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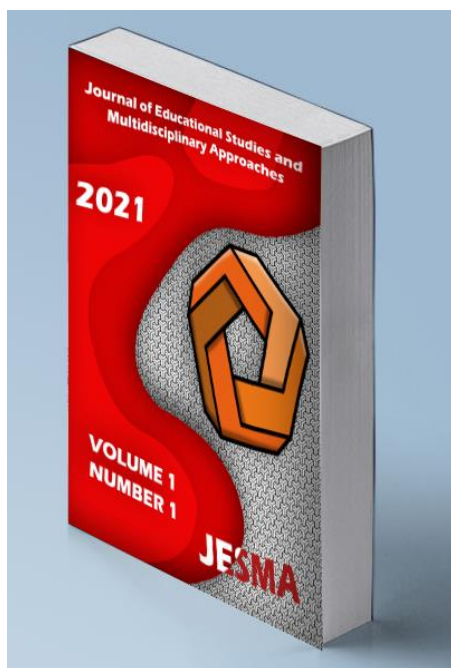
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Students' Views Toward Classroom-Based Assessment Processes in Moroccan EFL High Schools

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Students' Views Toward Classroom-Based Assessment Processes in Moroccan EFL High Schools

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ABSTRACT

In response to the need to foster positive attitudes toward Classroom-Based Assessment (CBA) and shift the test-oriented culture prevalent in various educational contexts to a learning-oriented mindset, this study examines students' views toward CBA processes. Using online self-report questionnaires, the data were collected from 120 Moroccan EFL high school students. This study uncovers several findings. First, the results demonstrated the student participants' tendency to agree with the importance of receiving descriptive feedback, understanding learning objectives, and participating in various assessment activities (e.g., portfolios), including peer assessment. Second, the results indicated a slight tendency toward agreement regarding the importance of participating in self-assessment, viewing grades as the primary objective for engaging in CBA, recognizing the importance of participating in group assessment activities, and defining the assessment criteria. Conversely, student participants remain neutral regarding the priority of written exams over other assessment techniques and the retention of information for a long time after taking written exams. The study concludes with important recommendations, implications and future research suggestions, emphasizing the necessity of involving students in CBA processes.

Keywords: students' views, CBA processes, learning objectives, assessment criteria, feedback, portfolios, peer assessment and self-assessment



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Introduction

In recent decades, students have emerged as the main participants in CBA who are concerned with both assessment processes and outcomes. From an early school age, they form views toward CBA based on how it is carried out, especially the roles they are expected to play during the assessment process. As a result, students' specific beliefs and perceptions about CBA processes and their outcomes tend to become more fixed over time. These views can greatly influence their level of involvement and motivation. For example, some students might set learning-oriented goals, while others may focus on performance goals (Amua-Sekyi, 2016; Shepard, 2000). Therefore, without a clear understanding of the reasons behind engaging in various CBA activities, students may not see assessment as a tool to improve their learning but rather as a way to judge the final product of their efforts. In summary, their central role highlights the importance of ensuring they have a clear understanding of CBA processes and what they mean for learning at different grade levels.

Throughout the educational spectrum, students develop views on CBA based on their experiences with common assessment practices and processes, the results and information they primarily receive, and the influence of their overall school culture. To elaborate, several factors shape their perceptions of CBA. These include but are not limited to the frequent use of specific assessment techniques, such as tests; an overemphasis on assessing lower-level skills; reliance on norm-referenced criteria; and a primary focus on the summative use of assessment results. This is especially evident in high-stakes testing environments. Therefore, CBA should fundamentally evolve into a learning culture (Tierney, 2013), where it is seen as a process that communicates key learning objectives to students and motivates teachers and students to align their efforts with meaningful learning and teaching (Alonzo, 2019). It should also empower students to take responsibility for their own progress and improvement, rather than relying solely on ranking or certification of achievement (Shepard, 2000). Consequently, effective assessment design involves the successful implementation of innovative, student-centered techniques that ensure active learner involvement throughout the assessment process.

In the Moroccan EFL context, it is argued that CBA is not well understood (Ghaicha, 2016). Presumably, this lack of understanding also extends to students, given that they are the primary stakeholders in the assessment process who are directly affected by and deeply involved in the implementation and outcomes of CBA. Furthermore, despite being the primary target of assessment alternations, students are often overlooked in research focusing on changes in assessment (Omarakly & Tamer, 2022). Additionally, assessment is still perceived as an end (e.g., to obtain grades) rather than a means of learning (Babni, 2019; Ouakrime, 2000). As a result, students come to see grades as the ultimate goal of education, often neglecting the importance of the learning process and how those grades are achieved (Ghaicha & Oufela, 2021). Building on these insights, exploring students' views on CBA processes will enable them to voice their stance regarding CBA, particularly their perceptions of alternative assessment techniques (Babni, 2019). Moreover, approaching CBA from students' perspectives may offer valuable insights into the reasons behind the discrepancy between EFL teachers' self-reported conceptions, research implications, and their actual practices (Ghaicha & Oufela, 2021; Mamad & Vigh, 2021).

While the existing literature emphasizes teachers' self-reported practices and the theoretical underpinnings of CBA, there remains a noticeable lack of attention to students' lived experiences and views toward CBA. Accordingly, this study aims to explore students' views toward CBA processes. In this study, processes encompass students' underlying goals for engaging in CBA activities, their awareness of learning objectives and assessment criteria, and their perspectives on participating in various CBA activities. It also includes their perception and reaction to feedback and mistakes. Therefore, the findings of this study hold valuable implications for high school English teachers, instructional and assessment material developers, and the Moroccan Ministry of National Education. Moreover, exploring students' perspectives on CBA processes offers critical insights into enhancing EFL teaching and assessment practices, thereby fostering a learning-oriented assessment culture that

promotes student involvement, autonomy, and improved learning outcomes. To realize these objectives, this study addresses the following research questions:

RQ1: What are Moroccan EFL high school students' views toward CBA processes?

