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Indonesian Early Childhood Teachers' Readiness For Climate Education: Self-Efficacy And Institutional Support

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ABSTRACT

Early childhood teachers are expected to introduce environmental and climate change issues, yet little is known about what drives their classroom practice. This study examined Indonesian early childhood teachers' knowledge, concern, self-efficacy, institutional support, and environmental teaching practice, tested whether self-efficacy mediates the links between knowledge, concern, and practice, and identified readiness profiles. A cross-sectional online survey was completed by 116 teachers from 19 provinces. Data were analysed using multiple regression, bootstrapped mediation analysis, group comparisons, and K-means cluster analysis. The four predictors explained 68.5% of the variance in practice, but only self-efficacy (β = .50) and institutional support (β = .42) contributed uniquely. Concern was related to practice entirely through self-efficacy, whereas knowledge showed no direct or indirect effect. Misconceptions were common: 66.4% of teachers believed that the ozone hole is the main cause of global warming. Three readiness profiles emerged, and the largest (n = 56) combined high practice with limited knowledge. Strengthening teachers' self-efficacy and institutional support, together with accurate climate content in teacher education, is essential for climate education in early childhood.

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1. *Introduction*

Climate change is no longer a distant topic for young children. UNICEF (2021) estimated that about one billion children live in countries at extremely high risk from climate and environmental hazards, which makes early childhood a strategic starting point for building environmental awareness. The issue also weighs on young people emotionally: in a ten-country survey of 10,000 people aged 16 to 25, 84% were at least moderately worried about climate change (Hickman et al., 2021). A systematic review of 66 studies found strong evidence that environmental education in early childhood supports children's development and environmental outcomes, particularly when it uses nature exposure and play-based learning (Ardoin & Bowers, 2020). Indonesian studies point in the same direction: environment-based learning strengthens young children's eco-literacy and naturalist intelligence (Setyaningsih et al., 2024; Priadi & Fatria, 2024), and curricula built around greening and local environmental risks have been developed for coastal early childhood settings (Fadhilah et al., 2026). Parents also shape young children's environmental attitudes, which makes collaboration between home and school important (Afwanni et al., 2024).

These benefits depend on teachers. Teachers decide whether environmental themes enter daily routines, how they are framed for young children, and whether children's questions about weather, waste, or floods are answered accurately. A systematic review of climate change education found that young people's understanding is often limited or inaccurate and that didactic transmission rarely changes their attitudes or behaviour, so participatory and creative approaches are needed (Rousell & Cutter-Mackenzie-Knowles, 2020). Research on education for sustainable development in early childhood describes a shift from teaching children facts about the environment towards enabling them to act for change (Hedefalk et al., 2015), and recent work recommends inquiry-based, project-led, and arts-integrated approaches to climate education in kindergarten (Hu, 2026). Sweden's preschool curriculum, for example, treats the environmental, social, and economic dimensions of sustainability as inseparable and presents

children as active agents in sustainability issues (Borg & Pramling Samuelsson, 2022), and scholars have argued that early childhood education in the Anthropocene needs a holistic and transformative orientation that still protects children's right to a safe childhood (Wolff et al., 2020). In everyday practice, such education often takes the form of gardening and foraging projects in which children, educators, and local communities form communities of practice (Bergan et al., 2021). However, sustainability is often only implicit in early childhood curriculum frameworks, which leaves much to teachers' interpretation (Weldemariam et al., 2017). In Indonesia, teachers who received information and motivation about environmental education began to implement activities such as tree planting and nature-based learning (Chandrawati & Aisyah, 2022). Such approaches demand more than goodwill; they require accurate content knowledge and the confidence to translate it into play.

Evidence on what makes teachers ready to teach climate change is still limited, particularly in Indonesia. A study of 329 Indonesian upper-secondary teachers found that, although nearly all accepted that climate change is human-caused, their average knowledge score was only 45.7 out of 100 and 88% wrongly linked ozone depletion to climate change (Tang, 2025). In the same study, attitudes were the strongest predictor of willingness to teach climate change, self-efficacy and institutional support also had significant effects, and cognitive factors worked indirectly through affective factors rather than directly (Tang, 2025). Among Indonesian secondary students, STEM-based climate materials improved the knowledge component of climate literacy more than its attitude and action components (Hakim et al., 2023), which suggests that gains in knowledge do not automatically lead to action. Whether a similar pattern holds for early childhood teachers, whose teaching relies on play and daily routines rather than subject lessons, has not been examined.

Self-efficacy offers a plausible bridge between what teachers feel and what they do. In social cognitive theory, self-efficacy shapes the activities people choose, the effort they invest, and their persistence when tasks are demanding (Bandura, 1997), and four decades of research link teacher self-efficacy with classroom processes, student outcomes, and teacher well-being (Zee & Koomen, 2016). In Indonesian early childhood settings, low teacher self-efficacy has been observed under demanding teaching conditions and was related to teachers' teaching approaches (Sibagariang & Pandia, 2021). Early childhood educators' self-efficacy for science instruction has been linked to more frequent science practice in the classroom (Gerde et al., 2018), and among Indonesian kindergarten teachers, technology-integration self-efficacy directly predicted readiness for online teaching (Warmansyah et al., 2022). Institutional conditions also matter: whole-school approaches link sustainability education with leadership, organisation, and school improvement (Mogren et al., 2019), and in Indonesian early childhood institutions, transformational leadership by principals has been associated with better learning quality and teacher motivation (Widyastuti et al., 2024). This suggests that teachers' practice depends not only on individual beliefs but also on the support of their institutions.

