

Confidence in the Classroom: How Self-Efficacy Shapes the Independent Character of Senior High School Students in Science Learning Activities

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ABSTRACT

Indonesian education policy now names independence as part of the graduate profile, yet how students actually become independent during ordinary science lessons has rarely been examined up close. This study describes how self-efficacy shapes the independent character of eleventh-grade students during science learning activities at a state senior high school in Pacitan Regency. Using a qualitative case study, data were gathered from ten purposively selected students with contrasting self-efficacy tendencies and one science teacher through in-depth interviews, classroom observation, and document review, then analyzed thematically following Miles and Huberman with technique and source triangulation, member checking, thick description, and an audit trail. Independent character appeared in four connected aspects, namely responsibility, initiative, adaptability, and self-reflection, all observable in group discussion, presentation, and written tasks rather than laboratory work. Students with stronger self-efficacy showed a fuller and steadier pattern, while several students with weaker self-efficacy began to grow after small successes and encouragement. Among the four sources of self-efficacy, mastery experience mattered most, verbal persuasion and vicarious experience reinforced it, and emotional states mainly acted as a manageable obstacle. The central finding is that self-efficacy does not create independence directly but works through a process of choosing to try, investing effort, persisting, and recovering from failure, with peer support and a reciprocal link between belief and action standing out as notable patterns. Teachers can nurture independence by designing graded tasks that let every student experience success, giving specific and timely encouragement, and using peer learning, without depending on laboratory facilities.

Keywords: Self-Efficacy, Independent Character, Science Learning Activities, Qualitative Case Study, Senior High School

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INTRODUCTION

Character has returned to the centre of Indonesian education policy. Regulation of the Minister of Primary and Secondary Education Number 10 of 2025 on Graduate Competency Standards places independence among the qualities expected of graduates and describes it through four markers, namely being responsible, taking initiative, adapting, and reflecting on oneself (Permendikdasmen, 2025). This emphasis continues a longer national commitment to character education that has grown steadily over the past decade (Aisyah et al., 2024; Susilo et al., 2022). For science, the policy matters in a concrete way, because learning science asks students to reason through problems, keep trying when an answer does not come at once, and take charge of their own work. In classrooms that do not run laboratory practicals, that independence has to show itself through discussion, presentation, and written tasks (Nadia et

al., 2023; Rahmayumita et al., 2024). One factor that keeps appearing behind independent behaviour is self-efficacy, a person's belief in the capacity to organise and carry out the actions needed to reach a goal (Bandura, 1997). Bandura argued that this belief is built from four sources, namely mastery experience, or past success, vicarious experience through watching others, verbal persuasion from people around us, and physiological and emotional states. A review of the school research literature confirmed that these four sources shape how students read their own ability and how far they are willing to push (Usher & Pajares, 2008). These sources do not act all at once. Bandura & Schunk (1981) found that efficacy usually grows in small steps, as a learner meets a series of near and reachable goals and treats each modest success as a sign of what can be done next. The people who supply this information are not only teachers. Schunk & Hanson (1985) showed that watching a capable classmate can lift a student's belief more than watching an adult, because a peer sits closer to the learner's own level and makes the task look within reach. When students believe they can handle a task, they tend to start sooner, work harder, and stay with a problem longer.

A body of Indonesian and international research reports a positive link between self-efficacy and learning independence. Studies have connected stronger self-efficacy to higher learning independence and achievement motivation (Miranda et al., 2022), to independence supported by peer interaction and motivation (Triwiratman et al., 2023), and to independent learning when face-to-face instruction was limited (Nuryanto & Ramadani, 2022). A systematic review reached a similar conclusion for elementary students (Azhari & Wibowo, 2025), and work on science subjects has related students' attitudes and independence to their beliefs about ability (Astalini et al., 2019). Most of these studies, however, are quantitative and correlational. They establish that a relationship exists, but they say little about how belief turns into independent action inside a real lesson.