RQ2: Do Moroccan EFL high school students hold positive views toward CBA processes?

RQ3: Do Moroccan EFL high school students' views toward CBA processes support their involvement?

Review of the Literature

This section provides a comprehensive overview of Classroom-Based Assessment (CBA), including the impact of the assessment environment and students' views toward CBA processes, with an emphasis on the Moroccan EFL context.

CBA in the EFL Context

In language classrooms, assessment denotes a process of collecting different sorts of data about learners' progress or achievement in language knowledge and skills using several techniques depending on the learning objective(s) being assessed and the purpose(s) of conducting the assessment. English as a Foreign Language (EFL) characterizes learners who learn the English language after their native language has been acquired outside an English-speaking environment (Bailey, 2017). Conceptually, assessment has two main purposes. The first is to summarize students' achievement up to the current time, and the second is to inform future decision-making concerning students' progress toward the desired learning outcomes (Heritage, 2013). Besides, classrooms imply a complex learning environment with various cognitive, social and emotional factors that come into interplay, therefore, influencing teachers' judgements and students' performance, including their views toward CBA processes. Notably, the educational context plays a significant role in shaping students' views toward CBA processes.

The Influence of the CBA Environment

CBA has the potential to shape students' views toward the learning objectives set by the teacher and, therefore, serves to communicate and reinforce the goals of instruction (Kane & Wools, 2019), affecting, in turn, students' perception, motivation, self-regulation, and performance. In good assessment design, students' success with previous similar assessment tasks is the main basis for building self-efficacy for assessment (Brookhart, 2013). Furthermore, Moss (2013) argues that the assessment environment and students' perceptions influence students' goals, effort and feelings of self-efficacy. Similarly, the surrounding environment of students, including the beliefs of peers and parents, can influence the development of students' self-concepts (Black & Wiliam, 1998). Therefore, CBA has a powerful influence on students' perceptions of learning goals, self-efficacy, self-concept, motivation and confidence, especially within educational environments where high-stakes tests prevail.

High-stakes situations are characterized by test-driven teaching and intensive test preparation (Finch, 2007). According to Moss (2013), students dislike high-stakes summative tests and exhibit high levels of anxiety toward them. They are also aware that test results do not accurately capture their depth of understanding and ability. In a similar context, Cheng et al. (2011) found in a study on students' and parents' views of School Based Assessment (SBA) in Hong Kong a significant correlation between students' perceptions of SBA and their perceptions of external examinations, suggesting that they view SBA simply as another exam that they have to prepare for. This normative approach emphasizes competition, communicating to the weaker students that they lack ability. As a result, they become demotivated, and they, ultimately, lose confidence in their ability to learn (Black & Wiliam, 1998). Furthermore, both teachers and students find it difficult to convert from norm-referenced to criterion-referenced ways of thinking (Scott, 2001).

Students' Views Toward CBA Processes

Learning Objectives and Assessment Criteria

Students are found to be of two kinds: those who have a learning orientation and those who have a performance orientation (e.g., obtain high grades). Students who believe that academic success is the result of their own efforts are more likely to adopt a learning-oriented view. Simply, their aim is learning improvement (Shepard, 2000). In this regard, to foster positive attitudes among students about assessment and learning, they should be clear on the learning objectives, the expected standards of performance and the success criteria ahead of time as well as develop personal evaluation skills for self-monitoring (Ferrara et al., 2019; Shepard, 2000). Furthermore, when conducting CBA for formative purposes, students must be familiar with work examples to develop the success criteria (Andrade, 2013). Building on these insights, it is essential to ensure that students fully understand both the learning objectives and success criteria: the key characteristics of expected high-quality work products.

CBA Feedback

CBA information influences students' perceptions and conclusions about their academic journey from their earliest school experiences. Over time, this accumulated evidence becomes a critical factor in determining their success, commitment to learning, and self-confidence as learners (Stiggins & Chappuis, 2005). According to McMillan (2019), the usefulness of CBA information depends on students' perception, preparation, and reaction to assessment as well as the influence of assessment on students' learning and motivation. Furthermore, Ruiz-Primo and Li (2013) argue that "feedback can reinforce students' beliefs that they can always improve their work and that they can master new challenging goals and tasks, thus enhancing students' learning-goal orientation" (p. 220). For Amua-Sekyi (2016), it is noticeable that grades encourage a focus on performance goals, such as passing a test, rather than learning goals, such as understanding the subject. Therefore, CBA feedback shapes students' perceptions toward CBA and reinforces specific goals. Notably, descriptive feedback is more likely to engender positive views toward CBA while also enhancing students' motivation, engagement and autonomous learning.

CBA Activities

CBA techniques and activities also influence students' goals, motivation and effort. The choice of particular assessment and examination techniques reflects to both teachers and students the techniques that are more valued and ultimately define achievement (Elwood, 2001). Besides, students study differently depending on whether they expect constructed response tests- *studying for generalization*, or selected response tests- *preparing more for details* (Hogan, 2013). According to McSweeney (2014), despite the use of various assessment techniques, students reported preparing more for traditional essays and examinations, indicating the necessity of clarifying the purpose and goals of other assessment techniques to students. As highlighted previously, students accustomed to formal exams are more likely to prioritize summative assessment methods and focus on performance goals, such as achieving high grades. Al-Shehri (2008) attributed students' preference for formal assessment to factors, such as students' lack of familiarity with informal assessment from early stages, and their lack of the required language competency and motivation (e.g., intrinsic) to engage in this ongoing assessment process. Hence, previous schooling plays a pivotal role in shaping and reinforcing students' perceptions of CBA techniques, underscoring the need for training in the effective use of alternative assessments, such as self- and peer assessment.