Research on teachers' climate misconceptions has grown internationally, but it has concentrated on secondary and pre-service teachers. Secondary science teachers in Florida and Puerto Rico who reported teaching climate change extensively often attributed it mainly to ozone depletion (Herman et al., 2017), state context and political affiliation shaped how teachers in California and Texas prioritised climate topics and scientific consensus (Khalidi & Ramsey, 2021), and mixed messages about the causes of climate change remained common in United States middle schools even as climate teaching improved (Plutzer et al., 2024). Confusion about the greenhouse effect and the ozone hole has also been reported among pre-service geography teachers in Germany (Hanke & Schmalor, 2025), pre-service teachers in Russia (Fayzullina et al., 2024), and in-service teachers in South Africa (Hebe, 2020), while Indonesian pre-service and in-service science teachers mainly equated climate change with global warming (Meilinda et al., 2017). A comparison of middle school curricula in six countries, including Indonesia, further showed that causal knowledge about climate change receives more emphasis than action (Dawson et al., 2022). Evidence on teachers' pedagogical competence for sustainability follows a similar pattern: student teachers in several countries felt less prepared to teach for sustainability than for other professional tasks (Dahl, 2019), and Turkish early childhood pre-service teachers reported only moderate efficacy for teaching sustainable development (Köklü Yaylaçı & Olgan, 2021). Studies at the preschool level remain few and mostly descriptive. Maltese pre-service early childhood teachers held basic but partly inaccurate conceptions of climate change (Spiteri, 2026), about a third of Estonian kindergarten teachers had never discussed climate change with children (Jõgi et al., 2024), early childhood educators in Ireland reported feeling inadequately prepared to facilitate education for sustainable development (Collins & Garrity, 2025), and educators in Greece called for training in sustainability-oriented teaching methods (Petkou et al., 2025).

This body of evidence leaves three gaps that the present study addresses. First, it is not known whether the misconceptions documented among secondary and pre-service teachers also occur among practising early childhood teachers, whose climate teaching is embedded in play and daily routines rather than subject lessons. By testing teachers' knowledge item by item, this study extends the international misconception literature to the preschool level. Second, studies that model readiness for climate education in Indonesia have focused on secondary teachers (Tang, 2025), and research on early childhood environmental education, both in Indonesia and internationally, has mostly been qualitative or developmental (Chandrawati & Aisyah, 2022; Fadhilah et al., 2026; Güler Yıldız et al., 2021; Setyaningsih et al., 2024), so the relative weight of knowledge, concern, self-efficacy, and institutional support has not been tested together. Testing these factors jointly allows the study to examine, and possibly challenge, the assumption that more knowledge is the main route to better environmental practice (Kollmuss & Agyeman, 2002;

Tang, 2025). Third, variable-centred analyses describe average relationships but can hide subgroups of teachers whose readiness is uneven, which person-centred approaches are designed to reveal (Spurk et al., 2020). Identifying such profiles complements competence-based frameworks for early childhood education for sustainability (Bascopé et al., 2019) by showing which combinations of knowledge, confidence, and practice teachers actually bring to their classrooms.

This study therefore examined Indonesian early childhood teachers' readiness for environmental and climate education. It aimed to (1) describe teachers' knowledge, including misconceptions, concern, self-efficacy, institutional support, and practice; (2) test the effects of knowledge, concern, self-efficacy, and institutional support on practice (H1 to H4); (3) test whether self-efficacy mediates the effects of knowledge (H5) and concern (H6) on practice; (4) compare readiness by training history and institutional location (H7); and (5) identify readiness profiles. Readiness was treated as an umbrella construct covering cognitive (knowledge), affective (concern), efficacy (self-efficacy), and behavioural (practice) dimensions.

2. *Method*

This study used a cross-sectional explanatory survey design. Data were collected through an online questionnaire (Google Form) from 18 to 27 September 2026 using purposive sampling followed by snowball sampling. The first item asked for voluntary consent; only respondents who agreed could continue, and no identifying information was used in the analysis. Of 117 submitted responses, one trial response by the researcher was removed, leaving 116 teachers from 19 provinces.

Most participants were younger than 25 years (69.8%), had taught for one to five years (84.5%), and worked in private institutions (83.6%). They taught in kindergartens (TK or RA, 68.1%), similar early childhood units (SPS, 18.1%), playgroups (12.1%), and day-care centres (1.7%). Most held a bachelor's degree in early childhood education (60.3%), followed by a high school diploma (17.2%), a bachelor's degree in another field (15.5%), and a master's degree (6.0%). Institutions were located in urban (55.2%), rural (44.0%), and coastal (0.9%) areas. Almost half of the teachers (49.1%) had never attended environmental or sustainability training, and 28.4% reported that their institution had joined a green school or Adiwiyata programme. The largest provincial groups were Bengkulu (n = 30), West Java (n = 22), North Sumatra (n = 18), and East Java (n = 16).

The questionnaire measured five variables. Knowledge of climate change (X1) consisted of 12 statements answered true, false, or unsure; five statements were false and represented common misconceptions. Correct answers scored 1 and incorrect or unsure answers scored 0. Concern (X2), self-efficacy for environmental teaching (X3), and institutional support (X4) used five-point Likert scales, and environmental teaching practice (Y) used a five-point frequency scale covering ten activities such as observing weather, planting, sorting waste, and reading nature-themed stories. Self-efficacy items were developed with reference to an environmental education teaching efficacy instrument (Moseley et al., 2016). Two open items asked about barriers and needed support.

Item analysis showed that four reverse-worded items (C4, C6, D5, and D11) had corrected item-total correlations between −.63 and .07, so they were excluded from composite scores. Reliability was high for concern (α = .94), self-efficacy (α = .97), institutional support (α = .94), and practice (α = .96), and moderate for the knowledge test (KR-20 = .67). Discriminant validity was supported because all heterotrait-monotrait ratios were below .85 (Hair et al., 2019; Henseler et al., 2015); the highest was between concern and self-efficacy (HTMT = .847). A sensitivity analysis that retained the reverse-worded items produced the same hypothesis decisions.

Data were analysed in five stages. First, descriptive statistics and item-level analysis of the knowledge test were computed. Second, Pearson correlations and multiple linear regression tested H1 to H4, with checks for multicollinearity, heteroscedasticity, independence, and normality of residuals. Third, mediation (H5 and H6) was tested with a simple mediation model equivalent to PROCESS Model 4 using 5,000 percentile bootstrap samples, with the remaining predictors as covariates (Hayes, 2022). Fourth, Welch's t-tests and one-way ANOVA with Tukey post hoc tests compared groups by training history and location (H7). Fifth, K-means cluster analysis on standardised scores of knowledge, concern, self-efficacy, and practice identified readiness profiles, which were compared with ANOVA and chi-square tests. Common method variance was examined with Harman's single-factor test (Podsakoff et al., 2003).

3. *Results*

Table 1 presents descriptive statistics, reliability, and correlations. Teachers answered 8.09 of 12 knowledge items correctly on average. On the five-point scales, concern and self-efficacy were relatively high, while institutional support had the lowest mean. All variables correlated positively with practice; the strongest correlations were with self-efficacy and institutional support, and the weakest with knowledge.

