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Development of Madrasa Teacher Leadership Competency: Involving Project-Based Learning Methods in Students-Centered Learning

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Abstract

The purpose of this study is to determine whether increasing the use of project-based learning (PBL) by madrasa aliyah teachers in Indonesia enhances their capacity in leadership competences. This study employed a quasi-experimental approach to investigate how project-based learning (PBL) is connected with teachers' leadership competency and analyzed the data using a t-test. In general, we found that the PBL program positively affected the leadership competence of madrasa teachers in Islamic religious education learning. Also, that the PBL program positively affected students' perceptions of the level of effort a teacher exerted to provoke interest. Estimating an instrumental variable approach on the subset of schools with the most substantial increase in PBL use found that PBL was positively related to teachers' perceptions of class preparation, attempts to induce teacher interest, and the frequency with which students share ideas in class. This study introduces teaching practice as a mediating factor that affects the leadership competence of madrasa teachers, a contribution to the literature that seeks to understand the development of madrasa teachers' leadership competencies in Islamic religious education learning. This research has implications for developing the PBL model in improving the leadership competence of madrasa teachers in learning Islamic religious education.

Keywords: Project-based learning, leadership competence, learning and instruction, madrasa teacher professionalism.

Introduction

The leadership competence of madrasa teachers is the ability to teach in themselves as well as the ability to become leadership teachers (König, et al., 2021; Irmawati, Asri & Aziz, 2021; Murkatik, Harapan & Wardiah, 2020; Rusilowati & Wahyudi, 2020), is associated with various teacher characteristics and behaviors (Rusilowati & Wahyudi, 2020; Karuniawati, Rahayu, & Ladamay, 2021). In particular, various theories describe that the leadership competence of madrasa teachers determines the abilities and teaching methods related to instructional practice (Guillén-Gámez et al., 2021; König, et al., 2021; Snoek, 2021; Suprayogi, Valcke & Godwin, 2017). In addition, the leadership competence of teachers contributes to self-leadership development (McGarr & McDonagh, 2021; Guillén-Gámez et al., 2021; Snoek, 2021) and also improves the quality of an educational institution.

However, most studies examining the relationship between teachers' leadership competence and learning practices have relied on cross-sectional data (Rusilowati & Wahyudi, 2020; König, et al., 2021; McGarr & McDonagh, 2021; Tambak et al., 2020). This means that the data used for the analysis can allow for comparisons across respondents but cannot explain changes over time, severely limiting the empirical ability to

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identify causality. Furthermore, the theoretical discussion of teacher leadership competence implies a reciprocal or cyclical relationship with classroom experience (Tambak & Sukenti, 2020; Lukiianchuk et al., 2021; Komar et al., 2021; Muna, Sunardi & Widyastono, 2021). Thus, teacher leadership competence may be influenced by changes in instructional practice. Other research reveals that leadership competence implies the process of self-development with leadership in learning at a madrasa (Efendi, 2021; Hamzah, Tambak & Tanjung, 2020; Tambak, Ahmad & Sukenti, 2020; Muna, Sunardi & Widyastono, 2021).

On the other hand, research has found that leadership competencies require development from various aspects so that learning is more developed and passionate from time to time (Al-Kubaısı, Shahbal, & Khan, 2022; Muliati et al., 2022). Here a learning model is needed that emphasizes student learning activities such as in the development of higher order thinking, divergent thinking, and quality writing (Duke et al., 2021; Alt, & Raichel, 2022). Other research recommends that a new learning model be developed that can improve teacher leadership competence in the learning process. Teacher leadership competence will not develop if you only rely on the knowledge possessed by the teacher itself without improvisation and development. So far, research on the development of the madrasa teaching profession has focused more on pedagogoic competence (Zainuri, & Huda, 2022; Nurhayati, Mesiono, & Daulay, 2022), professional competence (Eshov, 2022; Raximovna, 2022), personal competence (Abnisa, & Zubairi, 2022; Dervenis, Fitsilis, & Iatrellis, 2022) and social competence (van der Wilt, Bouwer, & van der Veen, 2022; Skura, & Świderska, 2022), while the leadership competence of madrasa teachers has been rarely studied. While this leadership competence is closely related to the development of students' abilities in the field of religious and social life values, the values that become the pillars of life development go beyond the academic competence of students (Al-Kubaısı, Shahbal, & Khan, 2022; Muliati et al., 2022).

