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Development of Madrasa Teacher Leadership Competency: Involving Project-

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Based Learning Methods in Students-Centered Learning

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Abstract

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The purpose of this study is to determine whether increasing the use of project-based learning

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(PBL) by madrasa aliyah instructors in Indonesia enhances their capacity as learning leaders.

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This study employed a quasi-experimental approach to investigate how project-based learning

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(PBL) is connected with teachers' leadership competency and analyzed the data using a t-test.

10

In general, the leadership skills of madrasa teachers are only taken into consideration as a

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factor in the way Islamic religious education is actually taught. However, we discovered that

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the greater usage of PBL in the classroom can have a favorable impact on the leadership skills

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of madrasa teachers. PBL is positively correlated with student involvement and teaching in

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learning among the madrasa teacher leadership competence subscales. Analysis using student

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data shows that students' positive responses to Islamic religious education learning practices

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can mediate the relationship between PBL and the leadership competence of madrasa

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teachers. This research has implications for developing the PBL model in improving the

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leadership competence of madrasa teachers in learning Islamic religious education.

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Keywords: Project-based learning, leadership competence, learning and instruction,

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madrasa teacher professionalism.

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1 **Introduction**

2 The leadership competence of madrasa teachers is the ability to teach in themselves as well
3 as the ability to become leadership teachers (König, et al., 2021; Irmawati, Asri & Aziz, 2021;
4 Murkatik, Harapan & Wardiah, 2020; Rusilowati & Wahyudi, 2020), is associated with various
5 teacher characteristics and behaviors (Rusilowati & Wahyudi, 2020; Karuniawati, Rahayu, &
6 Ladamay, 2021). In particular, various theories describe that the leadership competence of
7 madrasa teachers determines the abilities and teaching methods related to instructional
8 practice (Guillén-Gámez et al., 2021; König, et al., 2021; Snoek, 2021; Suprayogi, Valcke &
9 Godwin, 2017). In addition, the leadership competence of teachers contributes to self-
10 leadership development (McGarr & McDonagh, 2021; Guillén-Gámez et al., 2021; Snoek,
11 2021) and also improves the quality of an educational institution.

12
13 However, most studies examining the relationship between teachers' leadership competence
14 and learning practices have relied on cross-sectional data (Rusilowati & Wahyudi, 2020; König,
15 ³⁸ et al., 2021; McGarr & McDonagh, 2021; Tambak et al., 2020). This means that the data used
16 for the analysis can allow for comparisons across respondents but cannot explain changes
17 over time, severely limiting the empirical ability to identify causality. Furthermore, the
18 theoretical discussion of teacher leadership competence implies a reciprocal or cyclical
19 relationship with classroom experience (Tambak & Sukenti, 2020; Lukianchuk et al., 2021;
20 Komar et al., 2021; Muna, Sunardi & Widyastono, 2021). Thus, teacher leadership competence
21 may be influenced by changes in instructional practice. Other research reveals that leadership
22 competence implies the process of self-development with leadership in learning at a madrasa
23 (Efendi, 2021; Hamzah, Tambak & Tanjung, 2020; Tambak, Ahmad & Sukenti, 2020; Muna,
24 Sunardi & Widyastono, 2021).

25
26 These ¹ various studies illustrate that leadership competence is more psychologically
27 researched in the learning process but has yet to reveal the strengthening of project-based
28 learning in madrasa teacher learning. This research is a new thing where the leadership
29 competence of madrasa teachers is given a solution with a project-based learning method
30 that is different from previous research. Thus, to empirically explore ³⁰ the relationship between

1 the leadership competence of madrasa teachers and instructional learning practices, this
2 study uses data from project-based learning (PBL) program intervention in Pekanbaru City,
3 Riau, Indonesia. In 2019, the Ministry of Religion of Riau Province provided four public
4 madrasa aliyah in Pekanbaru City with PBL program interventions to encourage teachers in
5 madrasa by changing the learning method from teacher-centered lectures to student-
6 centered PBL. In the PBL program, the treatment group teachers were given training on
7 applying PBL and asked to use it in the classroom for one semester. In contrast, the seven
8 control group teachers did not receive any encouragement to change their learning practices.
9 With data pooled on teachers and students from the program, we used a quasi-experimental
10 research method to assess how increased use of PBL over one semester was associated with
11 changes in teacher leadership competence in a madrasa in learning.

