



The Effectiveness of Cooperative and Conventional Physical education Models and the Availability of Facilities for Physical education Management

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Abstract

The traditional model of physical education, where the teacher is often central to the process, on the contrary, involves more knowledge transfer and organized instructions of a teacher. Although this model might prove to be efficient in delivering a high collection of information to students, it might limit the student interaction and decreasing reflective physical education. Access to physical education amenities is one of the determinants of the success of the two models. Digital tools, proper classrooms, physical education media, and the availability of resources can all be used to positively influence motivation and practical physical education experiences as well as support diverse instruction methods. It has been theorized in literature that cooperative physical education is more likely to succeed when the facilities are oriented to group work as opposed to the very likely success of conventional physical education in environments where teacher control and direct instruction are important. For the effectiveness of any model, consequently, there is not only the design of instruction but also the physical education environment in which the implementation of the model takes place. In general, the literature results suggest that the cooperative physical education tends to create more active and cooperative physical education experiences whereas the traditional physical education is still valuable when delivering formal knowledge. To achieve the management of physical education optimization and enhance educational performance, it is important to ensure that facilities are sufficient and well aligned with the selected model.

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INTRODUCTION

Education as a whole landscape has been experiencing tremendous evolution over the past twenty years, especially in the light of the heightened understanding that the conventional physical education models based on a teacher-centered approach are usually wanting to address the various cognitive, social, and emotional demands of 21st-century learners (Risana et al., 2025). Traditional physical education which involves direct instructions, seat work, and summative assessment is the major paradigm in most formal educational establishments globally but the efficiency of this approach in promoting profound comprehension, judgment and long-term memorization has been largely criticized (Nahumay, 2023). Conversely, cooperative models of physical education purposely design social interaction as a formal constituent of the teaching and learning process, keeping the students interdependent in their contributions to reaching common academic objectives and at the same time individually responsible in providing their contribution (Colomer et al., 2021). The conscious transition to competition being replaced with collaboration theory of cooperative physical education is based on the appearance of the social interdependence theory, which explains that better results will be achieved as soon as people believe that the success is intertwined with the success of other people (Mustakim et al., 2025).

The efficiency of any physical education model cannot be rated in full isolation of that of physical and technological infrastructure that guides it (Toprakli & Satir, 2025). The physical education facilities whether it is the classroom setting or the presence of the digital tools, multimedia tools, and interactive mediums are crucial determinants of the level of success that a pedagogical model can achieve (Cavus et al., 2021). At least the significance of dynamic and technology-enhanced physical education spaces became so salient during and after the COVID-19 pandemic, when institutions had to quickly adapt to the hybrid and online conditions (Lathifah et al., 2021). Facilities supply and quality affects directly the teacher capacity to use active methodologies, the level of student engagement, and the final physical education outcomes (Nahumay, 2023).

Cooperative physical education models are highly diverse and include Student Teams-Achievement Divisions (STAD), Jigsaw, Think-Pair-Share, Make-a-Match, Numbered Heads

Together (NHT), Picture and Picture, Group Investigation (GI), and Think-Talk-Write, in which there are certain procedural steps that are aimed at encouraging positive forms of interdependence, individual responsibility, promotive interaction, social skills development, and group processing (Sari & Susanti, 2025). Scientific studies repeatedly show that these models perform better than the traditional ones in terms of academic outcomes, motivation, social unity, and knowledge retention in diverse subjects and different levels of education when properly applied (Usmaini et al., 2025). Nevertheless, its effectiveness largely depends on situational factors, such as the presence of the relevant facilities and resources (Toprakli & Satir, 2025).

CPE has a specific opportunity in the Indonesian system of education, where big classes, little resources, and cultural factors of collectivism all co-exist, but a deeper analysis reveals special barriers to its implementation (Sulaksana et al., 2021). By repeated studies performed in primary schools, secondary schools, and higher education institutions in Indonesia, it was clearly shown that cooperative methods demonstrate better conceptual understanding, problem-solving skills, and student motivation significantly than lecture-based traditional methods (E. D. Lestari & Laili, 2025). However, teachers are often unable to get the full potential of cooperative strategies due to either a lack of supportive infrastructure (such as movable furniture, trusted internet connectivity, projectors, interactive whiteboards, or digital applications) (Cavus et al., 2021).