These various studies illustrate that leadership competence is more psychologically researched in the learning process but has yet to reveal the strengthening of project-based learning in madrasa teacher learning. This research is a new thing where the leadership competence of madrasa teachers is given a solution with a project-based learning method that is different from previous research. Thus, to empirically explore the relationship between the leadership competence of madrasa teachers and instructional learning practices, this study uses data from project-based learning (PBL) program intervention in Pekanbaru City, Riau, Indonesia. In 2019, the Ministry of Religion of Riau Province provided four public madrasa aliyah in Pekanbaru City with PBL program interventions to encourage teachers in madrasa by changing the learning method from teacher-centered to student-centered PBL. In the PBL program, the treatment group teachers were given training on applying PBL and asked to use it in the classroom for one semester. In contrast, the seven control group teachers did not receive any encouragement to change their learning practices. With data pooled on teachers and students from the program, we used a quasi-experimental research method to assess how increased use of PBL over one semester was associated with changes in teacher leadership competence in a madrasa in learning.

This research is urgent to empirically explore the relationship between the leadership competence of madrasa teachers and instructional practices using data from project-based learning (PBL) program interventions in teaching Islamic religious education for madrasa teachers. PBL, in various theories, provides development in the learning process (Syakur et al., 2020; Guo et al., 2020; Miller, Severance, and Krajcik, 2021; Santyasa, Rapi, and Sara, 2020; Sukenti & Tambak, 2020). The development of madrasa teacher leadership competencies is very important because it is one of the five competencies that must be improved at any time by madrasa teachers in their teaching profession. Furthermore, the application of PBL can develop a quality and competitive learning atmosphere and environment, as well as the development of a tradition of higher-order thinking for students (Wu, & Wu, 2020; Safaruddin et al., 2020; Pérez & Rubio, 2020; Kim, 2020; Abuhmaid, 2020). Thus, the focus of this study is to explore the following: the use of project-based learning affects the leadership competence of madrasa teachers in Islamic religious education. In this regard, the following hypothesis can be put forward; There is relationship PBL program with the leadership competence of madrasa teachers in instruction; There is significan effect PBL on leadership competence in classroom management; There is statistically significant relationship between the PBL program and other student variables; There is significant relationship between the perception of teacher class preparation and student class participation.

Method

Research Design

To assess the relationship between PBL and the leadership competence of madrasa teachers, this study used a quasi-experimental method using survey data collected from teachers and students in two periods, before and after the use of PBL in the classroom for one semester. We mainly use two empirical methods: the difference-in-difference design and the instrumental variables through a two-stage least squares

estimate. These two methods are often used in policy evaluation studies that aim to analyze the causal impact of policies on the outcome variables of interest (Angrist & Pischke, 2008). For the analysis using teacher data, the dependent variable of interest is a measure of teacher self-efficacy and its subscale. For the analysis using student data, the dependent variables of interest were students' perceptions of their teacher's efforts to encourage interest, level of class preparation, students' self-assessments about their class participation, and self-assessments about how often they shared ideas in class. However, since the teacher and student data can only be linked at the school level, and there was only 14 madrasa in the study, directly assessing the relationship between student and madrasa teacher variables is not feasible. Therefore, we first analyzed teacher data to assess how PBL was associated with teachers' leadership competence and subscales. Next, we analyzed student data to evaluate how students responded to PBL. This made it possible to indirectly assess whether the relationship between PBL and leadership competence might be related to PBL-induced changes in students.

Population and Sample

Fourteen Madrasa Aliyah in Pekanbaru City, Riau, Indonesia, participated in this study, seven of which consisted of a treatment group and seven a control group. The program's primary targets are teachers from this madrasa who teach one of the four core subjects of Islamic religious education: Akidah Akhlak, Al-Qur'an Hadith, Fiqh, and Islamic Cultural History, to students from Madrasa aliyah (grade XI). One hundred thirty-nine teachers who meet these criteria participate in the PBL program. The response rates of the treatment group teachers for the pre-treatment survey were 78% (56 teachers out of 72) and 67% (48 teachers out of 72) for the post-treatment survey. The control group teacher response rates were 55% (37 teachers out of 67) for the pre-treatment survey and 49% (33 teachers out of 67) for the post-treatment survey.

The analysis for this study was conducted based on disproportionate data, meaning that some teachers and students only participated in the pre-treatment or post-treatment surveys. Among the 117 unique teachers in the sample, 57 (48.7%) teachers took part in both the pre-treatment and post-treatment surveys, while 36 (30.8%) teachers took part only in the pre-treatment survey and 24 (20 .5%) took part only in the post-treatment survey. In the final analysis of the sample for teacher survey data, the number of observations in the pre-treatment period was 93 (53.4%), and the number of observations in the post-treatment period was 81 (46.6%). For student survey data, among a unique sample of 1268 students, 1107 (87.3%) took part in the pre-and post-treatment survey, while 109 (8.6%) only took part in the pre-treatment survey and 52 (4.1) %) took part only in the post-treatment survey.