12
13 This research is urgent to empirically explore ¹the relationship between the leadership
14 competence of madrasa teachers and instructional practices using data from project-based
15 learning (PBL) program interventions in teaching Islamic religious education for madrasa
16 teachers. PBL, in various theories, provides development in ²⁹the learning process (Syakur et al.,
17 2020; Guo et al., 2020; Miller, Severance, and Krajcik, 2021; Santyasa, Rapi, and Sara, 2020;
18 Sukenti & Tambak, 2020). Furthermore, the application of PBL can develop a quality and
19 competitive learning atmosphere and environment, as well as the development of a tradition
20 of higher-order thinking for students (Wu, & Wu, 2020; Safaruddin et al., 2020; Pérez & Rubio,
21 2020; Kim, 2020; Abuhmaid, 2020). Thus, the focus ¹⁰this study is to explore the following:
22 the use of project-based learning affects the leadership ¹competence of madrasa teachers in
23 Islamic religious education.

24 25 Method

26 Research Design

27 To assess the ¹relationship between PBL and the leadership competence of madrasa teachers,
28 this study used a quasi-experimental method using survey data collected from teachers and
29 students in two periods, before and after the use of PBL in the classroom for one semester.
30 We mainly use two empirical methods: the difference-in-difference design and the

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

15 **Population and Sample/ Study Group/Participants**

16 ***Population***

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

27 The analysis for this study was conducted based on disproportionate data, meaning that some
28 teachers and students only participated in the pre-treatment or post-treatment surveys.
29 Among the 117 unique teachers in the sample, 57 (48.7%) teachers took part in both the pre-

1 treatment and post-treatment surveys, while 36 (30.8%) teachers took part only in the pre-
2 treatment survey and 24 (20.5%) took part only in the post-treatment survey. In the final
3 analysis of the sample for teacher survey data, the number of observations in the pre-
4 treatment period was 93 (53.4%), and the number of observations in the post-treatment
5 period was 81 (46.6%). For student survey data, among a unique sample of 1268 students,
6 1107 (87.3%) took part in the pre-and post-treatment survey, while 109 (8.6%) only took part
7 in the pre-treatment survey and 52 (4.1%) took part only in the post-treatment survey.

8 A summary of the essential background characteristics of teachers and students is presented
9 that among the 56 teachers in the treatment group, 82% were female, 38% had attained a
10 master's degree or higher education level, the average total teaching experience was 150.13
11 months (SD 99.39), or about 12.5 years, the average school year at the current school is 24.15
12 months (SD 41.81), or about 2 years, and 79% are on permanent contracts. The essential
13 means t-test between the treatment and control groups found no statistically significant
14 difference between the two groups. Among the treatment group students in the pre-
15 treatment phase, 44% were female and had a mean language score of 2.66 (score range: 0 to
16 5; SD 1.48). T-tests of the baseline revealed no significant differences between the treatment
17 and control group students regarding gender composition and Islamic religious education
18 scores. However, the treatment group had a higher proportion of students with parents who
19 had a bachelor's degree. Therefore, we included them as control variables across all regression
20 models to account directly for these differences.

21 **Sample selection**

22 The selection of madrasa in the treatment and control groups was not random, which could
23 potentially bias estimates and limit the extent to which causal interpretations can be made.
24 Considering the sample's representativeness, one treatment school is selected from seven
25 different school districts within the city, and a suitable control school is selected within the
26 same district. Control madrasa was selected to be the same sex (one sex, at the madrasa and
27 grade level) as treatment schools and was located within 2 km. Thus, we have two madrasas
28 (one experimental school and one control school) per district in our sample, as close as
29 possible to each other regarding gender structure and geographic location. Madrasa teachers

1 or students did not voluntarily or self-select into the treatment or control groups, which
2 eliminates concerns for potential selection bias.