Ongoing CBA has the potential to boost students' confidence (Stiggins & Chappuis, 2005). According to Finch (2007), both the product and process can be emphasized when a learning journal (e.g., dairy) and one or more portfolios are used as sources of evidence of learning development during the language course. Moreover, collaborative peer assessment techniques where students work in groups to review work such as a presentation or assess their own group's work (Price et al., 2011), are likely to increase students' involvement in CBA. However, when students and probably their parents do not fully understand or value assessment for learning compared to the traditional scores and grades, they may resist or undermine the influence and the benefits of the portfolio assessment (Fox, 2017). To illustrate,

in a study on students' views on assessment, most student participants view it as a means of judging their knowledge and competence. In other words, a large percentage of students (75%) expressed their dislike of memorization-based examinations, considering them as stressful (McSweeney, 2014). Given this, students are likely to prefer ongoing assessment as it ensures their active involvement, provides regular feedback, reinforces learning and allows students to adjust their learning strategies. However, this requires cultivating a positive attitude toward mistakes, alongside equipping students with the skills to effectively use feedback for learning.

Students' Views Toward CBA: Moroccan EFL Empirical Perspective

In the Moroccan EFL context, assessment is conceptualized as a summative-final end in itself (Babni, 2019; Ouakrime, 2000). A potential reason for this conceptualization is the pervasive use of written exams with predominantly selected-response items for summative purposes. Consequently, students develop the view that the whole assessment experience is intended to provide grades to students through written exams. Besides, students are not aware of the learning objectives (Ouakrime, 2000), nor are they informed about the objectives of tests (Benzehaf, 2017). Furthermore, students are not adequately involved in self-assessment (Ghaicha & Oufela, 2021; Ouakrime, 2000). Therefore, to foster positive views toward CBA processes, students should view assessment as a process for providing constructive feedback on their learning experience using various techniques, including alternative assessments (e.g., portfolios accompanied by reflection and self-and peer assessment). In this regard, Omarakly and Tamer (2022) reported that students expressed appreciation for alternative assessments, such as portfolios, self-and peer assessments, and student-teacher conferences, and acknowledged the role of feedback in improving the quality of their reflection and writing.

Methods and Materials

This section presents the research design, participant profile, sampling technique, data collection instrument, ethical considerations and the procedures for data collection and analysis.

Research Design

To explore students' views toward CBA processes, this study adopted a cross-sectional survey design to collect descriptive numerical data, offering a snapshot of Moroccan students' current views toward CBA processes in EFL high schools (Creswell, 2009; Mills & Gay, 2016). To elaborate, the participants in this study were Moroccan EFL high school students who completed an online self-report questionnaire. An overview of the participants and the data collection instrument is provided below.

Participants

As Figure 1 demonstrates, the participants in this study were 120 Moroccan EFL high school students; 65.6% were females and 34.4% were males. Regarding their school level, 49.1% study at the common core level and about 25% at first-year or second-year baccalaureate levels.

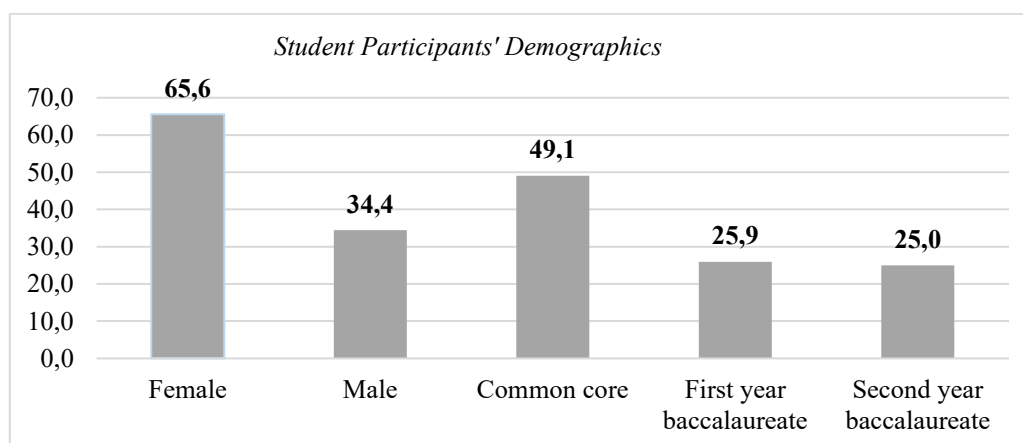


Figure 1. *The demographic information of student participants*

Sampling

Considering the nature of this study, an exploratory study, accidental sampling, also known as “convenience” or “opportunity” sampling, was utilized to select student participants who were voluntarily (self-selected) asked to complete an online self-report questionnaire with no obvious visible characteristic other than being a Moroccan EFL high school student. While this sampling strategy allowed for practical access to the intended participants, it may have introduced potential biases that could affect the generalizability of the findings. Specifically, with Common Core students comprising 49.1% of the sample, the target high school population was somewhat overrepresented by students with comparatively limited English proficiency.

Instrument

This study utilized an online self-report questionnaire since it is relatively inexpensive and allows the collection of large amounts of data from a large sample of participants in a short time (Mills & Gay, 2016). The questionnaire consists of two sections. The first section addresses the participants' background information using multiple-choice items. The second section includes two questions: one asks the participants to rate the extent of their agreement or disagreement with ten item views about CBA processes, and a multiple-choice question with three items assessing students' views toward making mistakes.