A summary of the essential background characteristics of teachers and students is presented that among the 56 teachers in the treatment group, 82% were female, 38% had attained a master's degree or higher education level, the average total teaching experience was 150.13 months (SD 99,39), or about 12.5 years, the average school year at the current school is 24.15 months (SD 41.81), or about 2 years, and 79% are on permanent contracts. The essential means t-test between the treatment and control groups found no statistically significant difference between the two groups. Among the treatment group students in the pre-treatment phase, 44% were female and had a mean language score of 2.66 (score range: 0 to 5; SD 1.48). T-tests of the baseline revealed no significant differences between the treatment and control group students regarding gender composition and Islamic religious education scores. However, the treatment group had a higher proportion of students with parents who had a bachelor's degree. Therefore, we included them as control variables across all regression models to account directly for these differences.

The selection of madrasa in the treatment and control groups was not random, which could potentially bias estimates and limit the extent to which causal interpretations can be made. Considering the sample's representativeness, one treatment school is selected from seven different scho1ol districts within the city, and a suitable control school is selected within the same district. Control madrasa was selected to be the same sex (one sex, at the madrasa and grade level) as treatment schools and was located within 2 km. Thus, we have two madrasas (one experimental school and one control school) per district in our sample, as close as possible to each other regarding gender structure and geographic location. Madrasa teachers or students did not voluntarily or self-select into the treatment or control groups, which eliminates concerns for potential selection bias.

Although the study sample was not randomly selected, the differences in background characteristics across madrasa teachers and students in the treatment and control groups were minimal. Also, we show that the probability of being in the treatment group versus the control group does not differ between teachers based on most of the observable characteristics. The same can be said for students. Each variable characteristic was controlled for all regressions. In terms of policy, the madrasa in our study are in the same city of Pekanbaru, and Pekanbaru operates a very centralized education system, where madrasa are identical in terms of minimum training and certification requirements to become a teacher, curriculum and textbooks, teacher salaries, and

finances. The relatively high degree of homogeneity across treatment and control schools lends credence to the validity of the quasi-experimental research design.

Data Collection

Over the years, various methods of measuring teacher leadership competence have been developed (Zee & Koomen, 2016). This study uses the short form of the Madrasa Teacher Leadership Competency Test (MTLCT) developed by Tambak (2017). MTLCT consists of a factor structure that is stable and broad enough to cover a wide range of relevant teacher abilities for teaching. It is one of the most widely used madrasa teacher leadership competency instruments, including in the national madrasa teacher survey. The questionnaire for the MTLCT used in this study consisted of 54 items divided into three subscales of madrasa teacher leadership competence, with madrasa teacher leadership competence as a whole being the average of ten subscales. Each of the 54 items measures the extent to which madrasa teachers feel they have the ability to manage to learn and is rated on a 4-point Likert scale, ranging from "not at all" to "A" a lot." The subscale of madrasa teacher leadership competence is (a) leadership competence of Madrasa teachers in learning, (b) Madrasa teachers' leadership competencies in learning management (c) and Madrasa teachers' leadership competencies in engagement. Cronbach's Alpha was used to assess the instrument's internal consistency, which showed (0.93) for the entire instrument.

To measure PBL frequency, we used a dummy variable derived from a teacher's self-reported use of "multiple projects in progress" reported on a four-point Likert scale: 1) Never or seldom; 2) Sometimes; 3) Often; 4) In all or almost all lessons. If the teacher reported using PBL either "never or almost never" or "sometimes," the variable was coded as 0, and if the teacher reported using PBL "often" or "In all or almost all lessons," the variable was coded as 1. The measure of PBL frequency in the student survey was constructed similarly to the madrasa teacher survey.

For student outcomes, we measured their perceptions of their teacher's level of effort to stimulate student interest, level of class preparation, students' level of class participation, and their frequency of brainstorming with other students in the class. All measures are reported on a four-point Likert scale: 1) Strongly disagree; 2) Disagree; 3) Agree; 4) Strongly agree. In addition, to assess students' academic ability, we provide an Islamic religious education exam consisting of five questions, with possible scores ranging from 0 to 5.

The PBL program consists of pre-semester training sessions and actual implementation during the madrasa semester. Between June and July 2019, teachers from the seven treatment madrasa were trained for about 30 hours (across four days) on how to conduct PBL in their classrooms. The sessions are led by six doctors who specialize in researching and implementing PBL. A pair of lecturers are responsible for training meetings for the two madrasas. The training consists of learning the basic concepts of PBL, developing inquiry questions for PBL, understanding the roles of teachers and students, and designing and planning courses. For each pair of lecturers in charge of training for two madrasas, one focuses on the first two training elements while the remaining lecturers focus on the last two.