3 Although the study sample was not randomly selected, the differences in background
4 characteristics across madrasa teachers and ¹⁰ students in the treatment and control groups
5 were minimal. Also, we show that the probability of being in the treatment group versus the
6 control group does not differ between teachers based on most of the observable
7 characteristics. The same can be said for students. Each variable characteristic was controlled
8 for all regressions. In terms of policy, the madrasa in our study are in the same city of
9 Pekanbaru, and Pekanbaru operates a very centralized education system, where madrasa are
10 identical in terms of minimum training and certification requirements to become a teacher,
11 curriculum and textbooks, teacher salaries, and finances. The relatively high degree of
12 homogeneity across treatment and control schools lends credence to the validity of the quasi-
13 experimental research design.

14

15 **Data Collection**

16 Over the years, various methods of measuring teacher leadership competence have been
17 developed (Zee & Koomen, 2016). This study uses the short form of the Madrasa Teacher
18 Leadership Competency Test developed by Tambak (2017). TKPGM consists of a factor
19 structure that is stable and broad enough to cover a wide range of relevant teacher abilities
20 for teaching. It is one of the most widely used madrasa teacher leadership competency
21 instruments, including in the national madrasa teacher survey. The questionnaire for the
22 TKPGM used in this study consisted of 54 items divided into three subscales of madrasa
23 teacher leadership competence, with madrasa teacher leadership competence as a whole
24 being the average of ten subscales. Each of the 54 items measures the extent to which
25 madrasa teachers feel they have the ability to manage to learn and is rated ⁸ on a 4-point Likert
26 scale, ranging from “not at all” to “A” a lot.” The subscale of madrasa teacher leadership
27 competence is (a) leadership competence of Madrasa teachers in learning, (b) Madrasa
28 teachers' leadership competencies in learning management (c) and Madrasa teachers'
29 leadership competencies in engagement. ¹⁵ Cronbach's Alpha was used to assess the
30 instrument's internal consistency, which showed (0.93) for the entire instrument.

1 To measure PBL frequency, we used a dummy variable derived from a teacher's self-reported
2 use of "multiple projects in progress" reported ⁵ on a four-point Likert scale: 1) Never or seldom;
3 2) Sometimes; 3) Often; 4) In all or almost all lessons. If the teacher reported using PBL either
4 "never or almost never" or "sometimes," the variable was coded as 0, and if the teacher
5 reported using PBL "often" or "In all or almost all lessons," the variable was coded as 1. The
6 measure of PBL frequency in the student survey was constructed similarly to the madrasa
7 teacher survey.

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

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

23 24 **Data Analysis**

25
26 For madrasa teacher survey data, the missing scores ranged from 0.6% to 2.3% across all
27 variables and periods. For student survey data, the two variables had two missing values each,
28 for a 0.08% loss rate. Average imputation is used to handle missing cases. Each missing value
29 is replaced by the mean value of the relevant variable, taken from the appropriate school and
30 respondent period. Although not presented in the study, ²⁵ there was no significant difference

1 in the results compared with the analysis performed after the deletion of the list of
2 respondents with missing values for any of the variables included in the regression model.

3 We first estimated the treatment effect of the PBL program using a difference-in-difference
4 design. The difference-in-difference method captures the treatment effect by comparing the
5 change in the mean over time of the outcome variable for the treatment group with the
6 change in the mean over time for the control group. The required assumption is that changes
7 over time in the outcome variables for the treatment and control groups will be identical in
8 the absence of treatment. This assumption is known as the parallel trend assumption because
9 it requires time trends in the outcome variables to be parallel between the two groups before
10 treatment. He should note that the assumptions require trends to be identical, not the rate of
11 outcome variables. If this assumption holds, the difference in changes over time between the
12 treatment and control groups is interpreted as a causal effect of treatment (Khaldi, 2017).
13 Empirical verification of the assumption of parallel trends requires data to be collected at
14 multiple time points before treatment takes place. However, we cannot directly assess the
15 assumption of parallel trends because we only have data for a single period before and after
16 treatment. Nonetheless, due to the relatively high degree of homogeneity across the
17 treatment and control groups, it is unlikely that any differences in the outcome variables were
18 attributable to factors other than the PBL program intervention. The empirical model (Garcia,
19 2020) that we used to derive the difference-in-difference estimate is stated:

$$20 \quad Y_{ijt} = \beta_0 + \beta_1 \text{Treat}_i \times \text{Post}_t + \beta_2 \text{Treat}_j + \beta_3 \text{Post}_t + X_{ij} + e_{ijt}$$