Table 1. Descriptive statistics, reliability, and correlations among variables (N = 116)

Variable	Items	M	SD	α	1	2	3	4
1. Knowledge (X1)	12	8.09	2.36	.67				
2. Concern (X2)	4	3.78	1.15	.94	.31**			
3. Self-efficacy (X3)	10	3.78	0.94	.97	.31**	.81**		
4. Institutional support (X4)	6	3.42	0.97	.94	.23*	.49**	.69**	
5. Practice (Y)	10	3.61	0.99	.96	.24**	.59**	.77**	.75**

Knowledge ranges from 0 to 12 (KR-20 reported); other variables range from 1 to 5. * $p < .05$; ** $p < .01$.

Knowledge was uneven across items (Table 2). Items on familiar impacts and mitigation, such as food availability and tree planting, were answered correctly by more than 90% of teachers. In contrast, two-thirds of teachers agreed that the ozone hole is the main cause of global warming, and two in five considered weather and climate to have the same meaning. About one third believed that recycling plastic is unrelated to climate change and that young children are too young to be affected by it. The item on electricity use and carbon emissions had the highest proportion of unsure answers.

Table 2. Distribution of responses to the climate change knowledge items (%)

Statement	Key	Correct	Incorrect	Unsure
Climate change is mainly caused by greenhouse gases from human activity	True	83.6	6.0	10.3
The ozone hole is the main cause of global warming	False	20.7	66.4	12.9
Burning waste in the yard adds greenhouse gas emissions	True	81.9	6.0	12.1
Organic waste piling up in landfills produces methane	True	75.0	14.7	10.3
Climate change impacts are felt only in polar regions	False	56.0	24.1	19.8
Planting and caring for trees helps absorb carbon dioxide	True	91.4	6.0	2.6
Weather and climate have the same meaning	False	48.3	40.5	11.2
Sea level rise threatens Indonesia's coastal areas	True	87.9	3.4	8.6
Recycling plastic waste is unrelated to climate change	False	53.4	32.8	13.8
Young children are too young to be affected by climate change	False	52.6	31.0	16.4
Electricity use at home and school is related to carbon emissions	True	66.4	11.2	22.4
Climate change can affect food availability	True	92.2	0.9	6.9

For false statements, "Incorrect" indicates agreement with a misconception.

The regression model was significant, $F(4, 111) = 60.36$, $p < .001$, and explained 68.5% of the variance in practice (adjusted $R^2 = .674$; Table 3). Self-efficacy and institutional support were significant unique predictors, whereas knowledge and concern were not, even though both correlated positively with practice. Adding self-efficacy to a model containing knowledge, concern, and institutional support increased R^2 by .056, $F(1, 111) = 19.79$, $p < .001$. VIF values ranged from 1.12 to 4.43, the Breusch-Pagan test was not significant ($p = .898$), and the Durbin-Watson statistic was 2.02. Residuals met the Kolmogorov-Smirnov criterion ($p = .321$) but not the Shapiro-Wilk test ($p = .030$). H3 and H4 were supported, whereas H1 and H2 were not.

Table 3. Multiple regression predicting environmental teaching practice

Predictor	B	SE	β	t	p	VIF
Constant	0.255	0.255		1.00	.319	
Knowledge (X1)	−0.004	0.024	−.008	−0.15	.882	1.12
Concern (X2)	−0.015	0.080	−.017	−0.18	.853	3.05
Self-efficacy (X3)	0.527	0.118	.499	4.45	< .001	4.43
Institutional support (X4)	0.424	0.077	.416	5.54	< .001	1.99

$R^2 = .685$; adjusted $R^2 = .674$; $F(4, 111) = 60.36$, $p < .001$.

Mediation results are reported in Table 4 and Figure 1. Concern predicted self-efficacy, and self-efficacy predicted practice. The indirect effect of concern through self-efficacy was significant, and the direct effect was not, indicating full mediation (H6 supported). Knowledge did not predict self-efficacy once concern and institutional support were controlled, and its indirect effect was not significant (H5 not supported). Without covariates, the

indirect effect of knowledge was small but significant (ab = 0.102, 95% CI [0.035, 0.174]), suggesting that the link between knowledge and self-efficacy overlaps with concern.

Table 4. Indirect effects of concern and knowledge on practice through self-efficacy

Path	a	b	c	c'	ab [95% CI]
Concern → Self-efficacy → Practice	0.500***	0.527***	0.248***	−0.015	0.263 [0.106, 0.421]
Knowledge → Self-efficacy → Practice	0.013	0.527***	0.003	−0.004	0.007 [−0.014, 0.030]

a = effect of predictor on self-efficacy; b = effect of self-efficacy on practice; c = total effect; c' = direct effect; ab = indirect effect with 5,000 percentile bootstrap samples. Covariates: knowledge and institutional support for the concern model; concern and institutional support for the knowledge model. *** p < .001.

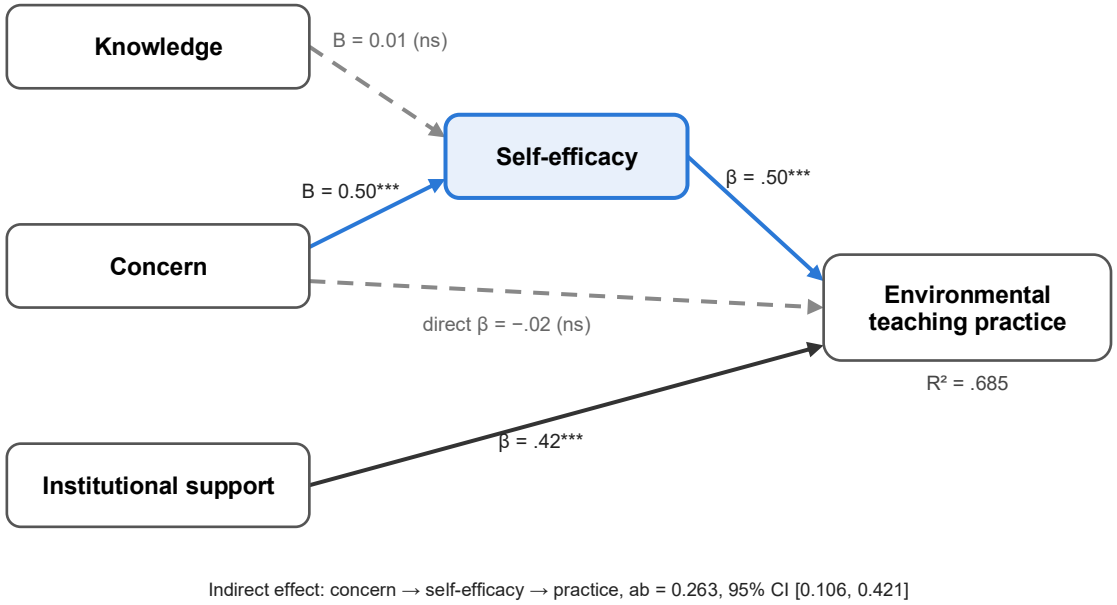

Figure 1. Path model of predictors of environmental teaching practice (N = 116). Solid lines indicate significant paths and dashed lines non-significant paths; B = unstandardised coefficient, β = standardised coefficient; *** p < .001