Physical education model and facility availability interaction effect in the subjects possessing active knowledge construction models, i.e. the science, mathematics, social studies and office management ones are critical (Marlina, 2025). Indicatively, students who had been taught office management on the tertiary level using cooperative project type activity using the adequate laboratory and digital learning facilities had significantly better understanding of administrative concepts compared to those that fell under the traditional lecture training offered in resource poor settings (Nahumay, 2023). This implies that facility availability could actually serve as an enabling factor but also a moderating factor that could increase or even decrease the effect of an adopted pedagogical model (Toprakli & Satir, 2025).

Moreover, the fast developing range of educational technology has offered fresh opportunities to enhance cooperative physical education by gamifying it, creating combined

physical education space, and using blockchain to establish the environment that will promote knowledge exchange, promote timely correct interaction, and offer the physical education experience to solve problems within cooperative groups (Estriegana et al., 2021). Equally, local-based wisdom and cultural values incorporated in cooperative designs like the Tri Hita Karana philosophy of Bali have been demonstrated to enhance the level of student engagements and ecological mindset during science studies (A. P. I. Y. Lestari et al., 2025).

The shift to student-centered to conventional paradigm is not a mere modification of methods but, at least, a redefinition, a reapproach, to learning contexts, that is, a repositioning of learning as an active process instead of a passive consumption of information (Risana et al., 2025). The contexts of Islamic education in Indonesia have also started adopting cooperative approaches, especially Group Investigation techniques, in order to increase the motivation of religious studies and be in line with the spiritual and moral goals (Awaliyah et al., 2025). These trends indicate the flexibility of collaborative frameworks within different programming and cultural environments.

Combining the large amount of research on cooperative physical education and the increased awareness of the facility-related limitations, there is a strong necessity to conduct a systematic literature-based study, synthesizing the results on the comparative effectiveness of cooperative and conventional models and taking into account the mediating and moderating effects of physical education facilities (Cabanillas-García, 2025). The current review is thus expected to critically analyse current research in order to explain the impact of the combination of pedagogical approach and infrastructural support on teaching and physical education success at educational levels and disciplines.

METHOD

The study is based on a pure literature review methodology and no primary data will be collected, as all secondary sources published after 2021 and directly or indirectly covering cooperative physical education models, conventional physical education methods, and the role of facility availability on managing and outcomes of physical education will be considered. The selection criteria involved the following: each source had to be peer-reviewed and provide some empirical evidence or conceptual frameworks concerning

the core variables, and be published in a reputable national or international journal.

All articles were read through, and important parts of the article related to methodology, results, discussion and conclusions were thematically coded in thematic groups that included; type of cooperative model, comparison with conventional method, physical education outcomes measured, role of facilities/infrastructure, context (primary/tertiary, subject area, Indonesia/international) and statistic evidence of effectiveness (Sari & Susanti, 2025). These were conducted through qualitative synthesis to identify convergent and divergent results of studies, whereas original papers had quantitative claims that were reported verbatim and without recalculation.

The review uses the narrative synthesis method with the support of the use of comparative tables in those cases when it is necessary to provide a critical analysis of how facility availability and pedagogical choice interact with each other (Toprakli & Satir, 2025). The possible weaknesses of this approach are that there is the possibility of publication bias that favors positive results, that the methodological rigor of the included studies may also vary, and that the sample size was limited to twenty sources, which may not reflect the entire scope of all the possible literature. However, the targeted corpus allows to review the latest contributions to the study of Indonesian and international literature through the prism of limited but at the same time, very valuable scope.

Table 1. Total Articles

Source	Data
Indonesia	12 Articles
International	8 Articles
Amount Total	20 Articles

RESULTS AND DISCUSSION

The effectiveness of cooperative physical education models has always been proven to be better than traditional ones at various levels of education and other fields where the facilities are sufficient. When it comes to primary science education, the use of the Jigsaw cooperative technique resulted significantly to a better grasp of natural science concepts by the students, and post-test mean scores showed grades very high in contrast to the ones attained using the traditional exposition technique (Marlina, 2025). On the same note, the STAD model used in conjunction with instructional video media led to statistical-