To account for the validity and reliability issues, the questionnaire was carefully proofread by the author, a university professor and two teachers of English. Following this, it was sent out for pilot testing to ten students- *five students from common core classes and five from first-year baccalaureate classes*. The goal was to spot deficiencies and provide suggestions for improvement (Mills & Gay, 2016). Accordingly, confusing items were revised in terms of language clarity. Besides, technical and abstract words were translated into the Arabic language.

Further, Cronbach's alpha was calculated to assess the internal consistency of the five-point Likert scale. As Table 1 shows, the five-point Likert scale assessing students' views on CBA processes demonstrated acceptable reliability, with a Cronbach's alpha value of 0.87, confirming its validity as a measure of the intended construct.

Table 1. *The Cronbach's Alpha value of students' views Likert scale*

Scale	Cronbach's Alpha	N of Items
Students' Views toward CBA Processes	.87	10

Ethical Considerations

Prior to conducting the study, formal approval was obtained from the Doctoral Center, Faculty of Education in Rabat, Morocco. Given the nature of the research, it posed no risk to the student participants. Participation was entirely voluntary, with all student participants providing informed consent before completing the questionnaire. Additionally, they were fully informed about the purpose of the study and the estimated completion time of the online self-report questionnaire. Furthermore, they were assured that their responses would remain anonymous and confidential.

Data Collection and Analysis Procedure

The self-report questionnaire was disseminated among Moroccan EFL high school students online via Google Forms® due to its feasibility of reaching a large number of participants in a short time. Afterwards, the quantitative data were coded using Microsoft Excel (2019) and then analyzed with SPSS 26.0 (IBM Corporation, Armonk, NY). Specifically, a contingency table and a graph were generated. The five-point Likert scale assessing students' views on CBA processes was analyzed descriptively, while the multiple-choice questions regarding students' perspective toward making mistakes were analyzed using percentage distribution.

Results

This section reports the analysis of the five-point Likert scale used to assess students' views on CBA processes through descriptive statistics, as well as the analysis of a multiple-choice item exploring students' views toward making mistakes using frequency distribution.

Students' views toward CBA processes

To address the question regarding students' views on CBA processes, participants were asked to rate their level of agreement on a five-point Likert scale, ranging from strongly disagree to strongly agree. Table 2 presents the descriptive statistics for students' views on CBA processes. As shown in the table, the mean scores for the items range from 3.00 to 3.92, while the standard deviation falls between 1.16 and 1.33. This indicates a moderate level of variability in responses, suggesting that most participants' views were centered around the mean.

Participants are neutral toward the importance of written tests compared to other assessment techniques (mean=3; SD=1.16) as well as retaining information for a long time after taking written tests (mean=3; SD = 1.29). The lowest mean of 3.00 indicates a neutral average response. However, participants agreed with the importance of receiving descriptive feedback (mean=3.92; SD=1.29), being aware of the learning objectives of each CBA activity (mean=3.65; SD=1.21), participating in various assessment activities (e.g., portfolios) (mean=3.58; SD=1.29), including peer-assessment to improve their learning (mean=3.52; SD=1.30). These items have higher means (superior to 3.5). In brief, these items indicate a tendency toward agreement.

Participants also expressed a small tendency toward agreement with the importance of participating in self-assessment (mean 3.46; SD=1.30), receiving grades as the primary objective behind taking part in CBA (mean=3.39; SD=1.30), the importance of participating in group assessment activities (mean=3.35; SD=1.33), and in specifying the assessment criteria (mean=3.33; SD=1.17). Overall, these items also have high means (superior to 3.3), indicating a small tendency toward agreement.

Table 2. *Students' views toward CBA processes*

Scale Items	Minimum	Maximum	Mean	Std. Deviation
1. The English exams I take every semester are more important than other activities (e.g. portfolio (شخصي ملف), project, etc).	1	5	3.00	1.16
2. I can remember all the information I learned a long time after the exams.	1	5	3.00	1.29
3. My primary objective for participating in classroom assessments (e.g., exams, projects) is to get good marks and grades.	1	5	3.39	1.30
4. It is important for me to know the learning objective(s) of each classroom assessment (e.g., exams, projects, etc) before participating in it.	1	5	3.65	1.21
5. It is important for me to get information about my learning problem(s) and what to do to develop myself.	1	5	3.92	1.29
6. I prefer to participate in many different activities (e.g. exams, portfolio (شخصي ملف), presentations, etc.).	1	5	3.58	1.29
7. I learn better when I participate in group assessment activities (e.g., project presentations).	1	5	3.35	1.33
8. It is important for me to participate in specifying the qualities of good answers in order to choose or set my learning objective(s).	1	5	3.33	1.17

9. Correcting my work (e.g. writing) by myself using a checklist (e.g. a list with correct responses) helps me learn better.	1	5	3.46	1.30
10. I learn better when I get information (e.g., corrections, suggestions to improve) from my classmate about my work (e.g., writing).	1	5	3.52	1.30

Students' Views Toward Mistakes

Upon inquiring about students' views on making mistakes as English language learners, the following responses, summarized in Figure 2 below, were reported. The data reveals that 76.9% of students perceive mistakes as opportunities for learning, 14.2% consider them as bad habits to be corrected, and only 4.7% view them as signs of lacking intelligence.