Group comparisons did not support H7. Teachers who had and had not attended environmental training did not differ on any variable (all p > .25), and neither did teachers in urban and rural institutions (all p > .28). When training frequency was examined in four groups, only knowledge differed, $F(3, 112) = 3.93$, $p = .010$, $\eta^2 = .095$. Teachers trained two to three times scored higher than those never trained ($p = .035$) and those trained once ($p = .006$), but did not differ from those trained more than three times, and training frequency was not correlated with knowledge ($\varrho = .09$, $p = .319$).

Cluster analysis produced three readiness profiles (Table 5 and Figure 2). Profile 1, low readiness (n = 18; 15.5%), scored low on all four dimensions. Profile 2, affective-practical with limited knowledge (n = 56; 48.3%), reported concern, self-efficacy, and practice close to those of Profile 3, yet its knowledge did not differ from Profile 1 ($p = .986$). Profile 3, high readiness (n = 42; 36.2%), scored highest on knowledge and concern; its self-efficacy ($p = .056$) and practice ($p = .239$) did not differ significantly from Profile 2. Institutional support, which was not used to form the clusters, followed the same order. Profile membership was related to educational background, $\chi^2(2) = 6.93$, $p = .031$, Cramér's V = .24: 41.4% of teachers with an early childhood education degree were in Profile 3, compared with 28.3% of other teachers, and only 8.6% were in Profile 1, compared with 26.1%. Profiles were not related to training history, location, or institutional status.

Table 5. Means (SD) of readiness dimensions across profiles

Variable	Profile 1 (n = 18)	Profile 2 (n = 56)	Profile 3 (n = 42)	F(2, 113)	η^2
Knowledge	6.67 (2.28)	6.73 (1.45)	10.52 (1.09)	87.29***	.61
Concern	1.68 (0.75)	3.96 (0.69)	4.44 (0.63)	107.98***	.66
Self-efficacy	2.00 (0.81)	3.99 (0.51)	4.25 (0.41)	119.73***	.68
Practice	1.97 (0.72)	3.81 (0.74)	4.04 (0.62)	61.19***	.52
Institutional support†	2.14 (0.94)	3.54 (0.84)	3.80 (0.66)	28.55***	.34

Profile 1 = low readiness; Profile 2 = affective-practical with limited knowledge; Profile 3 = high readiness. † Not used to form the clusters. *** p < .001.

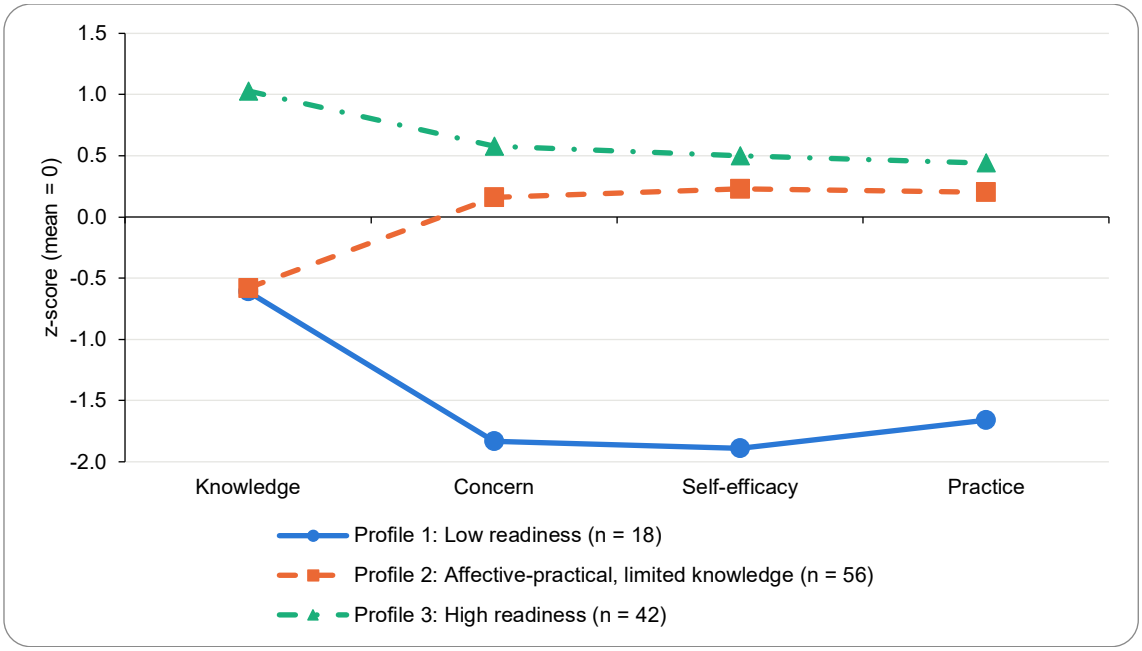

Figure 2. Standardised scores of the four readiness dimensions across the three profiles

Responses to the barrier item support these patterns. The most frequently selected barriers were limited facilities and outdoor space (47.4%), lack of training (34.5%), competing curriculum targets (28.4%), the perception that the topic is too heavy for children (25.9%), and limited personal knowledge (24.1%). In the open-ended item, teachers most often asked for practical training and concrete, age-appropriate media.