In science education, self-efficacy and student character have mostly been studied as two separate topics. A number of studies have measured self-efficacy and linked it to achievement, literacy, and problem-solving ability (Arifiyyati et al., 2023; Armainah et al., 2022; Aslam & Ali, 2017; Devi et al., 2023; Ernawati et al., 2021; Ram & Phogat, 2024) and one study even traced how self-efficacy can change through a discovery learning model (Ilyas et al., 2025). Based on these findings, self-efficacy appears to be a fairly strong predictor of science learning outcomes, yet little has been said about the student character that goes along with it. On the other hand, some studies have described student character in science lessons (Erita et al., 2024; Harizon et al., 2024; Lisnawati et al., 2023; Pasani & Yulinda, 2020; Sukarno et al., 2024). Unfortunately, this work tends to stop at description and rarely connects that character back to self-efficacy, so the relationship between the two remains largely underexplored. This gap is worth addressing because research on learning autonomy shows that students who choose and direct their own learning tend to engage more deeply (Cullen & Oppenheimer, 2024; Fitriah & Indrakurniawan, 2025). Building on this, the present study aims to connect the two by examining how students' self-efficacy relates to their independent character, expressed as responsibility, initiative, adaptability, and self-reflection, in science learning, in line with the four markers of independence in the 2025 graduate standards (Permendikdasmen, 2025).

Reading across these studies, three gaps stand out. First, the relationship between self-efficacy and independence is well documented in numbers but thinly described as a process, so the steps by which belief becomes independent behaviour remain unclear. Second, studies

of character in science learning seldom link that character to self-efficacy, and studies of self-efficacy seldom follow it through to the specific markers of independence named in the current graduate standards. Third, much of the evidence comes from elementary and junior high settings or from mathematics and language, and the few qualitative case studies of self-efficacy sit in those subjects rather than senior high school science (Jainuddin et al., 2026). Little is known about a senior high school that teaches science without laboratory practicals, where independence must appear through discussion, presentation, and written work.

This study addresses those gaps by connecting Bandura's four sources of self-efficacy to the four markers of independent character set out in the 2025 graduate standards, and by doing so through a qualitative case study in a science class that holds no laboratory practicals. The aim is to describe how self-efficacy shapes the independent character of eleventh-grade students during science learning activities at a state senior high school in Pacitan Regency. Three questions guide the study: (1) How does independent character appear in students during science learning activities? (2) How do the patterns differ between students with stronger and weaker self-efficacy? (3) Which source of self-efficacy plays the largest part in shaping that independence?

METHODS OF RESEARCH

Research Design

This study used a qualitative case study design. The choice fits the aim, which is to understand a process as it unfolds in one bounded setting rather than to measure how often it occurs or to test a hypothesis. A case study lets the researcher hold interviews, observation, and documents side by side and follow how self-efficacy and independent character relate in the day-to-day life of a single school. Similar qualitative case studies have been used to examine self-efficacy in other subjects and settings (Andriani et al., 2025; Aslam & Ali, 2017; Jainuddin et al., 2026).

Participants

The setting was a state senior high school in Pacitan Regency, kept anonymous to protect the participants. Informants were ten grade XI students and one science teacher (G-01), chosen purposively with maximum variation so that contrasting self-efficacy tendencies were represented. The tendency of each student was not fixed through a scale. It was judged qualitatively from the teacher's assessment, the researcher's early observation, and a preliminary interview, and it was treated as a provisional picture that the data could deepen or revise. This initial grouping drew on the teacher's assessment, early observation, and a preliminary interview, and it may therefore already have reflected some of the same independence-related behaviours (for example, readiness to speak up or to begin a task) that the study later analyses as outcomes. This raises a risk of circularity, in which part of the reported link between self-efficacy tendency and independent character could reflect how students were sorted into groups rather than an association established independently by the main data. To limit this risk, the tendency was treated only as a provisional, revisable label rather than a fixed measure, the main claims were grounded in interview, observation, and document evidence gathered after grouping, and the interpretation was tested through triangulation and member checking; the issue is revisited among the limitations. Inclusion

criteria were enrolment in grade XI, active participation in science learning for at least one semester, and willingness to take part and be recorded, with variation sought across the two classes and across the two tendencies. Students were coded S-01 to S-10 and the teacher G-01.

Table 1 Summarises the Informant Profile.