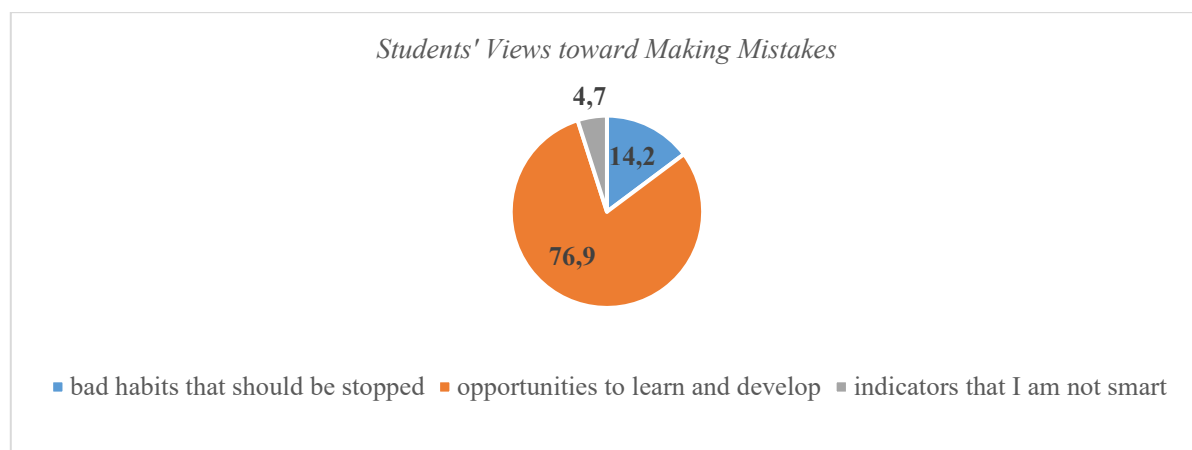


Figure 2. *Students' views toward making mistakes*

Discussion

CBA information shapes students' life conclusions from their earliest school experiences (Stiggins & Chappuis, 2005). Additionally, the assessment environment and students' perceptions influence students' goals, effort and feelings of self-efficacy (Moss, 2013), as well as their self-concepts (Black & Wiliam, 1998). Furthermore, in good assessment design, students' success with previous similar assessment tasks is the main basis for building self-efficacy for assessment (Brookhart, 2013). The results of this study demonstrated that participants hold positive views toward CBA processes. Similarly, most participants view making mistakes as opportunities to learn and develop. In comparison, Cheng et al. (2011) found that students view School-Based Assessment (SBA) in Hong Kong simply as another exam that they have to prepare for. This difference may be attributed to variations in local educational systems, including CBA policies, practices, and beliefs, as well as other student-related factors that warrant further investigation.

CBA serves to communicate and reinforce the goals of instruction (Kane & Wools, 2019). That said, the results of this study indicated that students showed a tendency toward agreement with the importance of understanding the learning objectives targeted by each assessment activity. McSweeney (2014) argued that clarifying the purpose and goals of other assessment techniques besides traditional essays and examinations to students is necessary. Furthermore, in the Moroccan EFL context, research showed that students are not aware of the learning objectives (Ouakrime, 2000), nor are they informed about the objectives of tests (Benzehaf, 2017). Therefore, it is essential to ensure that students comprehend the learning objectives and the rationale behind the implementation of CBA. This will, in turn, enhance their academic achievement, foster autonomous learning, and strengthen their self-regulated learning skills.

Given the role of students' perception, preparation and reaction to assessment in determining the usefulness of feedback (McMillan, 2019), the results of this study demonstrated that most student participants expressed their agreement toward the importance of receiving descriptive feedback. From the perspective of the local research conducted in the EFL context, Omarakly and Tamer (2022) found that students acknowledge the role of feedback in enhancing the quality of their reflection and writing. Therefore, descriptive feedback is significant for orienting students toward learning goals and reinforcing positive beliefs toward learning improvement (Ruiz-Primo & Li, 2013). Accordingly, students need information about their progress and suggestions to improve. This process should be supported by opportunities for reflection and corrective action, which is particularly important given students' positive views on making mistakes and improving their learning. However, it is crucial to ensure that students not only understand descriptive feedback clearly but also know how to use it effectively to enhance their learning.

Ongoing CBA has the potential to enhance students' confidence (Stiggins & Chappuis, 2005). Moreover, it places emphasis on both the product and the process of learning through tools such as learning journals and portfolio assessments accompanied by reflection. This kind of assessment is also considered a source of evidence of learning development (Finch, 2007). In this regard, the results of this study demonstrated a tendency toward agreement with the importance of participating in various assessment activities (e.g., portfolios), including peer assessment and, to a lesser extent, group assessment activities. The findings further indicated a modest inclination among participants to agree with the importance of self-assessment, even though opportunities for such involvement remain limited within the Moroccan EFL context (Ouakrime, 2000; Ghaicha & Oufela, 2021). Furthermore, Omarakly and Tamer (2022) reported that students expressed their appreciation toward portfolios, self- and peer assessments, and student-teacher conferences.

The choice of particular assessment and examination techniques reflects to both teachers and students the techniques that are more valued and ultimately define achievement (Elwood, 2001). Accordingly, CBA in the Moroccan EFL context is conceptualized as a summative-final end in itself (Babni, 2019; Ouakrime, 2000). The results of the study showed that student participants hold neutral views regarding the prioritization of written exams over other assessment activities, as well as the long-term retention of information following exams. This supports McSweeney's (2014) finding that a large percentage of students expressed their dislike of memorization-based examinations, considering them stressful. This is particularly the case with High-stakes summative tests (Finch, 2007; Moss, 2013), which emphasizes competition among students as well as a lack of confidence in their ability to learn (Black & Wiliam, 1998). It is, therefore, essential to maintain a balanced integration of both summative and formative applications of CBA techniques. More importantly, students require structured training in the effective use of alternative assessment techniques for learning improvement.