4. *Discussion*

The central finding is that environmental teaching practice in early childhood was driven by teachers' self-efficacy and institutional support rather than by their knowledge. Knowledge correlated only weakly with practice and lost its effect once other factors were controlled. This pattern supports the long-standing argument that information alone rarely translates into pro-environmental action, which also depends on internal factors such as motivation and values and on external factors such as institutional and social conditions (Kollmuss & Agyeman, 2002). A meta-analysis of psycho-social determinants of pro-environmental behaviour likewise found that attitudes, perceived behavioural control, and personal moral norms predict intention, whereas problem awareness works indirectly (Bamberg & Möser, 2007). It also agrees with the finding that cognitive factors influence climate teaching indirectly rather than directly (Tang, 2025). In early childhood settings, many environmental activities, such as planting or sorting waste, can be carried out as routines that do not require explicit climate concepts, which may explain why practice can be frequent even when knowledge is limited.

The second finding concerns the mechanism linking concern and practice. Concern was related to practice only through self-efficacy. Teachers who care about the environment act on that concern when they believe they can design activities, answer children's questions, and use the surroundings as learning resources. This interpretation echoes findings that pre-service teachers' intention to teach climate change rests mainly on their beliefs about its importance and their attitudes (Winter et al., 2026), and that practising teachers' confidence in guiding sustainability action is tied to how well they understand the content and how to teach it (Herranen & Aksela, 2024). Research on young people's climate engagement points in the same direction: constructive hope, which includes the belief that one's own actions make a difference, is associated with more pro-environmental behaviour (Ojala, 2012). Because concern and self-efficacy were closely related (HTMT = .847), this pathway should be read as strong but not fully separable, and longitudinal or intervention designs are needed to confirm it.

Third, institutional support emerged as nearly as important as teachers' own efficacy, even though it was the weakest dimension in the sample. Barriers reported by teachers were also largely institutional: limited facilities and space and competing curriculum targets. This is consistent with evidence that perceived classroom time and resources shape teachers' intention to teach climate change (Winter et al., 2026), that early childhood teachers look for age-appropriate, easy-to-use, and trustworthy resources when teaching climate topics (Beaver & Borgerding, 2023), and that institutional support predicts climate teaching among Indonesian secondary teachers (Tang, 2025). Studies of early childhood educators point in the same direction: Estonian kindergarten teachers who had not addressed climate change with children were linked to a need for clearer curriculum goals and training (Jõgi et al., 2024), and Irish educators were unsure whether their national curriculum framework included education for sustainable development (Collins & Garrity, 2025). For early childhood institutions, most of which in this sample were private, support from principals, written operational curricula, and access to gardens or waste-sorting facilities may be decisive.

Fourth, the study adds evidence on misconceptions among early childhood teachers. The confusion between ozone depletion and global warming found in two-thirds of teachers mirrors patterns reported among Indonesian

secondary teachers (Tang, 2025), Russian pre-service teachers (Fayzullina et al., 2024), German pre-service geography teachers (Hanke & Schmalor, 2025), secondary science teachers in Florida and Puerto Rico (Herman et al., 2017), in-service teachers in South Africa (Hebe, 2020), and United States science teachers, many of whom conveyed scientifically unsupported claims in class (Plutzer et al., 2016). Taken together, these studies indicate that the ozone misconception is not confined to one country or one group of subject teachers, and the present results show that it is also widespread among practising early childhood teachers, a group that comparative studies have rarely included. Because this study did not observe what teachers actually told children, it cannot show that misconceptions are passed on; however, effective climate education explicitly addresses misconceptions (Monroe et al., 2019), and a professional development study showed that elementary teachers' ozone-related misconceptions could be corrected with interactive climate models, which also raised their self-efficacy (Ibourk et al., 2025). Since the conceptions of pre-service early childhood teachers are shaped by their community funds of knowledge and identities (Spiteri, 2026), teacher education may need to address the everyday sources of climate ideas as well as scientific content.

The profile analysis adds a perspective that average relationships cannot show. Teachers in Profile 2 reported practice almost as frequent as the most ready teachers, yet their knowledge was as low as that of the least ready group. For this group, environmental activities seem to be sustained by concern, confidence, and routines rather than by conceptual understanding. This matters because young children's questions about floods, heat, or rubbish often require short but accurate explanations. Professional development frameworks for early childhood sustainability emphasise a scientific, action-integrated cornerstone alongside community-based and value-oriented work (Bascopé et al., 2019), and early childhood teachers look for trustworthy sources that can improve their own climate knowledge (Beaver & Borgerding, 2023). Story reading alone may not fill this gap, because children's picture books on climate change tend to lack informational content (Benevento, 2023). By contrast, children in STEM-oriented preschools explained climate-related ideas, such as the role of trees in absorbing carbon dioxide, more accurately than their peers in other preschools (Ramulumo & Shabalala, 2025), which indicates that content-rich provision makes a difference to what children understand. Profile 2 is therefore a natural target for content-focused support that builds on, rather than replaces, its existing practice.

The comparison with Indonesian secondary teachers is also instructive. In that study, attitudes were the strongest direct predictor of willingness to teach climate change (Tang, 2025), whereas in the present study concern had no direct effect on practice once self-efficacy was considered. One explanation is the difference in outcomes: willingness to teach reflects intention, while the frequency of activities reflects enacted practice, which may depend more on confidence and available resources. Another is the nature of early childhood teaching, in which environmental themes are woven into play and routines, so teachers' sense that they can manage such activities may weigh more than their feelings about the issue. Both explanations remain tentative and should be examined in studies that measure intention and practice together.

Finally, training history did not distinguish teachers' readiness, whereas educational background did. Only the frequency of training was recorded, so the result does not indicate that training is ineffective; it suggests that attendance alone is not enough. Professional development for sustainability in early childhood is more promising when it combines experiential, outdoor, and project-based approaches with value-oriented reflection (Bascopé et al., 2019), and teachers tend to feel least efficacious about supporting students' action for sustainability (Herranen & Aksela, 2024). Similar patterns appear in pre-service teacher education. Turkish early childhood pre-service teachers showed only moderate efficacy for teaching sustainable development, and sustainability coursework did not significantly influence it (Köklü Yaylaçı & Olgan, 2021). Student teachers in several countries felt less prepared to teach for sustainability than for other professional tasks, with large differences between programmes (Dahl, 2019), whereas taking dedicated courses improved several self-efficacy factors (Handtke et al., 2022). Professional development is more likely to change practice when it is content-focused, active, coherent, sustained, and collective (Desimone, 2009). The finding that graduates of early childhood education programmes were more likely to belong to the high-readiness profile highlights the role of initial teacher education in providing both accurate concepts and pedagogical confidence.

