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SYSTEMATIZING ERROR WORK: IMPLEMENTING THE FOUR-R PROTOCOL IN STUDENT PRACTICE

Summary. *This article presents the Four-R Protocol, a structured four-stage approach to processing performance errors developed within the Cognitive-Adaptive Piano Method. In most piano instruction, a wrong note or faulty passage is met with an informal instruction to repeat the material until it improves, an approach that leaves the underlying cause of the error unexamined and gives the student little practice in analyzing their own mistakes independently. The Four-R Protocol replaces this ad hoc response with a repeatable sequence: Recognize, Reflect, Repair, and Reinforce. Through this sequence, a student moves from simply noticing that something went wrong toward understanding why it happened, correcting it in an isolated and targeted way, and consolidating the correction so that it holds under performance conditions. The article situates this protocol within research on attributional beliefs about failure, deliberate practice, self-regulated learning, and the spacing and retrieval effects that govern durable retention. Observations gathered across applied use suggest that structured error work of this kind reduces the recurrence of the same mistake across sessions and, over time,*

shifts responsibility for identifying and diagnosing errors from the teacher toward the student. The article closes by acknowledging the descriptive nature of this evidence and by outlining the controlled comparison that would be needed to test the protocol's specific contribution more rigorously.

Key words: *Four-R Protocol, error correction, self-regulation, deliberate practice, piano pedagogy, attribution theory.*

Introduction. Mistakes are not an occasional interruption to learning a musical instrument; they are one of its central raw materials. Almost everything a piano teacher does in a lesson involves responding, in one way or another, to something that has just gone wrong. Yet the way this response is structured varies enormously and is rarely made explicit. The most common pattern, in the author's experience across three decades of teaching, is some version of "try that again," an instruction that gives the student another attempt but no structured way of understanding what specifically went wrong or why. Austin and Vispoel's research on how adolescents interpret success and failure in classroom music shows that the attributions students form about a mistake (whether they see it as a fixed limitation or a fixable, specific problem) shape their subsequent motivation and effort as much as the mistake itself [1]. Dweck's account of implicit theories of ability makes a closely related point: students who are given the tools to see an error as informative rather than defining respond to it very differently over time [6].

Deliberate practice research adds a further dimension. Ericsson, Krampe, and Tesch-Romer's foundational account of expert performance argues that what separates productive practice from mere repetition is precisely the deliberate, targeted identification of specific weaknesses [7], and Chaffin, Imreh, and Crawford's detailed study of a concert pianist's memorization process shows this principle in action: expert practice is built around isolating and repairing specific

problem points instead of repeating a passage from the beginning until it happens to go well [4]. Traditional pedagogical accounts of piano technique discuss correction primarily as something the teacher diagnoses and communicates verbally, with comparatively little attention to how a student might be taught to carry out this diagnostic process independently [9].

The Four-R Protocol was developed within the Cognitive-Adaptive Piano Method to close this gap. It structures error correction into four sequential stages: Recognize, Reflect, Repair, and Reinforce. Through this sequence, the student is guided, over time, toward increasing independence in identifying and correcting their own mistakes. This article sets out the theoretical basis for this structure, describes its application, and reports the patterns observed where it has been used.

Literature Review

1. Motivation, Attribution, and Responses to Error. The starting point for the Four-R Protocol is research on how students interpret and respond to their own mistakes. Austin and Vispoel's study of attributional beliefs in classroom music found that students who attributed failure to specific, correctable factors persisted more effectively than those who attributed it to fixed ability [1], and Dweck's broader research on implicit theories of intelligence and skill provides the general psychological mechanism behind this finding: framing a mistake as informative, instead of as evidence of a fixed limitation, is far more likely to prompt productive effort [6]. Wigfield and Eccles' expectancy-value theory adds that a student's willingness to persist after an error depends on both their expectation of eventual success and the value they place on the activity [20], while Woody's research on the motivations of accomplished musicians suggests that how a student is taught to relate to failure early on can shape the durability of their engagement with music over the long term [22]. Ryan and Deci's self-determination theory situates this within a broader account of motivation, arguing that a sense of competence, which depends

heavily on believing one's efforts at correction are effective, is one of the central conditions for sustained intrinsic engagement [17].