Code	Class	Self-efficacy tendency	Role
S-01	XI A	Stronger	Student
S-02	XI A	Weaker	Student
S-03	XI A	Stronger	Student
S-04	XI A	Weaker	Student
S-05	XI A	Stronger	Student
S-06	XI B	Weaker	Student
S-07	XI B	Stronger	Student
S-08	XI B	Weaker	Student
S-09	XI B	Stronger	Student
S-10	XI B	Weaker	Student
G-01	-	-	Science teacher

Data Collection

Data were collected through three techniques so that findings could be triangulated. In-depth semi-structured interviews followed an interview guide built around the four markers of independent character and the four sources of self-efficacy, with follow-up questions used to probe reasons and examples. Non-participant classroom observation recorded the real learning activities that took place at the school, namely group discussion, presentation, and written exercises, since no laboratory practicals were held. Document review examined students' assignments and notes as a further source of evidence. Interviews were audio-recorded with consent, transcribed word for word, and line-numbered. Excerpts are cited with codes, so that W-S01/30 means the interview with S-01 at line 30, W-G01/14 the interview with the teacher, and Obs-02 an observation record. Interview excerpts were translated from Indonesian for this article.

Data Analysis

Analysis followed the interactive model of [Miles & Huberman \(1994\)](#), which treats qualitative analysis as a continuous cycle of data condensation, data display, and conclusion drawing and verification that runs alongside data collection rather than only after it, as shown in Figure 1. To carry out this process systematically, the study used ATLAS.ti 9 as a computer-assisted tool for managing, coding, grouping, and visualising the interview data. In the data condensation stage, the verbatim, line-numbered transcripts were imported into ATLAS.ti 9 and read closely, and meaningful segments were given open codes (quotations) that were then grouped into axial categories through the software's code manager, so that the large body of interview text was reduced to a manageable and traceable set of codes. In the data display stage, ATLAS.ti 9 was used to organise the codes into code groups and to visualise the relationships among the emerging themes in interconnected network views, which made the links between self-efficacy and the markers of independent character easier to see and to compare across informants. In the conclusion drawing and verification stage, the patterns shown in the networks were interpreted into themes that answered the three research

questions, and these readings were checked back against the coded quotations to confirm that each conclusion was grounded in the data. The three stages did not run in a strict line but moved back and forth, so that codes, displays, and tentative conclusions were revisited as new data came in. The researcher carried out the coding in ATLAS.ti 9, and the codes and emerging themes were discussed with a peer and checked with the science teacher to reduce single-reader bias.

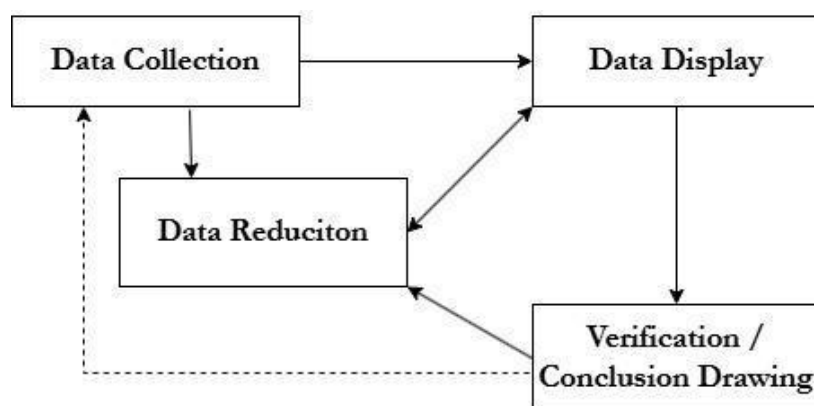


Figure 1 Interactive Model of Qualitative Data Analysis (Miles & Huberman, 1994)

Trustworthiness

Four procedures supported the credibility of the findings. Technique triangulation compared interview, observation, and document data, while source triangulation compared accounts across students and the teacher. Member checking returned interpretations to participants for confirmation. Thick description recorded the setting and excerpts in enough detail for readers to judge transferability, and an audit trail kept the raw data, codes, and analytic notes so the path from data to conclusion could be traced.

Researcher Reflexivity

The researcher was the main instrument and was familiar with the setting, which can colour what is noticed and how it is read. To keep this in check, the researcher kept reflective notes, separated observed behaviour from interpretation during coding, and relied on member checking and peer discussion to test readings against the participants' own understanding.

Research Ethics

Because the student participants are minors, informed consent was obtained from the students and from their parents or guardians, together with permission from the school. Participation was voluntary and participants could withdraw at any time. Consent covered audio recording and the use of anonymised verbatim quotations in publication. Identities were protected by naming the site only as a state senior high school in Pacitan Regency and by reporting all informants through codes.