21 Where i is the subscript i ; J ; and t represents the individual (either teacher or student), school,
22 and period, respectively? y_{ijt} is the dependent variable of interest, such as leadership
23 competence for madrasa teachers or student responses for students, individual i in school j at
24 time t : All dependent variables are standardized to have a mean of 0 and a standard deviation
25 of 1, based on the mean and standard deviation of group scores control. This was done to
26 facilitate interpretation, especially regarding how the results changed relative to the control
27 group. If it is equal to 1, the respondent belongs to a nursing school, and if 0, the respondent
28 is part of the madrasa control. Post is equal to 1 if time t is the post-treatment period (i.e.,
29 after the fall 2016 semester) and 0 if time t is the pre-treatment period (i.e., before the

1 intervention). Treaty **Post** (Djafar et al., 2021) is an interaction between indicator variables for
2 treatment and period. X_i is a vector control variable consisting of individual characteristics
3 such as respondents. For madrasa teachers, they included gender, education level, total
4 teaching experience (in months), recent teaching experience at the madrasa (in months), and
5 type of employment contract. For students, they included the student's gender, parental
6 education level, eldest child status, and test math scores. ϵ_{ijt} is an error term clustered at the
7 school level.

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

16

17

18

Findings

19 Teacher analysis

20 Table 1 reports the effect of the PBL program on the leadership competence of madrasa
21 teachers and their subscales, estimated through the design differences expressed in (Equation
22 (1)). The first column shows that the PBL program is associated with an increase in the
23 leadership competence of madrasa teachers by 0.942 standard deviations ($p < 0.01$). Column
24 2 reports that the PBL program has a significant relationship with the leadership competence
25 of madrasa teachers in instruction, with a standard deviation of 1.011 ($p < 0.01$), and Column
26 4 reports that leadership competence in engagement is significantly related to the PBL
27 program of 0.899 standard deviations ($p < 0.01$). The results in column 3 show that the PBL
28 program has no significant effect on the leadership competence of madrasa teachers in
29 classroom management. This indicates that leadership competence in teaching and student

1 engagement drive the positive impact that PBL programs have on the leadership competence
2 of madrasa teachers. Among the madrasa teacher leadership competence subscales, PBL had
3 the most decisive impact on teachers' leadership competence in engagement, which might be
4 expected, given that the significant change reflected in treatment was changed in instructional
5 practice.

6 Table 2 reports the results of the instrumental approach variables on the impact of using PBL
7 on the leadership competence of madrasa teachers and their subscales. The results of the first
8 stage regression (Equation (2)) are found in column 1 of panel (b). The intervention program
9 increased the likelihood of implementing PBL in the classroom either “often” or “in all or
10 almost all subjects” by 44.6 percentage points ($p < 0.05$). This provides further evidence that
11 the PBL intervention program causes significant changes in the way teaching takes place in
12 the classroom. Panel (a) of Table 2 reports the estimates of the second stage of the
13 instrumental-variable approach regression (Equation (3)). The predicted PBL frequency values
14 obtained from the first-stage regression estimation were collected and entered into the
15 regression to estimate equation (3). In column 1 of a panel (a), an exogenous increase in the
16 use of PBL was associated with an increase in the leadership competence of madrasa teachers
17 by 2,270 standard deviations ($p < 0.1$). Self-efficacy in instruction and engagement was also
18 found to be positively influenced by PBL, increasing by 2.115 standard deviations ($p < 0.1$) and
19 2.016 standard deviations ($p < 0.05$), respectively. As in the difference-within-difference
20 estimate, PBL was found to have no significant effect on leadership competence in classroom
21 management.