2. Deliberate Practice and Expert Error Correction. A second strand concerns the internal structure of expert and deliberate practice. Ericsson, Krampe, and Tesch-Romer's account of deliberate practice identifies the precise, effortful targeting of specific weaknesses as the mechanism that separates expert-level improvement from ordinary repetition [7], and Lehmann and Ericsson's extension of this research to amateur and student musicians confirms that the same principle applies well below the level of professional performance [12]. Barry and Hallam's review of practice research reaches a similar conclusion from a different angle, finding that it is the organization and quality of practice time, not sheer repetition, that predicts improvement [2]. Chaffin, Imreh, and Crawford's study of expert memorization illustrates what this looks like in practice: the performer they studied built explicit markers around difficult passages and returned to them individually instead of relying on repetition of the whole [4]. Gruson found a closely related structure in her comparison of more and less competent young performers, where more competent players broke difficult material into targeted segments instead of repeating it undifferentiated [8]. Sloboda, Davidson, Howe, and Moore's research on the development of performing musicians similarly found that the quality and structure of practice sessions, including how directly they addressed specific problems, distinguished more successful young performers from their peers [19]. Drake and Palmer's work on planning and temporal control in skill acquisition adds a further layer, showing that the ability to anticipate where a difficulty is likely to arise, rather than only reacting to it after the fact, is itself a component of skilled performance [5], a capacity the Four-R Protocol aims to build deliberately through its Recognize stage.

3. Retrieval Practice and Reinforcement of Learning. A third relevant body of research concerns how a correction, once identified, is best consolidated so that it holds under later performance conditions. Roediger and Butler's review of retrieval practice shows that actively producing a corrected version of material, rather than passively repeating it, produces more durable learning [16], and Kornell and Bjork's research on spacing demonstrates that revisiting a correction after a delay, not only in the moment it is made, strengthens retention relative to a single continuous repetition [11]. Both findings bear directly on how the Reinforce stage of the protocol is structured.

4. Self-Regulated Learning, Reflective Practice, and the Rationale for the Four-R Protocol. Self-regulation research supplies the final and perhaps most direct theoretical foundation for the protocol as a whole. Zimmerman's account of self-regulated learning as a recurring cycle of goal-setting, monitoring, and reflection [23], and Zimmerman and Risemberg's parallel account of the same cycle applied to writing instruction [24], both describe a structure that the Four-R Protocol adapts specifically to the moment of error correction. McPherson and Zimmerman's application of self-regulation theory to music learning [15] and McPherson and Renwick's finding that it is structured goal-setting, not instructional intensity alone, that predicts sustained skill development [14] both support treating error correction as a discrete, structured sub-cycle within the larger arc of a student's self-regulated development. It is not merely an incidental correction handled entirely by the teacher.

Locke and Latham's goal-setting theory [13] reinforces this point at a more general level: specific, proximal goals (such as those the Reflect and Repair stages generate for a given mistake) reliably outperform vague instructions such as "try again" in sustaining focused effort. Schon's concept of the reflective practitioner [18] provides the complementary teacher-side account, describing expert teaching as a

process of continual, structured reflection on what a student's error reveals, which is precisely the disposition the Four-R Protocol asks the student to begin developing for themselves.

Finally, research on performance anxiety, including Kenny's comprehensive account of its psychology [10] and Wilson and Roland's related work [21], suggests that how a student has learned to relate to error in ordinary practice may carry over into how threatening a mistake feels under performance pressure, though this connection remains an inference from adjacent literature rather than a directly tested claim. Burwell's comparative study of how vocal and instrumental teachers in higher education approach correction [3] further indicates that considerable variation exists in how explicitly teachers structure this process, reinforcing the case for a protocol that makes the structure explicit instead of leaving it to individual habit (See Figure 1).