Proceeding with CBA feedback, it is argued that students who believe that academic success is the result of their efforts are more likely to adopt learning goals (Shepard, 2000). Conversely, grades encourage a focus on performance goals (Amua-Sekyi, 2016). In this study, participants indicated a small tendency toward agreement on the view that receiving good grades is a primary objective behind participating in CBA. Therefore, to encourage students to adopt meaningful learning goals, it is essential that they clearly understand the expected performance standards and success criteria in advance (Ferrara et al., 2019; Shepard, 2000). In the present study, findings revealed a slight tendency toward agreement on the importance of clarifying assessment criteria. This aligns with Andrade's (2013) assertion that students must engage with exemplar work to effectively develop an understanding of success criteria. Consequently, students must understand the learning objectives and collaboratively take part in specifying the success criteria to be able to monitor their learning. Furthermore, they need guided opportunities, accompanied by appropriate mediation, to engage with assessment criteria and apply them in evaluating both their own work and that of their peers.

Despite the valuable insights offered by this study, several limitations should be acknowledged. First, the use of purposive sampling may restrict the generalizability of the findings to the wider population

of EFL students. Second, the reliance on a survey design using solely an online self-report questionnaire introduces the possibility of social desirability bias. Besides, this may not fully capture students' authentic views. Third, although efforts were made to simplify the language and clarify abstract or technical terms, some participants, particularly those at the Common Core level, may have struggled with comprehension due to limited English proficiency. Consequently, this may potentially lead to misinterpretation of items and inaccuracies in their responses. Building on this, these limitations highlight areas for future research and methodological refinement (e.g., using a mixed-method design). This would contribute to a deeper understanding of students' views, perspectives, and experiences with CBA processes, while also providing valuable implications to foster greater student involvement.

Conclusion and Implications

This study investigates students' views toward Classroom-Based Assessment (CBA) processes, focusing on their understanding of learning objectives and assessment criteria, the perceived role of feedback, and their engagement in various CBA techniques. These techniques include written exams, portfolios, self-assessments, peer assessments, and collaborative group-based activities. Data were collected from 120 EFL high school students through an online self-report questionnaire, employing a convenience sampling method. The results of this study demonstrated that the majority of student participants hold positive views toward CBA processes and mistake-making.

Student participants indicated a tendency toward agreement with the importance of receiving descriptive feedback, understanding the learning objectives, and participating in various assessment activities (e.g., portfolios), including peer assessment, meant to improve their learning. Additionally, the results indicated a small tendency toward agreement regarding the importance of engaging in self-assessment, viewing grades as the primary motivation for participating in CBA, recognizing the value of group assessment activities, and the need for clarity in assessment criteria. In contrast, participants expressed neutral attitudes toward the significance of written exams relative to other assessment methods and the extent to which information is retained long-term following such exams.

Based on the findings of this study, it is highly recommended to involve students in CBA processes by participating in selecting the learning objectives of their lessons, specifying the success criteria and taking part in self-directed assessment activities, such as portfolio assessment, peer and self-assessment. Additionally, Students require targeted training opportunities to effectively apply assessment criteria in both self- and peer assessment. Additionally, guidance on how to meaningfully integrate feedback into their learning process is essential. Such support is particularly vital for fostering autonomous learning, enhancing self-determination, and strengthening their sense of self-efficacy.

Proceeding with the implications of this study, the National Ministry of Education is urged to revise local assessment policies and instructional materials to promote the integration of alternative assessment techniques aimed at enhancing learning outcomes in EFL classrooms. Besides, teacher education and pre-service training programs should provide EFL teachers with comprehensive knowledge and practical skills in the effective implementation of diverse CBA techniques and the use of feedback to support learning. More broadly, all concerned stakeholders, including parents, should work collaboratively to challenge and gradually transform the long-standing exam-oriented culture that has characterized the Moroccan EFL context for decades. Instead, efforts should be directed toward cultivating a culture that values deep learning, understanding, and the development of lifelong learning skills.

Concerning future research, in-depth qualitative studies employing interviews and narrative inquiry are recommended to gain a more comprehensive understanding of students' perspectives, beliefs, and concerns surrounding CBA processes in the EFL context. Additionally, experimental research is needed to investigate the impact of student engagement in portfolio assessment, self-assessment, and peer assessment on motivation, academic achievement, and self-efficacy. Future research should further investigate the impact of using assessment criteria in self- and peer assessment on students' learning progress, particularly in enhancing the quality of their writing. Notably, studies involving high school

students in the Moroccan EFL context should account for the potential influence of language proficiency differences on participants' responses.

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How Procedural and Conceptual Knowledge in Math Course Drive Analytical Thinking Development

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How Procedural and Conceptual Knowledge in Math Course Drive Analytical Thinking Development

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ABSTRACT

The aim of this study is to examine the effects of instructional processes in mathematics courses, grounded in conceptual and procedural knowledge, on the analytical thinking skills of primary school students. To achieve this objective, a quasi-experimental design was employed. The study group consisted of 48 fourth-grade students enrolled in a primary school during the 2023–2024 academic year. The students' analytical thinking skills were measured using a 15-item multiple-choice academic achievement test developed by the researcher. The test assessed core components of analytical thinking, including comparison, part-whole relationships, cause-effect relationships, classification, and sequencing. Prior to data analysis, key statistical assumptions—normality, homogeneity of variances, and equality of variance-covariance matrices—were tested. An independent samples t-test was conducted to assess whether the groups were equivalent in terms of their pre-test scores. To examine the effects of instructional type and time, a mixed-design ANOVA was utilized. Paired samples t-tests were used to analyze within-group differences, and an additional independent samples t-test was conducted to evaluate between-group differences in post-test scores. The findings indicated that instructional processes based on conceptual knowledge were more effective in improving students' analytical thinking skills than those based on procedural knowledge.

Keywords: Conceptual Knowledge, procedural knowledge, analytical thinking, mathematics education.