22 **Student analysis**

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

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

4 Table 3 reports the estimated difference-in-difference obtained through equation (1) using
5 student survey data. Estimates were obtained for the entire sample and the madrasa
6 subsample consisting of the three treatments group madrasa in which PBL increased the most
7 and their respective control madrasa matched. Responses from the teacher and student
8 survey showed that teachers from Madrasa Aliyah Negeri 1, Madrasa Aliyah Negeri 2, and
9 Madrasa Aliyah Negeri 4 significantly increased the use of PBL after the PBL program. Column
10 2 of panel (a) shows that the PBL intervention program led to an increase in the perception of
11 efforts to attract teachers' interest by 0.155 standard deviations ($p < 0.1$). There was no
12 statistically significant relationship between the PBL program and other student variables. In
13 panel (b), where the analysis was limited to the three care schools in which: PBL increased the
14 most and their matched control madrasa, we found that the PBL program increased the
15 madrasa teacher's perception of interest by persuasion effort by 0.360 standard deviations (p
16 $< 0, 05$). This shows outstanding development.

17

18 **Table 1: Project-based learning and leadership competence: Difference-in-**
19 **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*** (0.299)	1.011*** (0.272)	0.509 (0.327)	0.899*** (0.242)
Post	0.012 (0.202)	0.318 (0.184)	0.028 (0.235)	0.013 (0.166)
Treat	0.740** (0.165)	0.811** (0.136)	0.588** (0.160)	0.571*** (0.157)
Student math score	0.046 (0.091)	0.103 (0.202)	0.089 (0.088)	0.067 (0.020)
Female	0.473 (0.473)	0.452 (0.452)	0.497 (0.497)	0.315 (0.315)
MA and above	0.082 (0.304)	0.022 (0.264)	0.077 (0.311)	0.083 (0.237)
Total teaching experience	0.004** (0.002)	0.003** (0.001)	0.003* (0.002)	0.003* (0.001)

Experience at current school	0.001 (0.002)	0.002 (0.003)	0.000 (0.002)	0.002 (0.002)
Permanent	0.724* (0.378)	0.559 (0.338)	0.662 (0.446)	0.674** (0.272)
Observations	174	174	174	174
R-squared	0.222	0.319	0.131	0.212

1 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;
 2 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
 3 education level is S2 or higher, 0 otherwise; Total teaching experience and current school experience in months; Permanent: coded 1 if the employee
 4 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
 5 the mean and standard deviation of the control group. Teacher self-efficacy was obtained through the average of three self-efficacy subscales
 6 (instruction, student engagement, and classroom management). The survey questions to assess the madrasa teachers' personal competence
 7 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
 8 clustered at the school level. ***p < 0.01, **p < 0.05, *p < 0.1.

9

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

23

24 **Table 2: Project-based learning and madrasa teacher leadership competence: Two-**
 25 **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* (1.190)	2.115* (1.159)	1.143 (0.945)	2.016** (0.949)
Post	0.122 (0.646)	0.421 (0.636)	0.250 (0.509)	0.378 (0.522)
Treat	0.841** (0.334)	0.768** (0.325)	0.603** (0.288)	0.597** (0.259)
Observations	174	174	174	174
(b) the First stage				
Dependent variable: Project-based learning	(1)			
Post Treat	0.446**			

Post	0.194 (0.131)
Treat	0.013 (0.066)
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," "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.

11

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

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

14 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
15 the control group. Teacher inducement: students' general perception of the teacher's efforts to encourage participation (1: "Strongly disagree" ~ 4:
16 "Strongly agree"); Teacher preparation: students' general perception of teacher preparation for class (1: "Strongly disagree" ~ 4: "Strongly agree");
17 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-
18 assessment of enthusiastic class participation (1: "Strongly disagree" ~ 4: "Strongly agree"). All control regressions were as follows: Gender: coded 1
19 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
20 school experience in months; Type of work: coded 1 if permanent worker, 0 if temporary contract. Top 3 PBL Madrasa refers to the treatment
21 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
22 school level. ***p < 0.01, **p < 0.05, *p < 0.1.