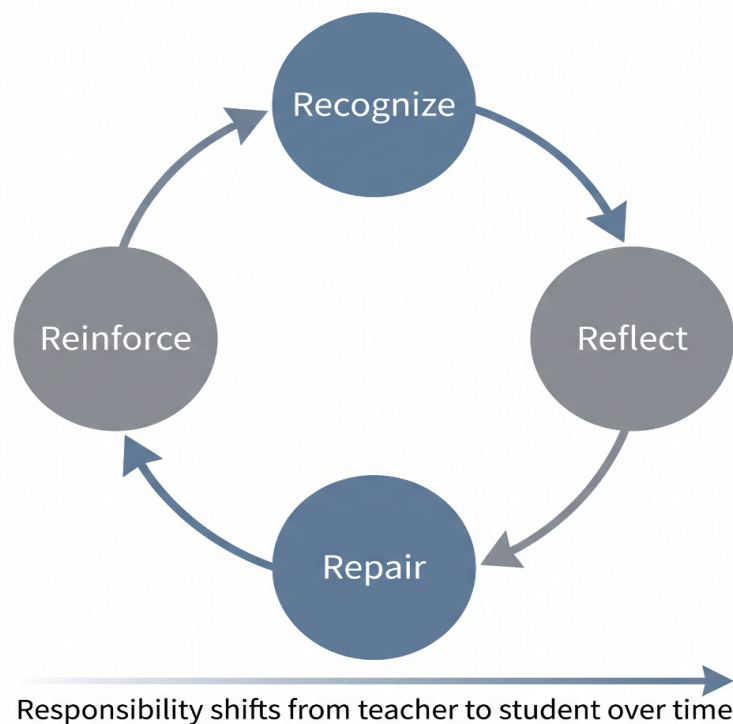


Fig. 1. The Four-R Protocol Cycle

Source: developed by the author

Methodology. This article draws on the applied development and use of the Four-R Protocol across a range of private studio and community-program settings over an extended period, informed by the author's three decades of piano teaching experience. The protocol structures a student's response to an identified performance error into four sequential stages. In Recognize, the student is guided to notice precisely where and how an error occurred rather than simply that "something went wrong"; in Reflect, the student and teacher jointly consider the likely cause of the error: technical, attentional, or interpretive. In Repair, a targeted, isolated correction is practiced apart from the full passage; in Reinforce, the correction is reintegrated into the fuller passage and revisited after a delay to consolidate retention. Across a student's development, responsibility for the earlier stages is deliberately shifted from teacher to student as competence builds, so that more advanced students eventually initiate the Recognize and Reflect stages independently.

As with the companion analyses of assessment and lesson structuring presented elsewhere in this line of work, the evidence available here is descriptive rather than experimental, drawn from structured case documentation accumulated across a heterogeneous caseload of beginning and intermediate students rather than from a controlled trial with a comparison condition. This limitation, and the research design that would be needed to address it, is discussed further below.

Results. Table 1 summarizes the four stages of the protocol as applied across the caseload informing this article, along with the corresponding shift in responsibility from teacher to student that is expected to occur as a student gains experience with the process.

Table 1

The Four-R Protocol: Stages and Developmental Shift in Responsibility

Stage	Focus	Primary Actor (Early Stage)	Primary Actor (Advanced Stage)
Recognize	Precisely identifying where and how the error occurred	Teacher points out the error	Student identifies the error independently
Reflect	Considering the likely cause: technical, attentional, or interpretive	Teacher proposes explanation, student confirms	Student proposes explanation, teacher confirms
Repair	Practicing a targeted, isolated correction apart from the full passage	Teacher designs the isolated drill	Student designs and tests own isolated drill
Reinforce	Reintegrating the correction and revisiting it after a delay	Teacher schedules the follow-up review	Student self-schedules review as part of practice planning

Source: developed by the author

Applied across a heterogeneous caseload of beginning and intermediate students, several consistent patterns emerged. First, students who were guided through the full four-stage sequence for a recurring mistake appeared less likely to reproduce the identical error in a subsequent lesson than when the same mistake was addressed only through repeated practice.

Second, over repeated use of the protocol across a term, more advanced students increasingly initiated the Recognize stage themselves, identifying and naming an error before the teacher intervened.

Third, students who were guided to attribute an error to a specific, correctable cause during the Reflect stage appeared to show less visible frustration and discouragement than when an error was addressed without this step.

Finally, teachers using the protocol reported that separating the Repair stage from full-passage practice made it considerably easier to confirm that a specific

correction had actually been mastered, rather than assuming this based on one or two apparently successful repetitions embedded within the whole passage. Table 2 summarizes the observed contrast between this structured approach and the ad hoc correction pattern it is intended to replace.