RESULTS AND DISCUSSION

This section presents the findings together with their interpretation, organised by the three research questions. The account draws on interviews, classroom observation, and

document review of the ten grade XI students and the science teacher described in Table 1. Excerpts appear in translation with their line codes. The excerpts reproduced below were selected because they express most clearly patterns that recurred across the wider set of informants, not because those patterns were unique to particular students. To make that breadth visible, illustrative excerpts from informants who were previously under-represented (S-02, S-03, S-05, S-06, S-09, and S-10) are integrated into each research question, alongside converging observation and document evidence.

Independent Character in Science Learning Activities

The analysis showed that independent character took shape in four connected aspects, namely responsibility, initiative, adaptability, and self-reflection. The four appeared consistently across interviews, observation, and documents. Responsibility showed in the habit of finishing work independently and on time. Students with stronger self-efficacy tended to work ahead and submit before the deadline.

I try to do it myself, and before the deadline. I do not like handing things in late, and when I leave it to the last minute the result is messy. Usually I start chipping away at it from the first day it is given. (W-S01/30)

Document review supported this, showing complete and tidy work among students with stronger self-efficacy, and the teacher confirmed that confident students often start on their own before asking (W-G01/8). Students with weaker self-efficacy were more likely to delay and wait for a friend (W-S04/28). Initiative showed in the willingness to ask questions, offer ideas, and take on the harder part of a task. This responsible pattern also appeared among informants who were not quoted above: S-05 described planning independently and finishing group work before the agreed deadline so that it could be checked (W-S05/26), and S-03 likewise set personal deadlines and reviewed the work before submission (W-S03/26).

I am not afraid to take the difficult part anymore. Sometimes I am the one who volunteers for the most challenging section. (W-S07/14)

The same behaviour was recorded during a presentation, when S-07 offered to answer a question aimed at another group (Obs-02), while students with weaker self-efficacy preferred to stay quiet for fear of being wrong (W-S04/20). Adaptability appeared in the readiness to try another approach when one route reached a dead end. Initiative of this kind was not confined to S-07; S-09 reported reading the sources, trying an example, and then asking a specific question rather than waiting for a complete explanation (W-S09/30).

If one approach hits a wall, I look for another reference, open a different book, or discuss it with a friend. I do not like stopping halfway. (W-S07/30)

This matched the observation that students with stronger self-efficacy switched strategies when they struggled, whereas students with weaker self-efficacy tended to stop and wait for help (W-S04/32; Obs-03). Self-reflection showed in the habit of reviewing mistakes and planning improvements. A comparable flexibility was voiced by S-03, who changed the way a problem was represented, for instance turning a description into a table or a diagram when one approach stalled (W-S03/32).

I look at where I went wrong. Usually I note the mistake, and next time I avoid the same

one. (W-S01/42)

What stood out is that this reflective habit had begun to grow among students with weaker self-efficacy as well. S-08, who at first let poor marks pass without comment, later started to trace where the error lay (W-S08/32). This suggests that independence is not a fixed trait but something that can develop. All four markers correspond to the description of independence in the 2025 graduate standards ([Permendikdasmen, 2025](#)), and here they were not abstract labels but visible acts inside discussion, presentation, and written exercises. Read against prior work, each marker finds specific support. The responsibility observed here, expressed as completing work independently and on time, echoes the diligence and persistence character reported in science classrooms by [Harizon et al. \(2024\)](#) and [Sukarno et al. \(2024\)](#). The initiative to ask questions and take on the harder part of a task is consistent with the active, self-directed engagement described by [Erita et al. \(2024\)](#) and with the autonomy literature ([Cullen & Oppenheimer, 2024](#)). The adaptability of switching strategies at an impasse reflects the self-regulatory, agentic adjustment that is central to Bandura's (1997) social cognitive theory. The self-reflection of reviewing mistakes to plan improvement corresponds to the self-reflective capability that [Bandura \(1997\)](#) treats as a core property of human agency and to the character descriptions offered by [Pasani & Yulinda \(2020\)](#). That grounding adds an empirical view of how the policy plays out in an ordinary classroom, and it extends earlier descriptions of student character in science by tying that character to a specific belief mechanism rather than leaving it at the level of description. The same reflective habit was emerging among less confident students: S-06 noted marking the mistakes that recurred and revisiting that material, adding that although the correction was not always immediate, the pattern had begun to be noticed (W-S06/34).