23

24 **Table 4:** Project-based learning and student outcomes: Two-stage least squares
25 estimates.
26

Dependent variable:	(1)	(2)	(3)	(4)
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	Teacher preparation	Teacher inducement	Share idea	Class participation
Predicted PBL	0.457 (0.438)	0.792* (0.439)	0.995* (0.603)	0.472 (0.429)
Observations	2266	2266	1944	2266
Dependent variable:	(1) Teacher preparation	(2) Teacher inducement	(3) Share idea	(4) Class participation
	(0.348)	(0.355)	(0.433)	(0.303)
Observations	1146	1146	988	1146
Dependent variable: Project-based learning	(1) All schools	(2) PBL top 3		
Treat Post	0.196*** (0.038)	0.357*** (0.052)		
Observations	2266	1146		
F-statistic	346.90	295.38		

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

11

12

Discussion

13 In this study, we explore ¹ whether increasing the use of PBL by madrasa aliyah teachers in
14 Indonesia improves the leadership competence of madrasa teachers. Estimates obtained
15 using a difference-in-difference design and an instrumental variable approach found that the
16 PBL program positively affected the leadership competence of madrasa teachers. Also,
17 analysis of student data using a difference-in-difference design found that the PBL program
18 positively affected students' perceptions of the level of effort a teacher exerted to provoke
19 interest. Finally, estimating an instrumental variable approach on the subset of schools with
20 the most substantial increase in PBL found that PBL was positively related to madrasa
21 teachers' perceptions of class preparation, efforts to induce madrasa teacher interest, and the
22 frequency with which students shared ideas in class.

1 The positive associations ¹ between PBL and the leadership ¹ competence of madrasa teachers
2 indicate that learning practices are not only the result of madrasa teachers' leadership
3 competence, as is generally perceived, but can also lead to changes in madrasa teachers'
4 leadership competencies. Mainly based on analysis using cross-sectional data, researchers
5 tend to treat the leadership ¹ competence of madrasa ¹ teachers only as a determinant of the
6 learning method approach (Suprayogi, Valcke, & Godwin, 2017; Zee & Koomen, 2016; Tambak
7 & Sukenti, 2020; Tambak ²⁸ et al., 2020; Ritonga et al., 2021). This study provides empirical
8 evidence for alternative ²⁸ understanding; it could also be for learning practices to influence the
9 leadership competence of madrasa teachers. Analysis of the data collected over two periods
10 with the quasi-experimental PBL method provided more excellent support for interpreting
11 causality than previous studies based on cross-sectional data. This study introduces teaching
12 practice as a mediating factor influencing the pedagogy of madrasa teachers, contributing to
13 the literature seeking to understand teacher leadership competency development
14 (Lobczowski ²⁴ et al., 2021; Tambak & Sukenti, 2019; Tambak et al., 2021; Ritonga et al., 2021).

15 From the three primary sources of developing the leadership competence of madrasa
16 teachers rooted in cognitive leadership theory, experience may play a significant role in
17 improving the leadership competence of madrasa teachers. Experience mastery occurs when
18 teachers view their performance as madrasa teachers to be successful. PBL may lead to a more
19 positive educational experience among students, leading to an increase in the leadership
20 competence of madrasa teachers (Owens & Hite, 2020; Untari et al., 2020; Hussein, 2021;
21 Tambak, Ahmad & Sukenti, 2020; Untari, et al. 2020; Hussein, 2021). Due to data limitations,
22 we did not directly assess ¹ the relationship between students and the leadership ¹ competence
23 of madrasa teachers. However, the positive associations between PBL and student outcomes
24 support the possibility of mastery experiences (Panadero, Jonsson & Botella, 2017; Marsh et ³¹
25 al., 2019; Tambak, et al., 2021; Hamzah, et al., 2020). Among the three ² madrasas that
26 experienced the tremendous increase in PBL, they were shown to have a positive and
27 statistically significant change in how they carried out their teacher's efforts to provoke
28 interest and preparatory classes and increased their frequency ² of sharing ideas with other
29 students in the class. Students have more positive perceptions of teachers in the classroom, if
30 conveyed to teachers, can contribute to teachers who understand their teaching to be

1 effective. Also, sharing ideas in class is likely related to involvement in the course material.
2 Therefore, Madrasa teachers' positive perceptions and involvement in the classroom through
3 sharing ideas tend to lead to mastery experiences that increase teacher leadership
4 competence.