Data Analysis

For madrasa teacher survey data, the missing scores ranged from 0.6% to 2.3% across all variables and periods. For student survey data, the two variables had two missing values each, for a 0.08% loss rate. Average imputation is used to handle missing cases. Each missing value is replaced by the mean value of the relevant variable, taken from the appropriate school and respondent period. Although not presented in the study, there was no significant difference in the results compared with the analysis performed after the deletion of the list of respondents with missing values for any of the variables included in the regression model.

We first estimated the treatment effect of the PBL program using a difference-in-difference design. The difference-in-difference method captures the treatment effect by comparing the change in the mean over time of the outcome variable for the treatment group with the change in the mean over time for the control group. The required assumption is that changes over time in the outcome variables for the treatment and control groups will be identical in the absence of treatment. This assumption is known as the parallel trend assumption because it requires time trends in the outcome variables to be parallel between the two groups before treatment. He should note that the assumptions require trends to be identical, not the rate of outcome variables. If this assumption holds, the difference in changes over time between the treatment and control groups is interpreted as a causal effect of treatment (Khaldi, 2017). Empirical verification of the assumption of parallel trends requires data to be collected at multiple time points before treatment takes place. However, we cannot directly assess the assumption of parallel trends because we only have data for a single period before and after treatment. Nonetheless, due to the relatively high degree of homogeneity across the treatment and control groups, it is unlikely that any differences in the outcome variables were attributable to factors other than the PBL program intervention. The empirical model (Garcia, 2020) that we used to derive the difference-in-difference estimate is stated:

$$Yijt=\beta0+\beta1TreatjxPostt+\beta2Treatj+\beta3Postt+Xig+\varepsilon ijt$$

Where is the subscript I; J; and t represents the individual (either teacher or student), school, and period, respectively? yijt is the dependent variable of interest, such as leadership competence for madrasa teachers or student responses for students, individual i in school j at time t: All dependent variables are standardized to have a mean of 0 and a standard deviation of 1, based on the mean and standard deviation of group scores control. This was done to facilitate interpretation, especially regarding how the results changed relative to the control group. If it is equal to 1, the respondent belongs to a nursing school, and if 0, the respondent is part of the madrasa control. Post is equal to 1 if time t is the post-treatment period (i.e., after the fall 2016 semester) and 0 if time t is the pre-treatment period (i.e., before the intervention). Treaty Post (Djafar et al., 2021) is an interaction between indicator variables for treatment and period. Xi is a vector control variable consisting of individual characteristics such as respondents. For madrasa teachers, they included gender, education level, total teaching experience (in months), recent teaching experience at the madrasa (in months), and type of employment contract. For students, they included the student's gender, parental education level, eldest child status, and test math scores. ijt is an error term clustered at the school level.

In addition to using PBL in the classroom, treatment group teachers were given PBL consultations during the semester, which may be independently related to teacher self-efficacy. Although we found that the use of PBL by treatment group teachers increased significantly after treatment, any treatment effects we found through the difference-in-difference design may still be partly attributable to consultation. We use a two-stage least squares instrumental variable estimation to solve this problem. This approach allows us to empirically estimate the changes in PBL use caused by PBL programs and analyze how these exogenous changes are associated with the leadership competence of madrasa teachers.

Findings

Teacher analysis

Table 1 reports the effect of the PBL program on the leadership competence of madrasa teachers and their subscales, estimated through the design differences expressed in (Equation (1)). The first column shows that the PBL program is associated with an increase in the leadership competence of madrasa teachers by 0.942 standard deviations ($p < 0.01$). Column 2 reports that the PBL program has a significant relationship with the leadership competence of madrasa teachers in instruction, with a standard deviation of 1.011 ($p < 0.01$), and Column 4 reports that leadership competence in engagement is significantly related to the PBL program of 0.899 standard deviations ($p <0.01$). The results in column 3 show that the PBL program has no significant effect on the leadership competence of madrasa teachers in classroom management. This indicates that leadership competence in teaching and student engagement drive the positive impact that PBL programs have on the leadership competence of madrasa teachers. Among the madrasa teacher leadership competence subscales, PBL had the most decisive impact on teachers' leadership competence in engagement, which might be expected, given that the significant change reflected in treatment was changed in instructional practice.