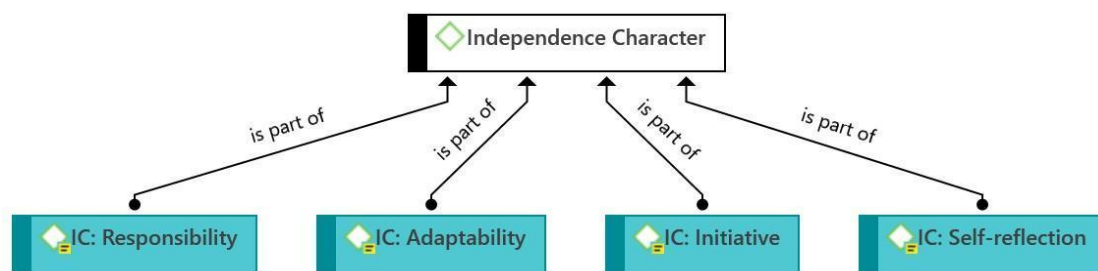


Figure 2 Thematic Network of Independent Character in Science Learning (Rq1): Each Code Is Part of the Category (ATLAS.Ti 9).

Patterns Among Students with Stronger and Weaker Self-Efficacy

Reading across informants revealed a clear difference in pattern. Students with stronger self-efficacy displayed a fuller form of independence. They were willing to begin, they persisted through difficulty, they moved flexibly between strategies, and they reflected on their results. Students with weaker self-efficacy leaned more on friends, gave up more easily, and avoided demanding situations such as presenting. The difference was not absolute, however. Some students with weaker self-efficacy showed signs of growth once they gained a small success and some support, so independence is better understood as something that develops in stages than as a line dividing two fixed groups. This staged, incremental pattern, in which small successes and a little encouragement move a student toward fuller independence rather

than sorting them into fixed types, echoes the gradual building of efficacy through proximal successes set out earlier (Bandura & Schunk, 1981). It also fits Bandura's (1997) account of how efficacy beliefs accumulate through mastery experience and the transformation of self-efficacy over time reported by Ilyas et al. (2025). This direction agrees with studies that report a positive link between self-efficacy and learning independence (Azhari & Wibowo, 2025; Miranda et al., 2022; Triwiratman et al., 2023) and it adds a qualitative account from a setting without practicals, where independence is read through discussion, presentation, and written tasks rather than laboratory performance (Aisyah et al., 2024; Astalini et al., 2019). Informants who were previously under-represented described this same gradual movement: S-02 said confidence grew slowly and that, once sure of one step, they dared to continue without waiting (W-S02/36), while S-10 reported beginning tasks sooner and asking questions more boldly, even though presentation remained a challenge (W-S10/46).

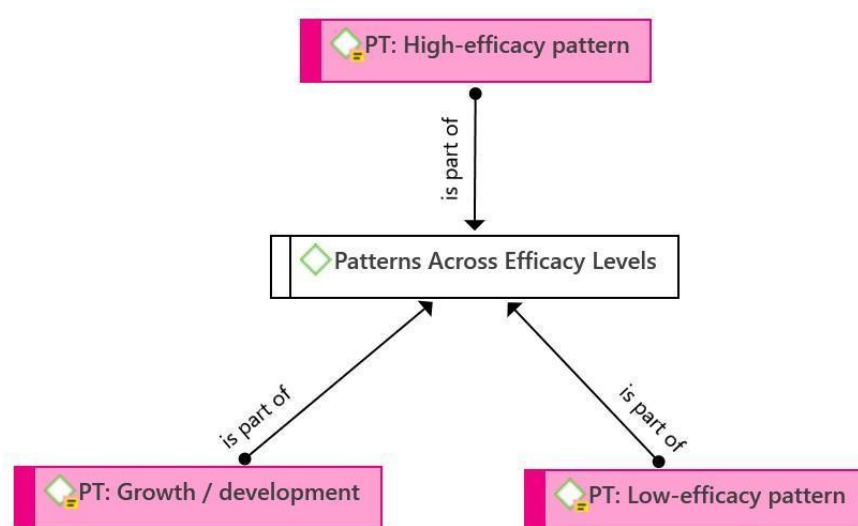


Figure 3 Thematic Network of Patterns of Independence Across Stronger and Weaker Self-Efficacy (Rq2) (ATLAS.Ti 9).

Sources of Self-Efficacy That Mattered Most

Of the four sources of self-efficacy, mastery experience stood out most clearly in building the belief that later drove independent action. This dominance of mastery experience was echoed by less confident informants as well: S-06 recounted that, after finishing one problem with a small hint about the information required, they felt able to attempt the second (W-S06/8), and S-10 described completing one problem after a friend pointed out the given information and then trying the next independently (W-S10/8).