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Introduction

In the past, mathematics education primarily focused on equipping learners with the ability to perform mathematical operations. However, contemporary approaches emphasize understanding why specific operations are performed and how the resulting outcomes can be applied across various fields. This shift is driven by the increasing complexity and data-intensive nature of modern problems. Therefore, identifying which data are necessary, why they are needed, and how much they contribute to solving a problem plays a crucial role in reaching effective solutions (Ye, et al., 2023). In other words, instead of merely performing operations, the essence of mathematics education has become knowing which operations to perform, why, and when, through analytical thinking. According to Sebetci and Aksu (2014), mathematics fosters analytical thinking through the abstract concepts it encompasses. Analytical thinking involves several steps, such as identifying the essential components of a problem, analyzing the relationships between these components, and constructing systematic solutions (Leron & Hazzan, 2009). Swartz and Parks (1994) define analytical thinking as a cognitive process that includes skills such as classification, sequencing, part-whole reasoning, cause-effect analysis, and comparison. These skills enable individuals to accurately identify the nature of a problem and what is required to solve it. Thus, this process demands a level of cognitive engagement far beyond simply performing prescribed mathematical operations. Among various thinking skills, analytical thinking holds particular importance in domains involving numerical and logical reasoning. It allows students to break down complex information, understand its components, and systematically evaluate relationships between them. This makes analytical thinking an indispensable component of mathematical learning. Mathematics, by its nature, requires abstract thinking, establishing cause-and-effect relationships, and generating systematic solutions. Therefore, a reciprocal relationship exists between mathematics education and the development of analytical thinking. Analytical thinking fosters the emergence of solutions that may seem initially unrelated but ultimately complement one another. This type of thinking refers to the ability to identify the necessary components of a problem, analyze their interconnections, and construct solutions in a systematic manner (Olkun & Toluk, 2003).

In this context, the aim of mathematical problem-solving is not merely to arrive at the correct answer but to understand the process and justify it logically. Analytical thinking helps students develop more structured and meaningful approaches to problem-solving, thus facilitating deeper comprehension of mathematical concepts. However, for this mode of thinking to be effectively cultivated, students must understand not only the procedural steps but also the conceptual foundations underlying these steps. At this point, two key types of knowledge frequently discussed in mathematics education—procedural and conceptual knowledge—become relevant. Procedural knowledge consists of the rules, formulas, and symbols necessary to perform mathematical operations. This type of knowledge is typically associated with rote memorization and the step-by-step execution of procedures, often without logical justification (Olkun & Toluk, 2003). In essence, it is about knowing how, rather than why, something is done. It includes recognizing symbols correctly, applying formulas and rules, following specific sequences, and adhering to algorithmic steps (Hiebert & Lefevre, 2013). Individuals with procedural knowledge often solve mathematical problems using memorized techniques. This type of knowledge is particularly effective in solving routine and standard problems. Rittle-Johnson and Schneider (2013) assert that procedural knowledge helps automate problem-solving processes, as frequently used procedures eventually require less cognitive effort.

Conceptual knowledge, on the other hand, refers to the understanding of mathematical concepts and their components, the ability to explain these concepts using symbolic representations, and the capacity to grasp the methods of operations while establishing meaningful connections between symbols, procedures, and concepts (Comrey & Lee, 1992). Conceptual understanding is achieved through the balanced integration of both conceptual and procedural knowledge, playing a crucial role in equipping students with advanced problem-solving skills (Lloyd, et al., 2010). Skemp (2012) defines conceptual knowledge as “knowing what to do, how to do it, and why it is done that way”. Based on this perspective, the present study seeks to address the question: Does mathematics instruction based on the conceptual knowledge model significantly differ from that based on the procedural knowledge model in terms of its effect on students' analytical thinking skills? Accordingly, the research is guided by the following hypotheses:

- 1.The change in scores between the pre-test and post-test significantly differs between students who receive mathematics instruction based on the conceptual model and those who receive instruction based on the procedural model.
- 2.There is no significant difference in the pre-test scores between students taught using the conceptual model and those taught using the procedural model.
- 3.There is a significant difference between the pre-test and post-test scores of students who receive mathematics instruction based on the conceptual model.
- 4.There is a significant difference between the pre-test and post-test scores of students who receive mathematics instruction based on the procedural model.

Methods and Materials

To evaluate the effect of instructional processes supported by procedural and conceptual knowledge on students' analytical thinking skills, two groups participating in different instructional models were compared (between-group comparison). Furthermore, by including repeated measures from the same participants, the study was designed using a pre-test–post-test control group experimental design. Since random assignments were not applied and intact classrooms were designated as experimental and control groups, the study employed a quasi-experimental design (Borji et al., 2021). The study group consisted of 48 fourth-grade students enrolled in two different classes within the same primary school located in a metropolitan city. The experimental group comprised 24 students (11 female and 13 male), while the control group also consisted of 24 students (14 female and 10 male).