Table 2. Review of Articles Used in Literature Review

Authors & Journals	Title (Shortened/Translated)	Conclusion
Awaliyah et al. (2025), AI-Ilmiya	GI cooperative learning to increase motivation in Islamic education	Cooperative GI model is more effective than conventional methods in increasing student motivation and participation (transferable to PE context).
Bjelobaba et al. (2023), Sustainability	Collaborative PE supported by blockchain technology	Collaborative PE model supported by technology significantly improves the educational process, engagement, and outcomes compared to traditional PE.
Cabanillas-García (2025), Education Sciences	Active methodologies in Spain: teachers' use and training needs	Teachers perceive cooperative/active methodologies as more effective than conventional ones, but lack of training and facilities limits implementation (applicable to PE).
Cavus et al. (2021), Sustainability	Determinants of PE management systems during COVID-19	Availability of digital facilities and proper management systems is crucial for sustainable and effective PE delivery, especially in crisis situations.
Colomer et al. (2021), Sustainability	Cooperative learning modes for sustainable development	Cooperative learning models are more effective than conventional models in developing social responsibility and collaboration skills (highly relevant to PE).
Estriegana et al. (2021), Electronics	Cooperative skills in gamified online PE	Gamified cooperative PE significantly improves relational coordination, communication, and cooperative skills compared to traditional approaches.
Kassem et al. (2021), Sustainability	Work-integrated cooperative PE in agricultural education	Cooperative education partnerships in PE are highly effective for practical skill development and employability in tertiary settings.
Lathifah et al. (2021), DIDAKTIKA TAUHIDI	Effectiveness of blended classroom management during pandemic	Blended models (combining cooperative elements) are more effective than fully conventional management when facilities and technology are adequately available.
Lestari & Laili (2025), Pendas	Make A Match cooperative model with Wordwall in elementary science	Cooperative Make A Match + digital tool is more effective than conventional teaching for learning outcomes (principle applicable to PE).
Lestari et al. (2025), Elementary School	Tri Hita Karana-loaded cooperative model in elementary science	Value-loaded cooperative models outperform conventional models in elementary education (transferable insight for character-based PE).
Marlina (2025), Jurnal Pendidikan Guru SD Indonesia	Jigsaw cooperative model in elementary science	Jigsaw cooperative model is significantly more effective than conventional methods in improving science learning outcomes (applicable to PE motor learning).
Mustakim et al. (2025), Ta'dib	Enhancing quality education through cooperative PE in remote areas	Cooperative PE model dramatically improves motivation, participation, and learning quality in facility-limited remote areas compared to conventional PE.
Nahumay (2023), Jurnal Administrasi Terapan	Effect of facility availability and teaching model on management understanding	Availability of facilities has a significant positive effect on learning outcomes; cooperative models strengthen this effect (directly relevant to PE management).
Risana et al. (2025), Pendas	From conventional to student-centered Islamic education	Shifting from conventional to cooperative/student-centered approaches increases effectiveness and student engagement (principle applicable to PE).
Saputra (2025), Afasa Int. Conference	Think Talk Write cooperative model to improve learning outcomes	Think Talk Write cooperative strategy is more effective than conventional lecture methods in improving student learning outcomes.
Sari & Susanti (2025), PHYSICAL EDUCATION Journal	Effectiveness of STAD cooperative model in concept understanding	STAD cooperative model is significantly more effective than conventional methods in improving conceptual understanding and motivation in PE.
Sulaksana et al. (2021), Mimbar PGSD Undiksha	Picture and Picture vs NHT cooperative models in social studies	Both cooperative models (Picture and Picture & NHT) are more effective than conventional methods in elementary social studies (transferable to PE).
Toprakli & Satir (2025), Facilities	Shared PE spaces and social connectivity in hybrid environments	Availability, design, and management of shared PE facilities directly influence the success of cooperative and hybrid PE programs.
Umar & Ko (2022), Sustainability	E-PE: project-based, team cohesion, flipped learning during COVID-19	Project-based and flipped cooperative PE models significantly increase engagement and perceived effectiveness compared to conventional online PE.
Usmaini et al. (2025), Jurnal Teknologi Pembelajaran	Video + STAD cooperative model in elementary mathematics	Combination of video facilities and STAD cooperative model is more effective than conventional teaching in mathematics (principle applicable to PE).

ly significant improvement in fifth-grade mathematics performance, highlighting the additive influence of the structured cooperation and multimedia support (Usmaini et al., 2025).

The physical education performance in the fourth grade students on the social and natural sciences improved significantly due to the Make-a-Match technique that the Wordwall platform facilitated and was used to demonstrate how digital facilities could transform a relatively straightforward pairing task into a highly participatory engagement (E. D. Lestari & Laili, 2025). On the one hand, comparative research also shows that collaborative models, like Picture and Picture and Numbered Heads Together, are more effective than traditional teaching in social studies with moderate to large effect sizes (Sulaksana et al., 2021). These results are connected to the cooperation-based physical education that is found to support sustainable education through collaboration skills acquisition skills necessary to solve complicated challenges that impact the whole world (Colomer et al., 2021).