These findings carry implications for teacher educators, trainers, and institution leaders. Teacher education programmes should combine accurate climate concepts, such as the difference between weather and climate and the role of greenhouse gases, with experiences in designing play-based activities and with systems thinking about shared responsibility for climate action, which pre-service teachers often oversimplify (Tolppanen & Kärkkäinen, 2021). In-service training should build self-efficacy through hands-on practice and concrete media, which matches the support teachers requested. For principals and managers of early childhood institutions, the barriers reported in this study point to concrete steps. Where outdoor space is limited, small-scale provisions such as container or vertical gardens, a waste-sorting corner, and composting bins, together with regular visits to nearby parks, gardens, or community spaces, can provide the settings that environmental activities require. Environmental themes can be written into the institution's operational curriculum and weekly schedule so that they no longer compete with other curriculum targets. Principals can also allocate part of the budget to low-cost, age-appropriate media, hold regular peer learning sessions in which teachers plan and review environmental activities together, and build partnerships with parents, local environmental agencies, and green school programmes such as Adiwiyata. These steps follow the whole-school logic that links sustainability education with leadership and organisation (Mogren et al., 2019), the collective and

sustained features of effective professional development (Desimone, 2009), and the community-of-practice approach observed in kindergarten gardening and foraging projects (Bergan et al., 2021), in line with the call for climate education that is relevant, hands-on, and community-based (Monroe et al., 2019).

Several limitations should be noted. The cross-sectional design does not allow causal conclusions about mediation. Practice was self-reported rather than observed. The snowball sample was unevenly distributed across provinces and dominated by young, early-career teachers in private institutions, which limits generalisation. Harman's test showed that a single factor explained 45.2% of the variance across all items, below the 50% threshold, but 62.0% when only the Likert items were analysed, so common method variance cannot be ruled out (Podsakoff et al., 2003). The reliability of the knowledge test was moderate, four reverse-worded items had to be excluded, and the three-cluster solution was chosen on theoretical grounds although the two-cluster solution had a higher silhouette value (.50 vs .31).

5. Conclusion

Indonesian early childhood teachers' environmental and climate teaching practice is driven mainly by their self-efficacy and by the support of their institutions, while their knowledge plays little role and misconceptions remain common. Teachers' concern for the environment becomes practice when it is accompanied by confidence in their teaching ability. The largest group of teachers teaches environmental themes frequently despite limited climate knowledge, which shows that readiness is uneven rather than simply high or low. Teacher education and professional development should therefore build accurate climate concepts and teaching efficacy together, and early childhood institutions should provide leadership, curricula, and facilities that make environmental learning part of daily practice. In practical terms, principals and managers can respond to the limited facilities and open space reported by teachers by creating small learning spaces such as container gardens and waste-sorting corners, making regular use of nearby community spaces, writing environmental themes into the operational curriculum and weekly schedule, allocating funds for concrete learning media, and organising regular peer learning among teachers. Future research should observe classroom practice, examine what teachers communicate to children, and test interventions that strengthen self-efficacy and institutional support over time.

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7. References

Afwanni, T., Alim, R. N., & Cholimah, N. (2024). The role of parenting in cultivating environmental attitudes in early childhood in digital era. *Jurnal Pendidikan Usia Dini*, *18*(2), 389–397. https://doi.org/10.21009/jpud.v18i2.46213

Ardoin, N. M., & Bowers, A. W. (2020). Early childhood environmental education: A systematic review of the research literature. *Educational Research Review*, *31*, 100353. https://doi.org/10.1016/j.edurev.2020.100353

Bamberg, S., & Möser, G. (2007). Twenty years after Hines, Hungerford, and Tomera: A new meta-analysis of psycho-social determinants of pro-environmental behaviour. *Journal of Environmental Psychology*, *27*(1), 14–25. https://doi.org/10.1016/j.jenvp.2006.12.002

Bandura, A. (1997). *Self-efficacy: The exercise of control*. W. H. Freeman.

Bascopé, M., Perasso, P., & Reiss, K. (2019). Systematic review of education for sustainable development at an early stage: Cornerstones and pedagogical approaches for teacher professional development. *Sustainability*, *11*(3), 719. https://doi.org/10.3390/su11030719

Beaver, B. C., & Borgerding, L. A. (2023). Climate change education in early childhood classrooms: A nature-based approach. *International Journal of Early Childhood Environmental Education*, *11*(1), 3–19. https://eric.ed.gov/?id=EJ1410621

Benevento, S. V. (2023). Communicating climate change risk to children: A thematic analysis of children's literature. *Early Childhood Education Journal*, *51*, 201–210. https://doi.org/10.1007/s10643-021-01294-y

Bergan, V., Krempig, I. W., Utsi, T. A., & Bøe, K. W. (2021). I want to participate—Communities of practice in foraging and gardening projects as a contribution to social and cultural sustainability in early childhood education. *Sustainability*, *13*(8), 4368. https://doi.org/10.3390/su13084368

Borg, F., & Pramling Samuelsson, I. (2022). Preschool children's agency in education for sustainability: The case of Sweden. *European Early Childhood Education Research Journal*, *30*(1), 147–163. https://doi.org/10.1080/1350293X.2022.2026439

Chandrawati, T., & Aisyah, S. (2022). ECE educator training: How to develop literacy and environment education for children? *Jurnal Pendidikan Usia Dini*, *16*(1), 133–148. https://doi.org/10.21009/JPUD.161.09

Collins, S., & Garrity, S. (2025). Early childhood educators' understanding of education for sustainable development. *Irish Educational Studies*, *44*(2), 281–299. https://doi.org/10.1080/03323315.2023.2266688

Dahl, T. (2019). Prepared to teach for sustainable development? Student teachers' beliefs in their ability to teach for sustainable development. *Sustainability*, *11*(7), 1993. https://doi.org/10.3390/su11071993

Dawson, V., Eilam, E., Tolppanen, S., Assaraf, O. B. Z., Gokpinar, T., Goldman, D., Putri, G. A. P. E., Subiantoro, A. W., White, P., & Widdop Quinton, H. (2022). A cross-country comparison of climate change in middle school science and geography curricula. *International Journal of Science Education*, *44*(9), 1379–1398. https://doi.org/10.1080/09500693.2022.2078011

Desimone, L. M. (2009). Improving impact studies of teachers' professional development: Toward better conceptualizations and measures. *Educational Researcher*, *38*(3), 181–199. https://doi.org/10.3102/0013189X08331140