Table 2 reports the results of the instrumental approach variables on the impact of using PBL on the leadership competence of madrasa teachers and their subscales. The results of the first stage regression (Equation (2)) are found in column 1 of panel (b). The intervention program increased the likelihood of implementing PBL in the classroom either "often" or "in all or almost all subjects" by 44.6 percentage points ($p < 0.05$). This provides further evidence that the PBL intervention program causes significant changes in the way teaching takes place in the classroom. Panel (a) of Table 2 reports the estimates of the second stage of the instrumental-variable approach regression (Equation (3)). The predicted PBL frequency values obtained from the first-stage regression estimation were collected and entered into the regression to estimate equation (3). In column 1 of a panel (a), an exogenous increase in the use of PBL was associated with an increase in the leadership competence of madrasa teachers by 2,270 standard deviations ($p < 0.1$). Self-efficacy in instruction and engagement was also found to be positively influenced by PBL, increasing by 2.115 standard deviations ($p < 0.1$) and 2.016 standard deviations ($p < 0.05$), respectively. As in the difference-within-difference estimate, PBL was found to have no significant effect on leadership competence in classroom management.

Student analysis

The effect could mediate the positive associations between madrasa teachers' leadership competencies and PBL that PBL has on students. At Madrasa aliyah Pekanbaru, students are placed in one classroom. Teachers in charge of different subjects come to different classes at different hours to teach their respective subjects, so grade-level analyses linking student and teacher outcomes cannot be carried out. Students and teachers can connect at the madrasa level, but the school-level analysis would need more statistical power because our data contains only twelve madrasas. Because of this, we can only estimate the relationship between PBL

student reports and student responses and indirectly conclude that any effect found in the student data may be related to the positive association between PBL and teachers' leadership competence in the madrasa teacher data.

Table 3 reports the estimated difference-in-difference obtained through equation (1) using student survey data. Estimates were obtained for the entire sample and the madrasa subsample consisting of the three treatments group madrasa in which PBL increased the most and their respective control madrasa matched. Responses from the teacher and student survey showed that teachers from Madrasa Aliyah Negeri 1, Madrasa Aliyah Negeri 2, and Madrasa Aliyah Negeri 4 significantly increased the use of PBL after the PBL program. Column 2 of panel (a) shows that the PBL intervention program led to an increase in the perception of efforts to attract teachers' interest by 0.155 standard deviations ($p < 0.1$). There was no statistically significant relationship between the PBL program and other student variables. In panel (b), where the analysis was limited to the three care schools in which: PBL increased the most and their matched control madrasa, we found that the PBL program increased the madrasa teacher's perception of interest by persuasion effort by 0.360 standard deviations ($p < 0, 05$). This shows outstanding development (Table 1).

Table 1: Project-based learning and leadership competence: Difference-in-Differences estimates.

	(1)	*(2)*	*(3)*	*(4)*
Dependent variable:	*Leadership competence of madrasa teachers*	*Leadership competence in instruction*	*Leadership competence in management*	*Leadership competence in engagement*
Post Treat	0.942***	1.011***	0.509	0.899***
	(0.299)	(0.272)	(0.327)	(0.242)
Post	0.012	0.318	0.028	0.013
	(0.202)	(0.184)	(0.235)	(0.166)
Treat	0.740** (0.245)	0.811** (0.263)	0.588** (0.250)	0.571*** (0.179)
Student math score	0.046	0.103	0.089	0.067
	(0.165)	(0.136)	(0.160)	(0.157)
Female	0.091	0.202	0.088	0.020
	(0.473)	(0.452)	(0.497)	(0.315)
MA and above	0.082	0.022	0.077	0.083
	(0.304)	(0.264)	(0.311)	(0.237)
Total teaching experience	0.004**	0.003**	0.003*	0.003*
	(0.002)	(0.001)	(0.002)	(0.001)
Experience at current school	0.001	0.002	0.000	0.002
	(0.002)	(0.003)	(0.002)	(0.002)
Permanent	0.724*	0.559	0.662	0.674**
	(0.378)	(0.338)	(0.446)	(0.272)
Observations	174	174	174	174
R-squared	0.222	0.319	0.131	0.212

Note Postal code: 1 if the post-treatment period, 0 if the pre-treatment period; Treatment: coded 1 if in the treatment group, 0 if in the control group; Math scores: School-level students' average math test scores (score 0e5); Female: coded 1 if female, 0 if male; MA and above: coded 1 if the highest education level is S2 or higher, 0 otherwise; Total teaching experience and current school experience in months; Permanent: coded 1 if the employee is permanent, 0 if the contract is temporary. The dependent variable was standardized to have a mean of 0 and a standard deviation of 1 based on the mean and standard deviation of the control group. Teacher self-efficacy was obtained through the average of three self-efficacy subscales (instruction, student engagement, and classroom management). The survey questions to assess the madrasa teachers' personality competence subscale were answered on four points: The Likert scale (1: "Not at all" ~ 4: "A lot"), with four questions, asked for each subscale. Standard errors clustered at the school level. ***$p < 0.01$, **$p < 0.05$, *$p < 0.1$.

Table 2: Project-based learning and madrasa teacher leadership competence: Two-stage least squares estimates.