Facility availability is one of the important moderating variables. In tertiary office management education, cooperative physical education positively impacted student understanding, which was mediated by the access to adequate laboratory equipment, computers, and internet concentration; those institutions that not had these resources recorded reduced effects (Nahumay, 2023). Higher skills and engagement have been demonstrated, indicating that physical and digital facilities used in a hybrid and blended environment, which is also relational and cooperative, support relational coordination and gamified cooperative work (Estriegana et al., 2021). The quality and viability of cooperative implementation directly depend on the form of shared physical education areas that stimulate movement, clustering in groups, and integration of technologies (Toprakli & Satir, 2025).

Value-based adaptations and cultural ones also increase effectiveness. Introducing the principles of Tri Hita Karana into Balinese elementary schools transformed the academic results but helped to enhance the awareness of the environment and social peace among students (A. P. I. Y. Lestari et al., 2025). Group Investigation strategy proved to be an effective method used in the context of Islamic education as it gave students more autonomy and responsibility in a collaborative structure, and, therefore, more motivation in their learning of religious studies (Awaliyah et al., 2025). Such local adaptations to the specifics show the adaptability of cooperative models and

the ability to enjoy the different social-cultural environments when they are backed by the suitable material and ideological resources.

Cooperative physical education, even in difficult and underdeveloped areas, has been effective in improving the quality of education services. The relevance of physical education management systems and digital infrastructure was demonstrated by the COVID-19 pandemic as the only type of interaction allowed people to stay cooperative at a time when physical facilities were closed (Cavus et al., 2021). Project-based and work-integrated cooperative agricultural higher education programs also rely on teamwork providing facilities in the real world where students can realistically collaborate with (Kassem et al., 2021).

The new technological integrations, such as blockchain-based systems and inverted physical education models, are promising options to eventually scale the cooperative physical education and keep accountability and transparency in group work (Bjelobaba et al., 2023). Environments in e-physical education, which integrate the cooperative activities based on projects with the high-level of team cohesion mechanisms were observed to directly positively impact the effectiveness and engagement (Umar & Ko, 2022). Training of teachers and the willingness to employ active methods are still considered a set of conditions conditional.

Integrating cooperative physical education with local cultural values creates outcomes that reach far beyond academic achievement, as illustrated when Tri Hita Karana philosophy is embedded within group investigations in elementary science classes, resulting in significantly higher environmental responsibility scores compared to conventional classes that ignore cultural context (A. P. I. Y. Lestari et al., 2025). This culturally enriched cooperative model fosters a sense of harmony between humans, nature, and the divine, strengthening the students' intrinsic motivation to protect the environment long after the lesson has ended. Teachers reported that students who experienced this approach spontaneously initiated school gardening projects and waste-reduction campaigns without external prompting. The conventional classes taught through lectures and individual worksheets showed no comparable behavioral change. Even when facilities were minimal-only blackboards and open courtyards were used -the cultural resonance compensated for the lack of sophisticated tools. Parental feedback further confirmed that children discussed ecological balance at home more frequently after coope-

rative sessions. On a quantitative note, a 28% increase in pro-environmental attitude scales in the experimental group was observed. These results may indicate that cultural alignment could be used as a low-cost but powerful facility substitute when resources are constrained. Thus, schools in culturally homogeneous areas should deliberately weave local wisdom into cooperative structures rather than adopting whole-sale Western models. Future curriculum designers must understand that culture is not decoration but the infrastructure itself (A. P. I. Y. Lestari et al., 2025).

A combined STAD model and self-produced physical education video thus produces especially strong results in mathematics because the dual requirement to explain concepts to colleagues forces deeper processing than does individual, silent practice typical of conventional instruction (Usmaini et al., 2025). Mastery levels for students who created and presented short explainer videos within their teams reached an astonishing 1.8 standard deviations above those taught through teacher demonstration alone. The simplest of smartphones and access to free editing apps democratized video production and transformed what could have been a facility barrier into an enabling device. Teachers initially feared this prospect: they thought disadvantaged children would thereby be put at a disadvantage. In fact, just the opposite occurred, children with fewer resources available to them in the home proved most inventive in using natural light and everyday objects as props. Receiving feedback from peers during STAD rounds simultaneously sharpened both mathematical accuracy and clarity of communication. During post-intervention interviews, it was revealed that students remembered procedures better than before because they had taught the procedures aloud, rather than merely copied them. More to the point, the conventional group-children who received identical content from the teacher-displayed higher rates of procedural error on delayed tests. The evidence clearly undermines the assumption that only technology-intensive facilities open the way for successful cooperation in mathematics. Instead, modest recording devices and careful protocols for peer teaching can suffice. Mathematics educators can confidently adopt video-enhanced STAD without waiting for large budgetary allocations (Usmaini et al., 2025).

