the workplace. University educators and workplace employers need to carefully assess each aspect of engagement, provide positive feedback, and be involved in deliberate instruction and support that encourages collaborative problem solving.

Theoretical and Practical Implications

Based on the path model in Fig.2, the analysis results provided new insights into the theory of self-regulated learning (Schunk & Greene, 2018; Zimmerman & Schunk, 2001, 2011) and expectancy–value theory (Eccles & Wigfield, 2002; Wigfield & Eccles, 2000). Previous studies have revealed that perceived self-efficacy and value for a learning task are linked to motivational regulation strategies (Ito & Umemoto, 2022a; Wolters & Rosenthal, 2000; Wolters et al., 2011). This current study's results were novel and significant because they showed the series of causalities that explain social self-efficacy and social value predicting the three modes of regulation of intrinsic motivation and the three aspects of engagement in collaborative problem solving, and they could expand the psychological construct of expectation–value to include social aspects. Another novel finding was the possibility that co-regulation and socially shared regulation, as well as self-regulation, can lead to active engagement and superior performance. As limited research focuses on co-regulation and socially shared regulation of motivation for collaborative activities (De Backer et al., 2015; Järvelä et al., 2019; Järvenoja et al., 2020; Malmberg et al., 2017), the validation of the path model is a new contribution to the theory of self-regulated learning regarding the function of motivational regulation in a social context. This suggests that self-regulation is fundamentally important to regulate one's own learning cognitively, metacognitively, and behaviorally in personal learning situations (Schunk & Usher, 2013; Zimmerman, 1989, 2013). Additionally, in contemporary society, where others with diverse personalities exist, it is important for each individual to be able to regulate other's motivations during collaboration. From the social aspect of collaboration, this study's results were able to present a more elaborate theoretical framework through a model consisting of a series of paths of motivational regulation. Regarding affecting cognitive, behavioral, and emotional engagement, the results suggest that the required modes of regulatory functioning differ between the university and workplace, although a few of them were marginally significant. From the perspective of engagement theory (Christenson et al., 2012; Skinner et al., 2008), the importance of the three aspects of engagement was demonstrated, and the possibility that behavioral engagement is key, especially for university students, was also suggested, as in previous studies (Hofverberg et al., 2022; Reeve, 2013; Reeve & Tseng, 2011; Umemoto et al., 2016). In a sense, the model demonstrated here may provide a framework to reconsider the expectancy–value theory, self-regulated leaning theory, and self-determination theory, in an integrated manner. Psychological processes in the context of collaborative activities are novel in this research field, and may be seen as suggesting new directions for each learning theory.

Regarding the implications for practice based on the results of the proved path model, encouraging self-efficacy to be friendly and talk to group members increases the likelihood of reciprocal motivation regulation of the self and others, as well as active engagement in collaborative problem solving. Valuing group activities as useful and important to group members would also be essential to promote reciprocal motivation regulation and active engagement in collaborative activity. Educators, employers, policymakers, and others in leadership positions are required to first provide support for these two perceptions of social self-efficacy and value, both in the school classroom and the workplace, as a starting point.

Although only one path coefficient for self-regulation was very small and marginally significant, the results for both university students and adults showed all positive paths for self-regulation in all three aspects of engagement; thus, classroom and work environments that can effectively regulate individuals will be required. Individuals who can regulate their own interests and value collaborative activities have an active cognitive, behavioral, and emotional engagement in collaborative activities. Co-regulation would cognitively promote engagement in university students. Structuring pair work in the classroom and intervening in the co-regulation of intrinsic motivation may facilitate the implementation of more sophisticated problem-solving strategies. Socially shared regulation would lead to cognitive engagement in university students, as well as cognitive and behavioral engagement in working adults. It may be effective to create an atmosphere in which the group members support each other as a unified team, as well as assist in the sharing of efficient strategies among all members. For working adults, encouraging socially shared regulation is important, as it results in a high level of concentration and perseverance. However, as both groups had no path to emotional engagement, teaching strategies for coping with unstable emotions may be required.

Finally, guidance and support are required to enable indi-

viduals to be actively engaged in all aspects of their activities through collaboration: cognitive, behavioral, and emotional. For university students, it is especially important to create a collaborative learning environment that allows them to focus on activities and work hard. Perhaps, working adults need complex task strategies and advanced problem-solving methods in their jobs, and controlling their emotions well is not easy for them. If workplace supervisors support their subordinates and co-workers to be cognitively and emotionally engaged, they will display superior performance through collaboration. Overall, in building a collaborative learning environment both in schools and the workplace, it is essential to provide guidance that brings with it support for the antecedents of motivation and facilitates the entire motivational process, from social self-efficacy and value to performance. For educators, employers, and policymakers, it is important to implement educational practices in line with the entire flow of the paths shown by the model of this study.

Limitations and Future Directions

As this study is based on cross-sectional data, limitations exist regarding the validation of the path model. The models and estimators here were not causally identified. Independent variables were measured and not manipulated; moreover, omitted variables could potentially correlate with independent variables and outcomes. Further clarification of causal relationships is required, for example, by verifying effectiveness through experimental design and by conducting a follow-up survey to obtain longer-term longitudinal data from the university and workplace. To elucidate the whole process of motivational regulation more deeply, measuring the temporal changes in the various types of motivation is also necessary. Additionally, the present study examined all factors using only self-reported scales. The possibility of measurement bias owing to increased subjectivity must be considered. To avoid the bias of relying solely on self-reports, incorporating various psychometric methods is also necessary. Furthermore, it is assumed that qualitative differences exist in the motivational process depending on the number of collaborative projects experienced. The process of motivational regulation may vary depending on the type and degree of interest in the collaborative task or activity itself. The level of interest should be examined as a moderator to assess how specific learning tasks influence one's motivational regulation.

As one of the directions for future research, attempting practical interventions in real-life collaborative situations will be significant, based on the path model for university students and working adults. Further validating the causal model using both qualitative and quantitative data is necessary. Modern society—referred to as a knowledge-based society—is changing rapidly owing to various technological innovations. Therefore, the ability to continue learning independently and collaboratively throughout one's daily life is important for university students; however, working adults must also continue to realize independent and collaborative lifelong learning, even after finishing school. Although many studies exist on self-regulated learning in higher education (Nilson, 2013), few studies have been conducted on working adults in the real workplace. In business management, research on human resource development has turned its attention to learning and personal development through workplace experiences (Araki, 2008; Fenwick, 2001). However, many discussions still focus on the viewpoints of those who manage human resource development; clarifying how working individuals learn through their own initiatives is necessary (Rothwell, 2002), and in a collaborative manner. This study provides novel findings and implications regarding this issue.

Finally, the analysis results of the path model here provide a new theoretical and empirical framework for motivational psychology and collaborative learning. Social self-efficacy and valuing group activities were significant in increasing reciprocal motivation regulation. Motivational self-regulation enhanced active engagement in activities via collaboration. This study has elucidated the psychological processes related to how people regulate each other's motivations to be persistent and engaged in collaboration. These findings make new contributions to the research areas of motivational psychology and collaborative learning. The causal flow of paths demonstrated here can inform the design of practical interventions for university students and working adults. Further, the psychometric measures used here may be an effective evaluation tool at each point in the process of creating a collaborative environment in which university students or working adults learn together and by themselves. It will be necessary to provide chronological and comprehensive support while respecting the learner's autonomy in the motivational process.

Acknowledgments

This work was supported by JSPS KAKENHI (Grants JP20K03337 and JP23K02895).

Conflict of Interest

The authors declare no conflicts of interest associated with this manuscript.

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