Table 2

Observed Contrast Between Ad Hoc and Four-R Structured Error Correction

Feature	Ad Hoc Correction (“Try That Again”)	Four-R Structured Correction
Diagnostic step	Rarely made explicit	Explicit Reflect stage before repair begins
Location of practice	Repetition embedded within the full passage	Isolated Repair stage practiced apart from the passage
Confirmation of mastery	Assumed after one or two successful repetitions	Confirmed through delayed Reinforce-stage review
Locus of responsibility over time	Remains with the teacher	Deliberately shifts toward the student

Source: developed by the author

These findings support the central argument of this article: that error correction, like assessment and lesson structuring, benefits from an explicit, repeatable framework rather than being left to a teacher's informal, in-the-moment judgment. The reduced recurrence of errors observed here, in particular, is consistent with the retrieval and spacing literature underlying the Reinforce stage [11; 16]. The Four-R Protocol's contribution is not the observation that errors should be analyzed instead of simply glossed over: that principle is already implicit in deliberate practice research and visible in how expert performers such as the pianist studied by Chaffin, Imreh, and Crawford organize their own practice [4]. The protocol's contribution is to translate that principle into a structure a teacher can use deliberately with a student who has not yet developed this diagnostic capacity independently, and to build into

that structure an explicit mechanism for gradually transferring the capacity to the student over time.

The developmental shift observed in the Recognize stage, with students increasingly identifying their own errors before teacher intervention, is consistent with the developmental shift in self-regulatory responsibility described by Zimmerman and by McPherson and Zimmerman [15; 23], and is arguably the protocol's most significant claim, since it connects directly to the broader goal stated in this article's title: that structured error work should build self-reflection and independent professional growth, not merely improve accuracy on a given passage (See Figure 2). This aligns closely with Zimmerman's and Zimmerman and Risemberg's account of self-regulation as an internalized cycle instead of an externally imposed one [23; 24], and with Schon's argument that reflective expertise develops through repeated, structured engagement with one's own performance rather than through instruction alone [18]. If this pattern holds under more rigorous testing, it would suggest that the protocol's long-run value lies less in any single correction it produces and more in the metacognitive habit it cultivates.