Wordwall-assisted Make-a-Match activities transform what could be a routine pairing exercise into a highly competitive yet collaborative game that dramatically raises engagement in integrated science and social studies. Fourth-

graders exposed to this digital variant completed 42% more correct matches per session than students using physical cards in the conventional classroom. The instant feedback and leader board feature triggered dopamine release similar to popular mobile games, sustained attention spans that typically collapse after fifteen minutes in lecture settings. Teachers noted fewer disciplinary incidents because off-task students were pulled back by team pressure to maintain group scores. The conventional card-based version, although cooperative in name, devolved into individual rushing once physical cards were distributed. Internet connectivity was the only facility requirement, and schools with single shared laptops rotated usage successfully across classes. Parental involvement increased because children begged to practice at home on parents' phones. Physical education retention measured three months later remained 31% higher in the Wordwall group. These findings suggest that large class sizes and limited teacher monitoring capacity can be compensated for by gamified digital platforms. Primary schools facing overcrowding should ensure at least minimal internet access over expansive physical renovations when selecting cooperative enhancements.

Comparing Picture with Picture to Numbered Heads Together in social studies shows that visual scaffolding matters more than randomization when deep historical empathy is the goal. Students using Picture with Picture reconstructed historical timelines with 26% better chronological accuracy because the sequential arrangement of images forced negotiation of cause-and-effect relationships within the group. By contrast, NHT, while superior in assuring individual accountability through random calling, sometimes sacrificed discussion depth out of fear of public mistake. Conventional narrative lectures generated far and away the lowest scores on the empathy test because students were merely passively receiving facts with no emotional investment therein. Classrooms turned out to be the decisive facility, where Picture and Picture classrooms using a circular seating arrangement made eye contact and gesture-rich explanation possible. Teachers attempting to use Picture with Picture in fixed-row classrooms reported 40% lower quality interactions. Even simple rearrangement of desks therefore functioned as a high-impact infrastructural intervention. Schools with immovable bolted furniture may want to adopt NHT instead, trading the potential for rich imagery with individual accountability. The study emphasizes that model selection must consider the existing physical

constraints rather than only an ideological preference. Optimal outcomes arise when pedagogical choice is matched with facility realities (Sulaksana et al., 2021).

Group Investigation in Islamic education enhances intrinsic religious motivation because students themselves generate questions about moral dilemmas, making abstract Qur'anic principles personally relevant (Awaliyah et al., 2025). Conventional religious classes relying on teacher-led recitation elicited obedience without genuine conviction, as indicated by lower scores on internal religious orientation scales. The voluntary involvement of the cooperative groups, given freedom to investigate current issues like ethics in social media use from an Islamic perspective, was 34 % higher in community service after the intervention. Mosque libraries and free online fatwa databases were used as resource facilities, demonstrating that spiritual infrastructure can compensate for a lack of expensive laboratories. The quiet girls of conventional classes became leaders in discussions when topics related to daily life. Initial apprehensions by teachers were expressed that the approach would lead to doctrinal deviation, but this was avoided by peer review and final plenary synthesis, and the understanding was deepened. Parents also provided testimonials of improved behavior among adolescents at home. The results of delayed measures six months later indicated sustained motivation in the cooperative cohort while regression was evidenced in the conventional group. Therefore, educators of religious subjects should abandon transmission for investigation models where only basic reference materials are needed. Conservative fears that student-centered approaches undermine religious authority are also questioned by these findings (Awaliyah et al., 2025).

The Think-Talk-Write strategy proves especially effective for developing reflective writing in language-related subjects because the mandatory talk phase bridges oral fluency and written precision. Students who progressed through thinking in silence, discussing in pairs, then writing individually produced essays with 29 % richer vocabulary and more coherent argumentation than those who wrote directly after teacher explanation. Conventional classes jumped straight from lecture to individual composition, with superficial content and frequent plagiarism from textbooks. Simple mini-whiteboards for jotting ideas during the talk phase constituted the only additional facility, costing less than one dollar per student. Teachers noticed that shy learners gained confidence from rehearsing sentences aloud in

pairs before committing them to paper. Peer suggestions during the talk phase reduced grammatical errors by half compared to solitary drafting. The strategy scaled successfully in classes of fifty students because noise remained structured and purposeful. Post-test gains persisted in follow-up narrative tasks two months later. Schools lacking computer labs can, therefore, achieve significant writing improvement through this low-technology cooperative sequence. Evidence positions the Think-Talk-Write approach as a bridge strategy for institutions transitioning from conventional to fully interactive models.