Fadhilah, Waluyo, E., & Formen, A. (2026). Curriculum development for early childhood education based on greening adaptation for coastal environmental resilience: A case study of rob disaster in Tirto Subdistrict. *Jurnal Pendidikan Usia Dini*, *20*(1), 159–171. https://doi.org/10.21009/jpud.v20i1.58625

Fayzullina, A. R., Khrisanova, E. G., Kashina, S. G., Savchenko, N. V., Terenichenko, A. A., & Tsomartova, E. S. (2024). Knowledge of ozone depletion and climate change: An empirical research from Russian pre-service teachers. *Eurasia Journal of Mathematics, Science and Technology Education*, *20*(11), em2536. https://doi.org/10.29333/ejmste/15629

Gerde, H. K., Pierce, S. J., Lee, K., & Van Egeren, L. A. (2018). Early childhood educators' self-efficacy in science, math, and literacy instruction and science practice in the classroom. *Early Education and Development*, *29*(1), 70–90. https://doi.org/10.1080/10409289.2017.1360127

Güler Yıldız, T., Öztürk, N., İlhan İyi, T., Aşkar, N., Banko Bal, Ç., Karabekmez, S., & Höl, Ş. (2021). Education for sustainability in early childhood education: A systematic review. *Environmental Education Research*, *27*(6), 796–820. https://doi.org/10.1080/13504622.2021.1896680

Hair, J. F., Risher, J. J., Sarstedt, M., & Ringle, C. M. (2019). When to use and how to report the results of PLS-SEM. *European Business Review*, *31*(1), 2–24. https://doi.org/10.1108/EBR-11-2018-0203

Hakim, A., Efwinda, S., Damayanti, P., Syam, M., Mutmainah, O., & Norsaputra, A. (2023). Improving climate literacy of high school students through physics teaching materials based on STEM. *Jurnal Pendidikan IPA Indonesia*, *12*(4), 526–537. https://doi.org/10.15294/jpii.v12i4.43188

Handtke, K., Richter-Beuschel, L., & Bögeholz, S. (2022). Self-efficacy beliefs of teaching ESD: A theory-driven instrument and the effectiveness of ESD in German teacher education. *Sustainability*, *14*(11), 6477. https://doi.org/10.3390/su14116477

Hanke, M., & Schmalor, H. (2025). (Un-)certain knowledge of pre-service geography teachers about climate change. *Journal of Geoscience Education*, *73*(1), 75–87. https://doi.org/10.1080/10899995.2024.2409605

Hayes, A. F. (2022). *Introduction to mediation, moderation, and conditional process analysis: A regression-based approach* (3rd ed.). Guilford Press.

Hebe, H. (2020). In-service teachers' knowledge and misconceptions of global warming and ozone layer depletion: A case study. *Journal for the Education of Gifted Young Scientists*, *8*(1), 133–149. https://doi.org/10.17478/jegys.618491

Hedefalk, M., Almqvist, J., & Östman, L. (2015). Education for sustainable development in early childhood education: A review of the research literature. *Environmental Education Research*, *21*(7), 975–990. https://doi.org/10.1080/13504622.2014.971716

Henseler, J., Ringle, C. M., & Sarstedt, M. (2015). A new criterion for assessing discriminant validity in variance-based structural equation modeling. *Journal of the Academy of Marketing Science*, *43*(1), 115–135. https://doi.org/10.1007/s11747-014-0403-8

Herman, B. C., Feldman, A., & Vernaza-Hernandez, V. (2017). Florida and Puerto Rico secondary science teachers' knowledge and teaching of climate change science. *International Journal of Science and Mathematics Education*, *15*(3), 451–471. https://doi.org/10.1007/s10763-015-9706-6

Herranen, J., & Aksela, M. (2024). Fostering teachers as sustainability and climate change educators through understanding of teachers' self-efficacy beliefs. *LUMAT: International Journal on Math, Science and Technology Education*, *12*(3), 30–52. https://journals.helsinki.fi/lumat/article/view/2085https://doi.org/10.31129/LUMAT.12.3.2085

Hickman, C., Marks, E., Pihkala, P., Clayton, S., Lewandowski, R. E., Mayall, E. E., Wray, B., Mellor, C., & van Susteren, L. (2021). Climate anxiety in children and young people and their beliefs about government responses to climate change: A global survey. *The Lancet Planetary Health*, *5*(12), e863–e873. https://doi.org/10.1016/S2542-5196(21)00278-3

Hu, H. (2026). Contemporary pedagogical approaches to climate change education in kindergarten. *Journal of Outdoor and Environmental Education*. Advance online publication. https://doi.org/10.1007/s42322-025-00233-4

Ibourk, A., Wagner, L., & Zogheib, K. (2025). Developing elementary teachers' climate change knowledge and self-efficacy for teaching climate change using learning technologies. *Journal of Science Education and Technology*, *34*(3), 504–520. https://doi.org/10.1007/s10956-024-10187-9

Jõgi, K., Kikkas, A., & Kiisk, M. (2024). Õpetajate hinnangud oma teadmistele ning arvamused kliimamuutustest ja teema käsitlemisvõimalustest lasteaias [Kindergarten teachers' opinions on dealing with the topic of climate change]. *Eesti Haridusteaduste Ajakiri. Estonian Journal of Education*, *12*(2), 109–131. https://doi.org/10.12697/eha.2024.12.2.05

Khalidi, R., & Ramsey, J. (2021). A comparison of California and Texas secondary science teachers' perceptions of climate change. *Environmental Education Research*, *27*(5), 669–686. https://doi.org/10.1080/13504622.2020.1838447

Köklü Yaylaçı, H., & Olgan, R. (2021). Investigating early childhood preservice teachers' personal teaching efficacy and outcome-expectancy beliefs regarding education for sustainable development in Turkey. *The Teacher Educator*, *56*(1), 4–24. https://doi.org/10.1080/08878730.2020.1767742

Kollmuss, A., & Agyeman, J. (2002). Mind the gap: Why do people act environmentally and what are the barriers to pro-environmental behavior? *Environmental Education Research*, *8*(3), 239–260. https://doi.org/13504620220145401

Meilinda, M., Rustaman, N. Y., & Tjasyono, B. (2017). The perceptions of pre-service science teachers and science teachers about climate change. *Jurnal Pendidikan IPA Indonesia*, *6*(2), 292–297. https://doi.org/10.15294/jpii.v6i2.9490