Once I have managed it even a single time, the next material does not feel so frightening. It gives me a bit of confidence to start. (W-S01/16)

The experience of successfully explaining material in front of the class was also a turning point for the confidence of S-07 (W-S07/10). The teacher strengthened this pattern by deliberately setting graded tasks so that every student had a chance to feel successful (W-G01/14). The next source that played a large part was verbal persuasion, especially encouragement from the teacher and from peers.

The teacher once said it is fine to be wrong, what matters is daring to try first. After that I forced myself to go up once, even though my hands were shaking. (W-S08/20)

The teacher added that peer encouragement is sometimes more effective than a teacher's prompt (W-G01/16). Watching or being helped by a friend, a form of vicarious experience, also built belief, particularly among students with weaker self-efficacy (W-S08/12). Physiological and emotional states, such as nerves before presenting, worked mainly as an obstacle that could be managed through preparation and repeated practice (W-S08/8; Obs-02); it should be noted, however, that this source rested on the thinnest evidentiary base of the four, drawing on a single interview line and one observation record, so the reading offered here is more tentative than that for mastery experience or verbal persuasion. This ordering matches Bandura's (1997) claim that mastery experience is the most influential of the four sources, with the review by Usher & Pajares (2008) reaching the same conclusion for school settings. The reinforcing roles of verbal persuasion and vicarious experience are likewise consistent with these same accounts, which identify social persuasion and the observation of capable peers as genuine, if generally weaker, sources of efficacy (Bandura, 1997; Usher & Pajares, 2008), and with evidence that peer interaction and encouragement support learning independence and motivation (Triwiratman et al., 2023). It also suggests that building confidence in a science class rests less on verbal motivation alone and more on designing graded experiences of success, a reading consistent with reports that success and motivation feed self-efficacy in science learning (Devi et al., 2023; Fitriah & Indrakurniawan, 2025; Ilyas et al., 2025). At the same time, the dominance of mastery experience should be read with the grouping procedure in mind: because students' early successes may have informed the teacher's and researcher's initial impression of their self-efficacy tendency before the main data were collected, part of the prominence of mastery experience could reflect that initial classification rather than being established wholly independently by the interview data. This possibility, discussed further among the limitations, does not remove the pattern but tempers how strongly it should be read. Illustrations of these two sources also came from informants not quoted earlier: S-02 said the teacher's encouragement helped most when it was given calmly, and that they became braver to try when told it was acceptable to be wrong provided one was willing to improve (W-S02/16); and S-10 reported feeling more encouraged when a peer who had faced a similar difficulty succeeded, since it showed that the steps could be learned (W-S10/12).

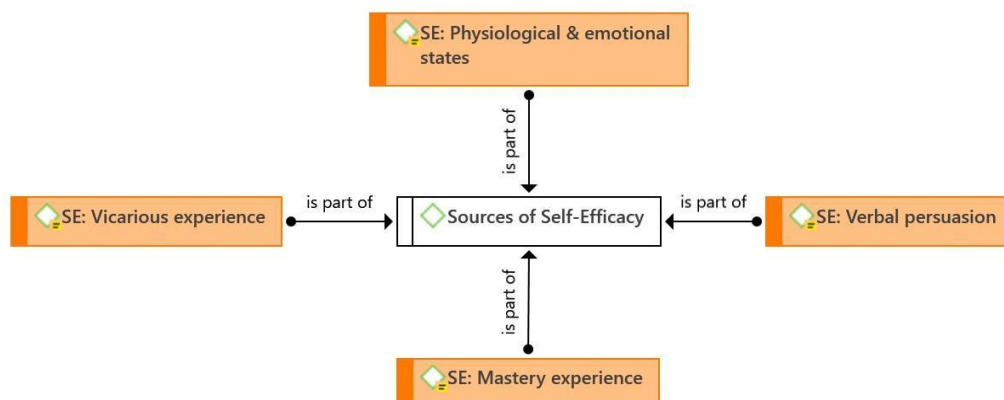


Figure 4 Thematic Network of the Sources of Self-Efficacy That Mattered Most (Rq3) (ATLAS.Ti 9).