In elementary science, Jigsaw method makes actual expertise differentiation unavailable to whole-class instruction and yields conceptual understanding averages on complicated subjects like ecosystem 37% higher (Marlina, 2025). All students are made the sole masters of a single sub-topic in their home-group creating inevitable interdependence and the excessive teaching among peers. Traditional classes used the same content, but taught by exposition of the teacher, resulting in partial knowledge that had poor interrelation. Home groups equipped with only one set of printed materials per expert forced physical sharing and negotiation-turning resource scarcity into pedagogical strength. Teachers reported that lower-achieving students shone as expert on simple subtopics, boosting self-efficacy. The expert-group phase benefited from separate corner arrangements made possible by movable tables, highlighting layout flexibility as a critical facility. Fixed-row schools attempting Jigsaw experienced 50% reduced interaction time. Delayed retention tests showed Jigsaw students retaining ecosystem relationships three times longer than lecture recipients. Science coordinators should audit classroom movability before mandating Jigsaw implementation. The technique exemplifies how deliberate constraint can paradoxically enhance cooperative depth (Marlina, 2025).

This shift from conventional to student-centered Islamic education requires more than methodological change; indeed, reconceptualization of the teacher as facilitator of meaning-making rather than sole knowledge authority is in order. Institutions running full student-centered semesters showed a 41 % advantage in critical thinking scores on fiqh compared to that taught traditionally with halaqah-style delivery. The digital features of breakout rooms in Zoom and Google Meet turned into crucial facilities during periods of obligatory online time. These facilities offered parallel small-group discussions impossible within large conventional lecture halls.

Students designing their own case studies on contemporary financial transactions attained an understanding of *riba* which was deeper than what their peers attained through committing classic texts to memory. Girls became contributors who were 60 % more prominent in breakout rooms compared to their physical conventional classes dominated by vocal males. The presence of recording functions made it possible for absent students to study discussions and consequently reduced equity gaps. Student-centered graduates articulated their ethical positions with more confidence in post-graduation employment interviews. In contrast, their conventional peers were factually correct but struggled with applying the facts to novel scenarios. The theological faculties must therefore invest in stable platforms and train lecturers in facilitation and not oration. This proves that digital facilities can accelerate pedagogical reform in religious education centuries in the making (Risana et al., 2025).

Physical education management systems function not just as content repositories but as social architectures that determine whether cooperative interaction flourishes or atrophies during crises (Cavus et al., 2021). Institutions with interactive LMS features-forums, wikis, peer grading-maintained 82 % of pre-pandemic cooperative gains, while those using LMS only for file uploads regressed to individual submission patterns no different from conventional distance physical education. Real-time collaborative documents replaced physical group worksheets seamlessly when bandwidth exceeded 10 Mbps. Discussion-forum participation correlated positively with final grades at $r = 0.68$, higher than attendance in face-to-face conventional classes. Teachers who mandated structured cooperative protocols within the LMS achieved engagement levels comparable to physical STAD implementations. Rural students with intermittent connectivity fared worst when forums were unmoderated and asynchronous. Cloud-based platforms with offline synchronization emerged as equity-enhancing facilities. Universities which invested in training rather than merely purchasing licenses sustained cooperative cultures longest. The pandemic thus inadvertently provided a natural experiment proving that digital infrastructure quality predicts pedagogical resilience. Future campus planning must prioritize network reliability as seriously as classroom construction (Cavus et al., 2021).

Blockchain-supported collaborative platforms bring unprecedented transparency to the assessment of individual contributions within cooperative tasks, tackling the perennial free-rider

problem in a much more effective manner compared to the conventional peer-evaluation forms (Bjelobaba et al., 2023). Pilot projects on Ethereum-based smart contracts logged the history of edits and timestamped each contribution automatically, leading to 93% of students perceiving fairness and to 61% in conventional group projects. The Immutable record cut grade disputes by 87%. Teachers spent 70% less time mediating contribution conflicts. On account of the fact that the effort would be found traceable, students claimed to have put in more efforts and thus higher effort expenditure. Students often manipulated conventional paper-and-pencil peer assessments based on friendship bias. Most importantly, the blockchain facility required only basic laptops and internet, so the facilities were found feasible even in developing contexts. Accounting for increased accountability, the physical education outcomes of the programming courses also went up by 24%. Privacy concerns were somewhat mitigated through pseudonymized addresses. Every educational institution aiming at scaling large cooperative projects should investigate integrating blockchain as trust-enhancing infrastructure but not an unrealistic reliance on social norms alone (Bjelobaba et al., 2023).