Mogren, A., Gericke, N., & Scherp, H.-Å. (2019). Whole school approaches to education for sustainable development: A model that links to school improvement. *Environmental Education Research*, *25*(4), 508–531. https://doi.org/10.1080/13504622.2018.1455074

Monroe, M. C., Plate, R. R., Oxarart, A., Bowers, A., & Chaves, W. A. (2019). Identifying effective climate change education strategies: A systematic review of the research. *Environmental Education Research*, *25*(6), 791–812. https://doi.org/10.1080/13504622.2017.1360842

Moseley, C., Utley, J., Angle, J., & Mwavita, M. (2016). Development of the Environmental Education Teaching Efficacy Belief Instrument. *School Science and Mathematics*, *116*(7), 389–398. https://doi.org/10.1111/ssm.12189

Ojala, M. (2012). Hope and climate change: The importance of hope for environmental engagement among young people. *Environmental Education Research*, *18*(5), 625–642. https://doi.org/10.1080/13504622.2011.637157

Petkou, D., Kounani, A., Tsiouni, M., & Afedoulidou, E. (2025). Can sustainable schools influence environmental consciousness and behavior in early childhood? The perspectives of early childhood educators. *Education Sciences*, *15*(7), 916. https://doi.org/10.3390/educsci15070916

Plutzer, E., Branch, G., & Townley, A. L. (2024). Climate change education in U.S. middle schools: Changes over five pivotal years. *Journal of Microbiology & Biology Education*, *25*(2), e00015-24. https://doi.org/10.1128/jmbe.00015-24

Plutzer, E., McCaffrey, M., Hannah, A. L., Rosenau, J., Berbeco, M., & Reid, A. H. (2016). Climate confusion among U.S. teachers. *Science*, *351*(6274), 664–665. https://doi.org/10.1126/science.aab3907

Podsakoff, P. M., MacKenzie, S. B., Lee, J.-Y., & Podsakoff, N. P. (2003). Common method biases in behavioral research: A critical review of the literature and recommended remedies. *Journal of Applied Psychology*, *88*(5), 879–903. https://doi.org/10.1037/0021-9010.88.5.879

Priadi, A., & Fatria, E. (2024). The development of early childhood naturalist intelligence through environmental education. *Jurnal Pendidikan Usia Dini*, *18*(1), 30–52. https://doi.org/10.21009/JPUD.181.03

Ramulumo, M., & Shabalala, N. P. (2025). Comparing environmental literacy in STEM and non-STEM preschools: Evaluating the impact on young children's understanding and attitudes. *International Journal of Early Childhood*, *57*(2), 447–462. https://doi.org/10.1007/s13158-024-00405-1

Rousell, D., & Cutter-Mackenzie-Knowles, A. (2020). A systematic review of climate change education: Giving children and young people a 'voice' and a 'hand' in redressing climate change. *Children's Geographies*, *18*(2), 191–208. https://doi.org/10.1080/14733285.2019.1614532

Setyaningsih, D., Handasah, R. R., Mamma, A. T., Krobo, A., Olua, E., & Iryouw, V. (2024). Fostering eco-literacy and naturalistic intelligence through environmentally based education in coastal preschool. *Jurnal Pendidikan Usia Dini*, *18*(1), 251–269. https://doi.org/10.21009/JPUD.181.18

Sibagariang, P. P., & Pandia, W. S. S. (2021). Teaching approach and teacher self-efficacy during early childhood distance learning. *Jurnal Pendidikan Usia Dini*, *15*(1), 41–59. https://doi.org/10.21009/JPUD.151.03

Spiteri, J. (2026). Pre-service ECEC teachers' conceptions of climate change: A community funds of knowledge and identity approach. *Education 3-13*, *54*(3), 529–543. https://doi.org/10.1080/03004279.2024.2322999

Spurk, D., Hirschi, A., Wang, M., Valero, D., & Kauffeld, S. (2020). Latent profile analysis: A review and "how to" guide of its application within vocational behavior research. *Journal of Vocational Behavior*, *120*, 103445. https://doi.org/10.1016/j.jvb.2020.103445

Tang, K. (2025). Teacher conceptions of climate change and their role in climate change education: Insights from Indonesian upper-secondary teachers. *Discover Sustainability*, *6*, 486. https://doi.org/10.1007/s43621-025-01334-2

Tolppanen, S., & Kärkkäinen, S. (2021). The blame-game: Pre-service teachers views on who is responsible and what needs to be done to mitigate climate change. *International Journal of Science Education*, *43*(14), 2402–2425. https://doi.org/10.1080/09500693.2021.1965239

UNICEF. (2021). *The climate crisis is a child rights crisis: Introducing the Children's Climate Risk Index*. UNICEF. https://www.unicef.org/reports/climate-crisis-child-rights-crisis

Warmansyah, J., Komalasari, E., Febriani, E., Gusmiati, & Amalina. (2022). Factors affecting teacher readiness for online learning (TROL) in early childhood education: TISE and TPACK. *Jurnal Pendidikan Usia Dini*, *16*(1), 32–51. https://doi.org/10.21009/JPUD.161.03

Weldemariam, K., Boyd, D., Hirst, N., Sageidet, B. M., Browder, J. K., Grogan, L., & Hughes, F. (2017). A critical analysis of concepts associated with sustainability in early childhood curriculum frameworks across five national contexts. *International Journal of Early Childhood*, *49*(3), 333–351. https://doi.org/10.1007/s13158-017-0202-8

Widyastuti, N., Suminar, T., & Waluyo, E. (2024). The role of transformational leaders in improving the quality of early childhood education. *Jurnal Pendidikan Usia Dini*, *18*(2), 322–349. https://doi.org/10.21009/jpud.v18i2.49615

Winter, V. A., Büssing, A., Gericke, N., & Möller, A. (2026). Pre-service teachers and climate change education: A belief-intention gap yet to be bridged. *Environmental Education Research*. Advance online publication. https://doi.org/10.1080/13504622.2025.2608774

Wolff, L.-A., Skarstein, T. H., & Skarstein, F. (2020). The mission of early childhood education in the Anthropocene. *Education Sciences*, *10*(2), 27. https://doi.org/10.3390/educsci10020027

Zee, M., & Koomen, H. M. Y. (2016). Teacher self-efficacy and its effects on classroom processes, student academic adjustment, and teacher well-being: A synthesis of 40 years of research. *Review of Educational Research*, *86*(4), 981–1015. https://doi.org/10.3102/0034654315626801