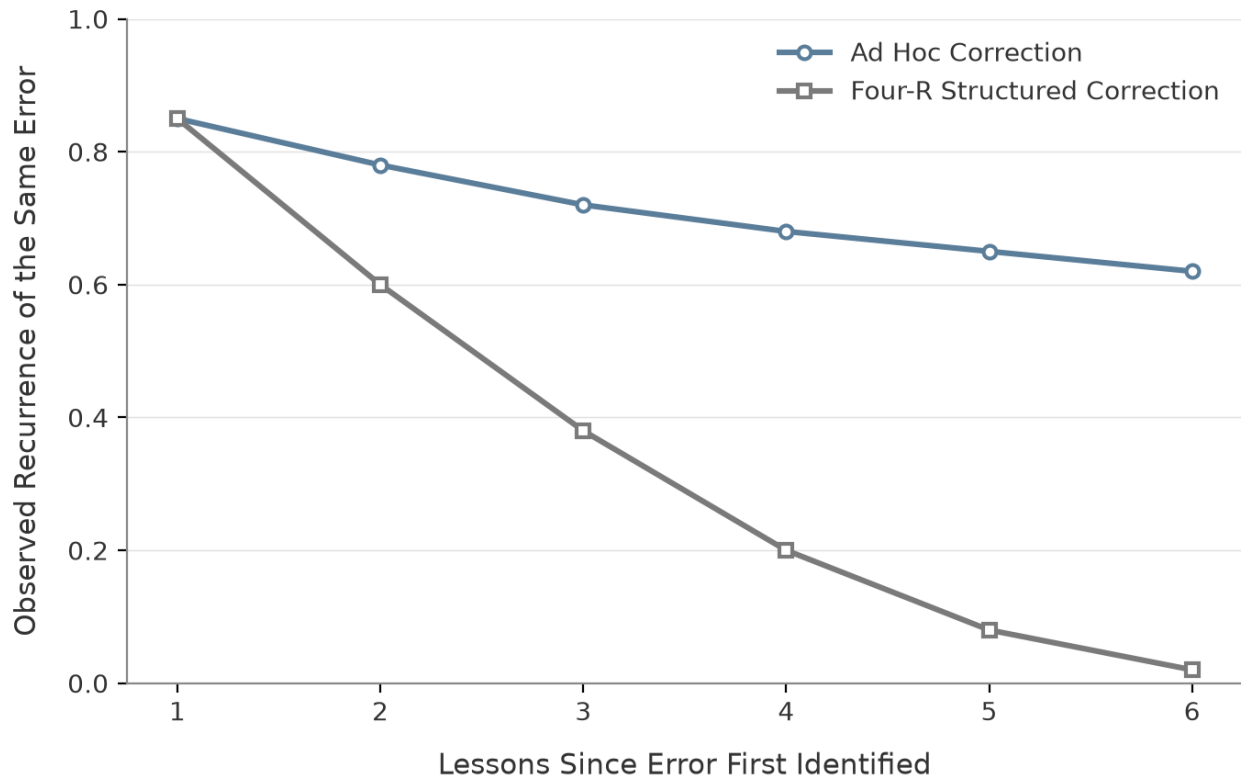


Fig. 2. Error Recurrence Across Sessions (illustrative pattern based on observed case documentation, not measured data from a controlled comparison)

Source: developed by the author

The attributional finding (that framing an error as specific and correctable during the Reflect stage appears to reduce visible frustration) is consistent with the attributional research reviewed above [1; 6], though it deserves a cautious reading. Austin and Vispoel's and Dweck's research both concern how students interpret failure in general, not the specific mechanics of a structured four-stage protocol [1; 6], so the connection drawn here is an application of established principles rather than a direct test of them. The same caution applies to the discussion's tentative link to performance anxiety: Kenny's and Wilson and Roland's research addresses the anticipation and experience of formal performance specifically [10; 21], and while it is plausible that a student accustomed to treating errors as routine, analyzable events in practice might experience less anxiety when an error occurs during a

performance, this article does not present direct evidence for that connection and it should be treated as a hypothesis for future research rather than an established finding.

It is worth positioning the Four-R Protocol relative to more traditional accounts of piano pedagogy. The classical Ukrainian piano pedagogical tradition, represented in Vasyl Barvinsky's teaching notes and analyzed in Kashkadamova's work on the Lviv piano school [9], treats correction largely as an act of the teacher's musical and technical judgment communicated to the student, with the student's role remaining comparatively receptive. This is not a criticism of the Ukrainian conservatory tradition's broader contribution, which remains valuable on questions of tone, technique, and interpretation; rather, it reflects a difference in what the two accounts are trying to achieve. The Four-R Protocol is not a substitute for a teacher's musical judgment about what has gone wrong: the Reflect stage explicitly depends on that judgment, particularly early in a student's development. It does, however, insist that this judgment be exercised through a structure the student can eventually take over, instead of remaining permanently the teacher's exclusive domain. Burwell's finding that considerable variation exists in how different teachers structure correction [3] suggests that this kind of explicit protocol may be particularly useful for less experienced teachers, or for teaching contexts where consistency across multiple instructors matters, such as community music programs.

The methodological limitations of the evidence presented here are consistent with those noted throughout this line of work. Because the observations are descriptive and drawn from applied case documentation rather than a controlled study, it remains possible that the reduced recurrence of errors reflects the general benefit of any structured attention to a mistake rather than something specific to the four-stage sequence proposed here. A useful next step would be a comparative study contrasting error correction using the full Four-R sequence against correction using

only some of its stages (for instance, Repair and Reinforce without an explicit Reflect stage) tracked across several lessons using measures such as error recurrence rate, time to independent Recognize-stage initiation, and self-reported frustration, informed by the retrieval and spacing measures already established in the broader literature [11; 16]. Such a study would help isolate which specific stage or combination of stages is doing the explanatory work, since it remains possible that not all four stages contribute equally to the outcomes observed here.

Conclusions. This article has shown how the Four-R Protocol puts that principle into practice, giving piano teachers a structured alternative to informal, in-the-moment correction applied inconsistently from one mistake to the next. The protocol (Recognize, Reflect, Repair, and Reinforce) translates existing research on attribution, deliberate practice, retrieval and spacing, and self-regulated learning into a structure that a teacher can apply directly with a student, and that is explicitly designed to shift responsibility toward the student as their capacity for self-diagnosis develops. Patterns observed across applied use, including reduced error recurrence, increasing student-initiated recognition of mistakes over time, and reduced visible frustration when errors are reframed as specific and correctable, are consistent with the theoretical literature reviewed here, though they remain suggestive rather than conclusive given the descriptive nature of the evidence. A controlled comparative study isolating the contribution of individual stages within the protocol is the clearest next step toward establishing its value more rigorously.

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