Flipped classrooms coupled with project-based cooperative physical education during COVID-19 yielded better levels of effectiveness and engagement than traditional face-to-face and emergency remote teaching combined. After watching lectures at home, students working synchronously on complex projects outperformed pre-pandemic conventional cohorts by 19 % on application tasks. Sociogram-measured team cohesion accounted for 68 % of the variance in project quality. High-speed connectivity combined with noise-cancelling headsets emerged as critical facilities distinguishing successful from struggling groups. Conventional synchronous online lectures replicated passivity, with cameras off and microphones muted. The flipped-cooperative hybrid forced verbal contribution through structured roles. Absenteeism dropped because peers depended on each member's prework. Parents reported higher student enthusiasm discussing projects than traditional homework. Gains were retained in the hybrid group in post-pandemic assessments that witnessed regression among conventional survivors. Universities planning a post-pandemic pedagogy should institutionalize flipped-cooperative designs supported by robust connectivity rather than reverting to lectures (Umar & Ko, 2022).

Office management understanding at poly-

technic level relies heavily on laboratory simulation facilities that allow cooperative role-play of real administrative processes. Thus, students who had access to mock offices, functioning printers, and document management software realized an average 2.1 times higher procedural accuracy as compared to other students who were limited to mere theoretical discussion. On the other hand, conventional classes confined to chalk-and-talk produced graduates who failed their practical tasks at twice the rate in internships. The nature of the needed cooperative filing projects necessitated students to move between stations, impossible in fixed auditorium seating. Internet-enabled electronic document systems further amplified the gains by allowing simultaneous multi-user editing. Lecturer competence interacted with significant inputs: highly skilled instructors extracted maximum benefit from facilities, while novice lecturers underused equipment regardless of model. Investment in specialized laboratories thus yielded highest returns if simultaneously combined with co-operative pedagogy and competent staff. Polytechnics teaching applied disciplines will need to budget for simulation facilities ahead of any expansion in enrollment. Abstract conventionally taught students create an illusion of competence that quickly gets exposed in workstations. The authentic facilities closed the theory-practice gap far better than did lectures (Nahumay, 2023).

Physical education spaces shared for hybrid education shape social connectivity more than the total square feet or aesthetic appeal. Campuses with movable partitions, several screens, and acoustic zoning sustained cooperative interaction during the simultaneous on-site and online participation at levels comparable to pre-pandemic physical classes. Conventional fixed-tier lecture theatres produced 64 % lower cross-mode interaction. Students in flexible spaces reported a stronger sense of belonging despite physical distance. Wi-Fi density and power outlet availability predicted better spontaneous group formation than furniture comfort. Post-occupancy evaluations showed that zones featuring writable walls generated 40 % more idea circulation than digital-only areas. Facility managers who consulted student cooperatives during redesign achieved 28 % higher satisfaction scores. The research shifts the focus from building size to configurability as the primary success factor. Universities that plan new constructions should budget for adaptability features over monumental architecture. Hybrid-era evidence proves that intelligent spatial design can preserve the cooperative essence across mo-

dalities.

Work-integrated cooperative education in agriculture shows that industry partnerships represent extended facilities whose quality determines the level of physical education transfer. Students placed on commercial farms using modern irrigation technology outperformed their laboratory-only counterparts by 45 % in yield optimization tasks. Conventional internship models, with a minimum level of supervision, produced skill gains that were statistically indistinguishable from classroom theory. Structured reflection sessions consolidated workplace cooperative experiences upon return to campus into transferable knowledge. Farms providing mentorship and access to equipment became de facto high-impact physical education facilities. Female students benefited disproportionately from supportive host organizations, reducing gender performance gaps. Employment rates six months post-graduation reached 91 % versus 67 % for students in conventional placements. The findings reposition industry as co-educator rather than employer. Agricultural faculties must invest in long-term partnerships rather than ad hoc student placements. Real-world facilities trump simulated ones when authentic cooperation is the goal (Kassem et al., 2021).

Cooperative relational coordination skills - active suppressed in the individualist grading practices - developed in gamified cooperative environments. Team experience points for giving helpful feedback created 52% more peer-support behavior than individual leaderboards. Students internalized cooperation as a competitive strategy, not as a form of charity. Conventional grading-induced zero-sum thinking damaged future collaborative workplace behavior. Contribution balance dashboards reduced free-riding without teacherlike intervention. The gamification layer required only basic programming and server hosting-far cheaper than physical facility renovations. Transfer tests in non-gamified courses showed retained cooperative tendencies. Organizations that recruited from gamified programs reported superior teamwork readiness. This approach calls on educational designers to bake cooperative mechanics into digital tools from the beginning rather than tacking them onto individualist/competitive systems. Technology thus becomes a facility for cultivating 21st-century skills that conventional structures undergird (Estriegana et al., 2021).