The Central Finding: Self-Efficacy Works Through a Process

Taken together, the data point to one main finding. Self-efficacy does not produce independent character directly. It works through a process in which belief in one's own ability shapes the choice to try, the amount of effort invested, the persistence shown under difficulty, and the resilience found after failure. That chain is what surfaces as responsible, initiative-taking, adaptable, and reflective behaviour. This reading fits the idea of human agency in [Bandura \(1997\)](#) social cognitive theory, in which belief is the mover that turns intention into independent action, and it helps explain why two students of similar ability can act with very different degrees of independence, since what separates them is the belief that sets ability in motion. Two further patterns were not anticipated. Peer support acted as a strong source of belief that in several cases outweighed the teacher's prompting, which can be read as a blend of social persuasion and vicarious experience that feels more equal and more genuine to students. Although unexpected in this setting, this pattern is consistent with research identifying peers as a potent source of self-efficacy through social persuasion and the observation of capable others ([Usher & Pajares, 2008](#)) and with evidence that peer interaction shapes learning independence alongside, and sometimes more strongly than, formal instruction ([Triwiratman et al., 2023](#)). It also bears out the point raised earlier that a capable classmate can lift a peer's belief more than an adult can, because a peer sits closer to the learner's own level and makes the task look within reach ([Schunk & Hanson, 1985](#)). There was also a two-way relationship between self-efficacy and independence, in which belief drove independent action and the success of that action fed back into belief, an instance of reciprocal determinism. Table 2 maps each research question to its analytical anchor, the key finding, and the evidence that supports it, so that the claims can be traced back to the data.

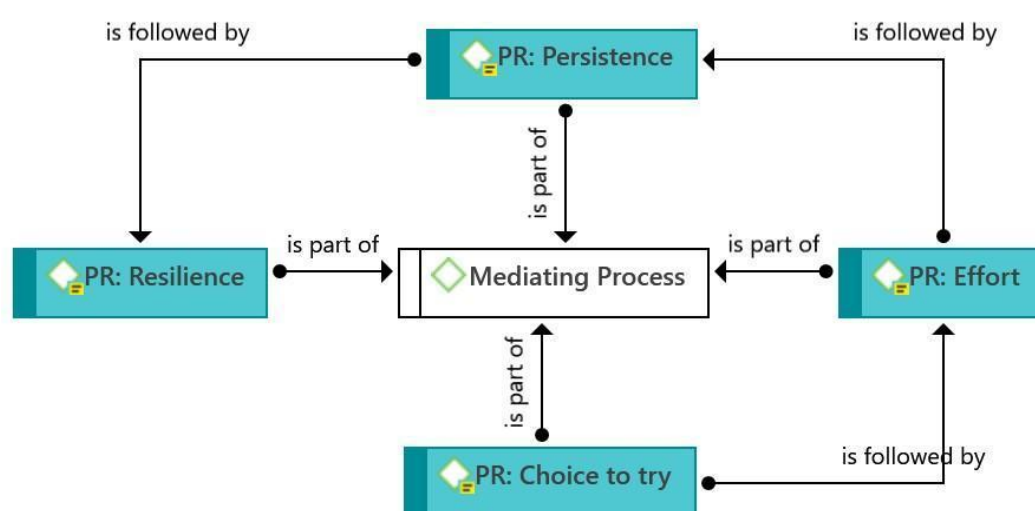


Figure 5 Thematic Network of the Mediating Process, the Central Finding: Self-Efficacy Works Through Choice, Effort, Persistence, and Resilience (ATLAS.Ti 9).

These two unanticipated patterns are drawn together in the thematic network in Figure 6, which maps peer support and the reciprocal belief–action loop as linked parts of the same mediating process rather than as separate effects.

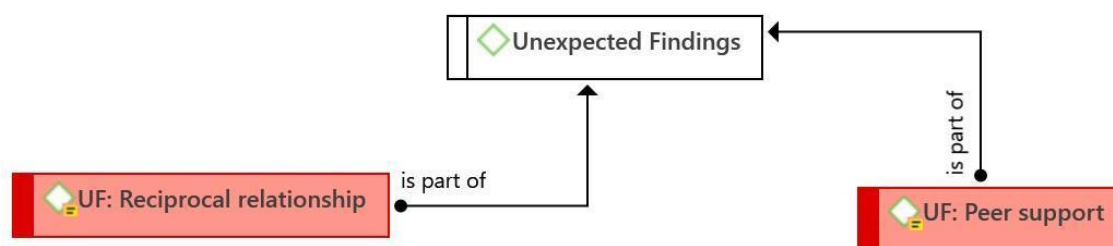


Figure 6 Thematic Network of Unexpected Findings: Peer Support and the Reciprocal Self-Efficacy-Character Relationship (ATLAS.Ti 9).