Dependent variable:	*(1)*	*(2)*	*(3)*	*(4)*
	Leadership competence of madrasa teachers	*Leadership competence in instruction*	*Leadership competence in management*	*Leadership competence in engagement*
Predicted PBL	*2.270**	*2.115**	*1.143*	*2.016***
	(1.190)	*(1.159)*	*(0.945)*	*(0.949)*
Post	*0.122*	*0.421*	*0.250*	*0.378*
	(0.646)	*(0.636)*	*(0.509)*	*(0.522)*
Treat	*841** (0.334)	*0.768** (0.325)	*.603** (0.288)	*0.597** (0.259)
Controls	*YES*	*YES*	*YES*	*YES*
Observations	*174*	*174*	*174*	*174*
(b) the First stage				
Dependent variable: Project-based learning	*(1)*			
Post Treat	*0.446** (0.158)			
Post	*0.194*			
	(0.131)			
Treat	*0.013*			
	(0.066)			
Controls	*YES*			
Observations	*174*			
F-statistic	*14.89*			

Note Project-based learning: The dummy variable is coded 1 if project-based learning is used either "Often" or "In all or almost all lessons," 0 if "Never or almost never" or "Sometimes"; PBL prediction in panel (a) is the PBL prediction value obtained from regression in panel (b); Post: coded 1 if the post-treatment period, 0 if the pre-treatment period. Treatment: coded 1 if in the treatment group, 0 if in the control group. All regressions control for the following: Gender: coded 1 for female, 0 for male; Teacher education level: coded 1 if the highest education level is S2 or higher, 0 otherwise; Total teaching experience and current school experience in months; Permanent employee: code 1 if permanent employee, 0 if temporary contract. The second stage dependent variable was standardized to have a mean of 0 and a standard deviation of 1, based on the mean and standard deviation of the control group. Madrasa teacher personality competence was obtained through an average of three subscales of madrasa teacher personality competence (instruction, student involvement, classroom management). Survey questions to assess the personality competence subscale of madrasa teachers were answered on a four-point Likert scale (1: "Not at all" ~ 4: "A lot"), with four questions, asked for each subscale. Standard errors clustered at the school level. ***p < 0.01, **p < 0.05, *p < 0.1.

Estimates obtained through the instrumental variable approach are reported in table 4. Separate estimates are reported for those obtained with the entire sample (Panel (a)) and the subset of the three madrasas with tremendous improvement in PBL and their matched control schools (Panel (b)). In panel (a), it was found that PBL increased the perception of madrasa teacher interest induction efforts by 0.792 standard deviations ($p < 0.1$) and the extent to which students shared ideas in class with a standard deviation of 0.995 ($p < 0.1$). There is no significant relationship between the perception of teacher class preparation and student class participation. When the analysis is limited to three madrasas that experienced the tremendous increase in PBL and their matched control madrasa, increased use of PBL was associated with an increase in the perception of classroom preparation teachers by 0.674 standard deviations ($p < 0.1$), an increase in perceptions of the madrasa teacher's interest in persuasion efforts of 1.010 standard deviations ($p < 0.1$ 0.01), and an increase in students' sharing of ideas in class with a standard deviation of 0.724 ($p < 0.1$) (Table 2 to 4)).

Table 3: Project-based learning and student outcomes: Difference-in-differences estimates.

Dependent variable:	*(1)*	*(2)*	*(3)*	*(4)*
	Teacher preparation	*Teacher inducement*	*Share idea*	*Class participation*
Treat Post	0.090	0.155*	0.159	0.093
	(0.086)	(0.084)	(0.114)	(0.079)
Controls	YES	YES	YES	YES
Observations	2266	2266	1944	2266
R-squared	0.013	0.011	0.011	0.072
(b) Sample: PBL top 3 schools				
Dependent variable:	(1)	(2)	(3)	(4)
	Teacher preparation	Teacher inducement	Share idea	Class participation
Post Treat	0.240	0.360**	0.214	0.027
	(0.130)	(0.090)	(0.157)	(0.114)
Controls	YES	YES	YES	YES
Observations	1146	1146	988	1146
R-squared	0.012	0.018	0.011	0.059

Note: All dependent variables were standardized to have a mean of 0 and a standard deviation of 1 based on the mean and standard deviation of the control group. Teacher inducement: students' general perception of the teacher's efforts to encourage participation (1: "Strongly disagree" ~ 4: "Strongly agree"); Teacher preparation: students' general perception of teacher preparation for class (1: "Strongly disagree" ~ 4: "Strongly agree"); Sharing ideas with classmates: the extent to which ideas are shared with classmates during class (1: "Not at all" ~ 4: "A lot"); Class participation: self-assessment of enthusiastic class participation (1: "Strongly disagree" ~ 4: "Strongly agree"). All control regressions were as follows: Gender: coded 1 if female, 0 if male; Teacher education level: coded 1 if the highest education level is S2 or more, 0 otherwise; Total teaching experience and current school experience in months; Type of work: coded 1 if permanent worker, 0 if temporary contract. Top 3 PBL Madrasa refers to the treatment madrasa and its rival madrasa, where the increase in the use of PBL is among the largest (top 3) treatment schools. Standard error clustered at the school level. ***p < 0.01, **p < 0.05, *p < 0.1.