5 This study has ⁸ limitations that should be addressed in future research. First, the potential
6 limitation of this study is the use of a subject-near measure of madrasa teacher leadership
7 competence. Some scholars argue the need to develop the leadership competence of madrasa
8 teachers in a closer relationship with the specific teacher context, such as the subject being
9 taught (Ljung-Djärf, Agneta, & Peterson., 2014; Chaijum, & Hiranyachattada, 2020; Akharraz,
10 2021; Sukenti, Tambak & Siregar, 2021). Although the additional predictive value and
11 generalizability of such constructs have not been determined, using various measures of
12 madrasa teacher leadership competence in future research may lead to more robust
13 estimates. Second, this study only used teacher self-reported measures of teacher leadership
14 competence. However, assessing teachers' own assessments can lead to positive or negative
15 self-assessment bias, distorting and underestimating the relationship between teachers'
16 leadership competencies and others. Drawing on multiple data sources to measure leadership
17 competence, such as using teacher and student ratings, can allow for more reliable and stable
18 measurements (Panadero, Jonsson, & Botella, 2017; Marsh et al., 2019). Third, there are
19 limitations concerning the generalizability of the main findings. The ³⁶ sample size of this study
20 was relatively small, and the study was only conducted in schools in Pekanbaru Metropolitan
21 City. Also, the madrasa teacher survey has a relatively low response rate. Thus, there may be
22 limitations in generalizing the findings to national or international levels. Future studies should
23 expand the sample of madrasa teachers, both in scope and number, to obtain more
24 generalizable findings. Finally, this study only assessed the impact of PBL immediately after it
25 was implemented for one semester. To understand how PBL affects the leadership
26 competence of madrasa teachers, the instructional approach can be expanded (e.g., more
27 than one semester). Also, long-term effects should be assessed through outcomes measured
28 at later time points.

29

1 **Conclusion**

2 Estimates obtained using a difference-in-difference design and an instrumental variable
3 approach found that the PBL program positively affected the leadership ¹ **competence of**
4 **madrasa teachers in Islamic religious education** learning. Also, analysis of student data using
5 a difference-in-difference design found that the PBL program positively affected students'
6 perceptions of the level of effort a teacher exerted to provoke interest. Estimating an
7 instrumental variable approach on the subset of schools with the most substantial increase in
8 PBL use found that PBL was positively related to teachers' perceptions of class preparation,
9 attempts to induce teacher interest, and the frequency with which students share ideas in
10 class.

11 This study provides empirical evidence for alternative understanding; it could also be for
12 learning practices to influence the leadership ¹ **competence of madrasa teachers in learning**
13 **Islamic religious education**. Analysis of the data collected over two periods by quasi-
14 experimental methods provided more excellent support for causal interpretation than
15 previous studies based on cross-sectional data. This study introduces teaching practice as a
16 mediating factor that affects the leadership competence of madrasa teachers, a contribution
17 to the literature that seeks to understand the ³⁴ **development of madrasa teachers'** leadership
18 **competencies in Islamic religious education** learning. ¹⁶ **This research aims to develop the theory**
19 **of "project-based learning on the leadership competence of madrasa teachers" in learning** ²⁷
20 **Islamic religious education. The findings of this study can be universally** ²³ **developed by the**
21 **Ministry of Religion of the Republic of Indonesia** in all madrasa in learning at the madrasa.
22 However, this study only assessed the impact of PBL immediately after it was implemented
23 for one semester. ²¹ **To gain a complete understanding of how PBL affects the leadership**
24 **competence of madrasa teachers, the duration of using the instructional approach can be**
25 **extended (e.g., more than one semester). Also, long-term effects should be assessed through**
26 **outcomes measured at later time points. So, madrasa teacher self-efficacy is a crucial thing to**
27 **be developed in language learning through a capable PBL process in the madrasa teacher**
28 **profession.**

29

30

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