Across the five thematic networks and the interview, observation, and document evidence behind them, the analysis converges on a single, traceable account of how self-efficacy shapes independent character. Table 2 consolidates that account by mapping each research question and the central finding to its analytical anchor, key finding, and supporting evidence, so that every claim can be followed back to its source.

Table 2 Summary of Research Questions, Key Findings, and Supporting Evidence

Research question	Analytical anchor	Key finding	Evidence sources
RQ1: How does independent character appear?	Four markers in the 2025 graduate standards	Responsibility, initiative, adaptability, and self-reflection in discussion, presentation, and written tasks	Interviews (S-01, S-04, S-07, S-08), observation (Obs-02, Obs-03), documents
RQ2: How do patterns differ by self-efficacy?	Self-efficacy and learning independence	Stronger self-efficacy shows a fuller pattern; weaker self-efficacy can grow with success and support	Cross-informant interviews, teacher account (W-G01/8)
RQ3: Which source matters most?	Bandura's four sources of self-efficacy	Mastery experience is dominant; verbal persuasion and vicarious experience reinforce; emotion is a manageable obstacle	Interviews (S-01, S-07, S-08), teacher account (W-G01/14, W-G01/16), observation
Central finding	Social cognitive agency and reciprocal determinism	Self-efficacy shapes independence through choice, effort, persistence, and resilience, with peer support and a reciprocal belief-action loop	Full dataset across the three techniques

Implications, Limitations, and Recommendations

Read against the process model, the findings carry a few practical implications for science teaching. Teachers can design graded tasks so that every student meets a genuine success early, give feedback that is specific and timely, keep a safe space where being wrong is part of learning, and use peer learning to strengthen the belief of students who still hesitate. Approaches like these can nurture independence without relying on laboratory facilities, which matters for schools with limited equipment. Theoretically, the study offers a grounded account of how the four sources of self-efficacy relate to the four markers of independence named in national policy, joining a belief mechanism to a character outcome that earlier science studies had mostly kept apart.

Several limitations should temper how the findings are read. The study was carried out

in one school with a small number of informants, so the findings are meant to give depth of understanding in this context rather than to be generalised. The self-efficacy tendency of each student was judged qualitatively, which depends on observation, the teacher's account, and interviews rather than a validated measure. These sources may already reflect some of the independence-related behaviours later analysed as outcomes, which introduces a risk of circularity: part of the observed association between self-efficacy tendency and independent character, including the prominence of mastery experience, could partly reflect how students were initially grouped rather than a link established independently by the main data. The evidence base was also uneven across constructs; in particular, the source of physiological and emotional states rested on notably thinner evidence than the other three sources of self-efficacy. The data were collected over a limited period, so the developmental side of independence was only partly captured. These limits were addressed as far as possible through technique and source triangulation, member checking, thick description, and an audit trail. Future research could follow students across more than one school and over a longer period, use an independent or blinded procedure to establish self-efficacy tendency separately from the behaviours of interest, and could test whether the process model holds in subjects and settings beyond science taught without practicals.

CONCLUSIONS

This study set out to describe how self-efficacy shapes the independent character of eleventh-grade students during science learning activities at a state senior high school in Pacitan Regency. It found that independent character appears in four connected markers, namely responsibility, initiative, adaptability, and self-reflection, that students with stronger self-efficacy display a fuller and steadier pattern while several students with weaker self-efficacy begin to grow after small successes and encouragement, and that mastery experience is the most influential source of self-efficacy, reinforced by verbal persuasion and vicarious experience and held back at times by emotional states. Its contribution is to show that self-efficacy does not produce independence directly but works through a process of choosing to try, investing effort, persisting, and recovering from failure, with peer support and a reciprocal belief-action loop as notable patterns, thereby joining Bandura's four sources of self-efficacy to the markers of independence named in the 2025 graduate standards within a science class held without practicals. The study is limited to one school with a small, purposively selected group of informants, a qualitative reading of self-efficacy tendency, and a short data-collection period, so its findings are offered as depth of understanding rather than generalisation. Future research could extend the inquiry across several schools and over a longer time, and could examine whether the process model holds in other subjects and learning settings.

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