Table 4: Project-based learning and student outcomes: Two-stage least squares estimates.

Dependent variable:	*(1)*	*(2)*	*(3)*	*(4)*
	Teacher preparation	*Teacher inducement*	*Share idea*	*Class participation*
Predicted PBL	0.457	0.792*	0.995*	0.472
	(0.438)	(0.439)	(0.603)	(0.429)
Controls	YES	YES	YES	YES
Observations	2266	2266	1944	2266
(b) Second stage - PBL top 3				
Dependent variable:	(1)	(2)	(3)	(4)
	Teacher preparation	Teacher inducement	Share idea	Class participation
Predicted PBL	0.674*	1.010***	0.724*	0.075
	(0.348)	(0.355)	(0.433)	(0.303)
Controls	YES	YES	YES	YES
Observations	1146	1146	988	1146
(c) First stage				
Dependent variable: Project-based learning	(1)	(2)		
	All schools	PBL top 3		
Treat Post	0.196***	0.357***		
	(0.038)	(0.052)		
C9ntrols	YES	YES		

Dependent variable:	*(1)*	*(2)*	*(3)*	*(4)*
	Teacher preparation	*Teacher inducement*	*Share idea*	*Class participation*
Observations	2266	1146		
F-statistic	346.90	295.38		

Note: Regression in Panel (b) is limited to the top 3 treatment madrasa in terms of increased use of PBL and corresponding control madrasa. PBL predictions in panel (a) are obtained from the first stage regression in panel (c), Column 1; PBL predictions in panel (b) were obtained from the first stage regression in panel (c), Column 2. Teacher induction: student motivation general perceptions of teacher efforts to encourage participation (1: "Strongly disagree" ~ 4: "Strongly agree"); Teacher preparation: students' general perceptions of class preparation teachers (1: "Strongly disagree" ~ 4: "Strongly agree"); Sharing ideas with classmates: the extent to which ideas are shared with classmates during class (1: "Not at all" ~ 4: "A lot"); Class participation: self-assessment of enthusiastic class participation (1: "Strongly disagree" ~ 4: "Strongly agree"). All regressions control for the following: Gender: coded 1 if female, 0 if male; Teacher education level: coded 1 if the highest education level is S2 or more, 0 otherwise; Total teaching experience and current school experience in months; Permanent employee: coded 1 if permanent employee, 0 if temporary contract. Standard error clustered at the madrasa level. ***p < 0.01, **p < 0.05, *p < 0.1.

Discussion

In this study, we explore whether increasing the use of PBL by madrasa aliyah teachers in Indonesia improves the leadership competence of madrasa teachers. Estimates obtained using a difference-in-difference design and an instrumental variable approach found that the PBL program positively affected the leadership competence of madrasa teachers. Also, analysis of student data using a difference-in-difference design found that the PBL program positively affected students' perceptions of the level of effort a teacher exerted to provoke interest. Finally, estimating an instrumental variable approach on the subset of schools with the most substantial increase in PBL found that PBL was positively related to madrasa teachers' perceptions of class preparation, efforts to induce madrasa teacher interest, and the frequency with which students shared ideas in class.

The positive associations between PBL and the leadership competence of madrasa teachers indicate that learning practices are not only the result of madrasa teachers' leadership competence, as is generally perceived, but can also lead to changes in madrasa teachers' leadership competencies. Mainly based on analysis using cross-sectional data, researchers tend to treat the leadership competence of madrasa teachers only as a determinant of the learning method approach (Suprayogi, Valcke, & Godwin, 2017; Zee & Koomen, 2016; Tambak & Sukenti, 2020; Tambak et al., 2020; Ritonga et al., 2021). This study provides empirical evidence for alternative understanding; it could also be for learning practices to influence the leadership competence of madrasa teachers. Analysis of the data collected over two periods with the quasi-experimental PBL method provided more excellent support for interpreting causality than previous studies based on cross-sectional data. This study introduces teaching practice as a mediating factor influencing the pedagogy of madrasa teachers, contributing to the literature seeking to understand teacher leadership competency development (Lobczowski et al., 2021; Tambak & Sukenti, 2019; Tambak et al., 2021; Ritonga et al., 2021).