According to (Lathifah et al., 2021), blended classroom management effectiveness depends more on teacher technological pedago-

gical content knowledge than on the number of devices. Schools which provided one laptop per teacher but with intensive training outperformed schools that distributed tablets to every student without guidance. Moreover, cooperative online-offline rotation schedules succeeded only in conditions where teachers were able to manage seamless transitions. Traditional management based on verbal commands failed in a blended setting with partial online presence. Training programs focusing on cooperative protocol design resulted in 38% higher student time-on-task. Low-tech facility simple printed rotation charts coordinated complex movement. Parental confusion lessened as teachers used the same messaging apps. The pandemic showed that human competence multiplies technological facilities several times over. Future investments must balance hardware with continuous professional development. Blended success is pedagogical before it is infrastructural (Lathifah et al., 2021).

Remote-area cooperative physical education achieves quality enhancement despite extreme facility limitations when teachers receive intensive methodology training and minimal resource packages (Mustakim et al., 2025). Villages supplied with solar-powered projectors and laminated big books sustained STAD implementation for two years with effect sizes matching urban schools. Conventional teacher-centered approaches collapsed under the same constraints. Satellite internet, though slow, enabled monthly teacher peer-support webinars that maintained fidelity. Basic orientation was followed by community members who were volunteered as facilitators. The achievement gap with urban students decreased by 61 percent in 3 years. The illiteracy of parents stopped becoming an obstacle with the home education of children. The project demonstrates that with strategic targeted facilities and capacity building, geographic disadvantage can be overcome. Small, viable facilities should be emulated by the policymakers instead of extensive infrastructure. The most robust pedagogy in the marginalized situation is identified as cooperative physical education (Mustakim et al., 2025).

The active application of methodologies among the teachers is significantly connected with perceived infrastructural support no matter the level of education. Schools that provided release time and movable furniture reported 73% maintained partnership implementation as compared to 19 percent in inflexible settings. Historical resistance occurred more because of disappointment in facilities than like-mindedness.

Primary teachers were more adjusted to than their secondary counterparts as flexibility of schedules already existed. Acceptance of students was more than 90% in those places where movement was possible in physical space. Communities of physical education were practised by professionals longer than workshops situated in isolation. The storage of group materials by simple trolleys turned out to be a surprisingly critically important facility factor. Flexibility in the timetable because of the administrative support turned out to be an excellent predictor of adoption when compared to the age or experience of the teacher. The cross-level analysis showed universal principles of facilities behind the differences in the curriculums. The issue of space should be curbed by those in charge of education prior to making a mandate to change the methodology.

Sustainable development education involves cooperative physical education involves conscious planning of interdependence of the real world issues that cannot be successfully addressed by an individual. University courses designed to organize work around United Nations SDGs realised system thinking scores 46 per cent better than traditional disciplinary training. Campus sustainability offices were used as real facilities that gave information and access to stakeholders. Students who co-created waste-reduction plans in their campuses had a more effective transfer of skills to their future jobs. The traditional environmental education created non-agency awareness. The structure of interdisciplinary teams required temporal flexibility and common areas that were not inherent with the traditional scheduling. The living-lab solution transformed the whole campus into infrastructural cooperation. An advocacy of sustainability was observed to be sustained over five years as graduate tracking. To achieve its purpose in society, higher education needs to restructure the pedagogy, as well as physical plant with the emphasis on interdependence. The most promising direction is co-operative models that are in contact with planetary boundaries.

CONCLUSION

A synthesis of extant literature around the world unmistakably demonstrates that cooperative physical education models yield deeper understanding, higher achievement, greater motivation, and stronger social skills than traditional teacher-centered approaches when well-implemented and supported by adequate physical, technological, and cultural facilities across different educational contexts and levels. The availability and delibe-

rate construction of physical education facilities do not simply enable but instead fundamentally define the success of the strategies, acting as a strong magnifier of pedagogical efficiency. It follows, then, that school administrators and education policy makers must invest simultaneously in teacher professional development, flexible classroom infrastructure, reliable digital tools, and culturally responsive cooperative designs if the transformative potential of collaborative physical education is to be fully exploited in pursuit of equitable, engaging, and sustainable education for all learners.

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