From the three primary sources of developing the leadership competence of madrasa teachers rooted in cognitive leadership theory, experience may play a significant role in improving the leadership competence of madrasa teachers. Experience mastery occurs when teachers view their performance as madrasa teachers to be successful. PBL may lead to a more positive educational experience among students, leading to an increase in the leadership competence of madrasa teachers (Owens & Hite, 2020; Untari et al., 2020; Hussein, 2021; Tambak, Ahmad & Sukenti, 2020; Untari. , et al. 2020; Hussein, 2021). Due to data limitations, we did not directly assess the relationship between students and the leadership competence of madrasa teachers. However, the positive associations between PBL and student outcomes support the possibility of mastery experiences (Panadero, Jonsson & Botella, 2017; Marsh et al., 2019; Tambak, et al., 2021; Hamzah, et al., 2020). Among the three madrasas that experienced the tremendous increase in PBL, they were shown to have a positive and statistically significant change in how they carried out their teacher's efforts to provoke interest and preparatory classes and increased their frequency of sharing ideas with other students in the class. Students have more positive perceptions of teachers in the classroom, if conveyed to teachers, can contribute to teachers who understand their teaching to be effective. Also, sharing ideas in class is likely related to involvement in the course material. Therefore, Madrasa teachers' positive perceptions and involvement in the classroom through sharing ideas tend to lead to mastery experiences that increase teacher leadership competence.

This study has limitations that should be addressed in future research. First, the potential limitation of this study is the use of a subject-near measure of madrasa teacher leadership competence. Some scholars argue the need to develop the leadership competence of madrasa teachers in a closer relationship with the specific teacher context, such as the subject being taught (Ljung-Djärf, Agneta, & Peterson.,

2014; Chaijum, & Hiranyachattada, 2020; Akharraz, 2021; Sukenti, Tambak & Siregar, 2021). Although the additional predictive value and generalizability of such constructs have not been determined, using various measures of madrasa teacher leadership competence in future research may lead to more robust estimates. Second, this study only used teacher self-reported measures of teacher leadership competence. However, assessing teachers' own assessments can lead to positive or negative self-assessment bias, distorting and underestimating the relationship between teachers' leadership competencies and others. Drawing on multiple data sources to measure leadership competence, such as using teacher and student ratings, can allow for more reliable and stable measurements (Panadero, Jonsson, & Botella, 2017; Marsh et al., 2019). Third, there are limitations concerning the generalizability of the main findings. The sample size of this study was relatively small, and the study was only conducted in schools in Pekanbaru Metropolitan City. Also, the madrasa teacher survey has a relatively low response rate. Thus, there may be limitations in generalizing the findings to national or international levels. Future studies should expand the sample of madrasa teachers, both in scope and number, to obtain more generalizable findings. Finally, this study only assessed the impact of PBL immediately after it was implemented for one semester. To understand how PBL affects the leadership competence of madrasa teachers, the instructional approach can be expanded (e.g., more than one semester). Also, long-term effects should be assessed through outcomes measured at later time points.

Conclusion

Estimates obtained using a difference-in-difference design and an instrumental variable approach found that the PBL program positively affected the leadership competence of madrasa teachers in Islamic religious education learning. Also, analysis of student data using a difference-in-difference design found that the PBL program positively affected students' perceptions of the level of effort a teacher exerted to provoke interest. Estimating an instrumental variable approach on the subset of schools with the most substantial increase in PBL use found that PBL was positively related to teachers' perceptions of class preparation, attempts to induce teacher interest, and the frequency with which students share ideas in class.

This study provides empirical evidence for alternative understanding; it could also be for learning practices to influence the leadership competence of madrasa teachers in learning Islamic religious education. Analysis of the data collected over two periods by quasi-experimental methods provided more excellent support for causal interpretation than previous studies based on cross-sectional data. This study introduces teaching practice as a mediating factor that affects the leadership competence of madrasa teachers, a contribution to the literature that seeks to understand the development of madrasa teachers' leadership competencies in Islamic religious education learning. This research has implication for developing the theory of "project-based learning on the leadership competence of madrasa teachers" in learning Islamic religious education. The findings of this study can be universally developed by the Ministry of Religion of the Republic of Indonesia in all madrasa in learning at the madrasa.

However, this study only assessed the impact of PBL immediately after it was implemented for one semester—and this is part of the research limitation. In order to gain a full understanding of how PBL influences the leadership competence of madrasa teachers, the duration of using the learning approach can be extended (eg more than one semester)—another limitation of this research. Also, long-term effects must be assessed through outcomes measured at later time points. So, the self-efficacy of madrasa teachers is crucial to be developed in learning Islamic religious education through a qualified PBL process in the madrasa teaching profession.

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