Data Collection Instrument

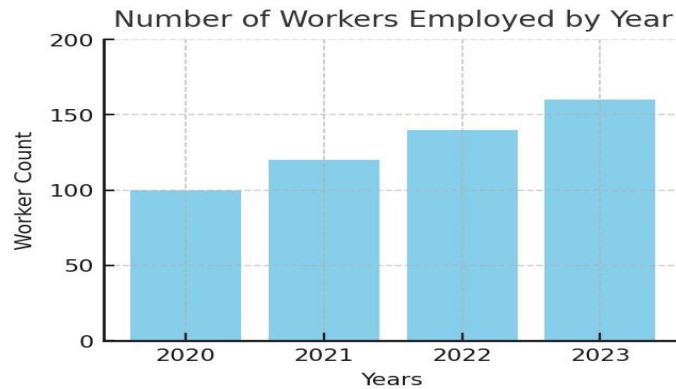
As part of the research process, an academic achievement test was developed. To construct this test, 20 items were written based on analytical thinking and aligned with the intended learning outcomes of the fourth-grade math course. These items were revised based on experts' (one of them had PhD. degree in mathematics and the other one is a professor in the field of instruction) opinions regarding clarity, alignment with visuals, and age appropriateness. The revised version of the test was then administered to 225 fifth-grade students for pilot testing. Considering that comparison, part-whole relationships, cause-effect reasoning, classification, and sequencing together represent a holistic analytical thinking ability, item selection was guided by the total discrimination indices (r_{jx}) of the scale. As a result of the item analysis, the discrimination indices of the initial 20-item test ranged from $-.15$ to $.53$. From each sub-dimension, the three items with the highest discrimination indices were selected and reanalyzed. The final application form consisted of 15 items with discrimination indices ranging from $.31$ to $.79$. The difficulty levels (p_j) of these items ranged from $.35$ to $.85$. The reliability of the 15-item form was calculated using the KR-20 coefficient, which was found to be $.75$. Given that all items had discrimination indices above $.30$ and the reliability exceeded $.70$, the final version of the application form was accepted. Items 1–3 represent the comparison dimension, items 4–6 assess part-whole relationships, items 7–9 focus on cause-effect reasoning, items 10–12 address classification, and items 13–15 cover sequencing.

One of the items on sequencing skills is given below:

The number of workers employed in a factory by year is shown in the chart on the right.

If the increase in the number of workers continues as shown in the chart, in which year will the number of workers in the factory exceed 240?

- A) 2026
- B) 2027
- C) 2028
- D) 2029



Procedure

The finalized achievement test was administered as a pre-test to all fourth-grade student groups. Lessons were then designed separately based on either the procedural or conceptual knowledge model, in alignment with the national curriculum outcomes. While the experimental group received instruction based on the conceptual model, the control group was taught using the procedural model. Both groups received 40 hours of instruction in total. The learning outcomes and respective instructional hours (as indicated national curriculum) were as follows: explaining the relationship between units of time (4 hours), solving problems involving units of time (6 hours), making interpretations and predictions based on graphs (10 hours), creating bar graphs and using various representations to present data (10 hours), and solving real-life problems using bar graphs, tables, and other visual data representations (10 hours). In the procedural model-based instruction, the emphasis was placed on the outcomes of operations and error correction. Students were presented with traceable algorithms, and operations were carried out step-by-step with guided practice and examples. Students were encouraged to independently complete similar problems. The correct sequence of operations, special rules, and shortcuts were highlighted. For students who made mistakes, the step where the process was broken was explained and the correct steps were repeated together with the student. Conversely, in conceptual model-based instruction, lessons began with activities that activated students' prior knowledge and presented real-life examples of the concept. Concept maps, brainstorming, visuals, and concrete materials were used to create connections. The same concept was presented in visual, verbal, numerical, and symbolic forms. Students were asked exploratory questions such as "Why?", "How?", and "What difference does it make?". Open-ended questions were used to explore the boundaries and applications of the concepts. Additionally, the learning outcomes were supported by real-life problem scenarios or modeling activities.

Ethical Process

All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards. This study was conducted with the approval of the Human Research Ethics Committee of Aksaray University in Turkey, under the decision dated October 23, 2023 (Reference No: 2023/06-39). Due to the participants being primary school students, their parents were informed about the research process and written consent was obtained. Additionally, the necessary permissions from the Provincial Directorate of National Education were secured to conduct the implementation.

Data Analyses

Before initiating the data analysis process, assumptions for parametric testing were evaluated using the data collected after the implementation. The normality of the dataset was assessed using skewness-kurtosis coefficients and the Shapiro-Wilk test. Homogeneity of variances was tested with Levene's test, and equality of variance-covariance matrices was examined using Box's M test. First, an independent samples t-test was conducted to determine whether the groups had equivalent pre-test

scores. Then, a mixed-design ANOVA was used to analyze the effects of time (pre-test–post-test) and instructional model (procedural–conceptual) on analytical thinking skills. To explore within-group differences between pre-test and post-test scores, paired samples t-tests were performed separately for each group. Finally, an independent samples t-test was conducted to evaluate the differences in post-test scores between the groups. The significance level for all analyses was set at .05.

Findings

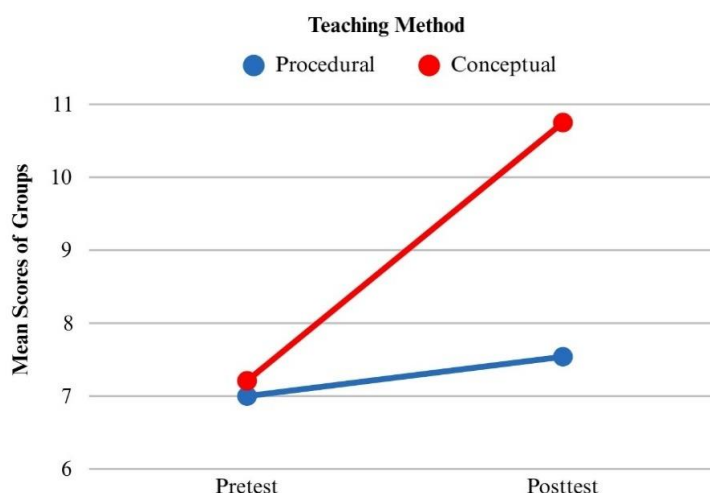
Descriptive statistics regarding the participants' pre-test and post-test scores are presented in Table 1. To determine whether the groups were equivalent prior to instruction, an independent samples t-test was conducted on the pre-test scores. Before the analysis, it was observed that the skewness and kurtosis coefficients fell within the acceptable range of -1.5 to $+1.5$ and the Shapiro-Wilk test was non-significant ($p > .05$), indicating that the assumption of normality was met. Additionally, Levene's test confirmed the homogeneity of variances ($p > .05$). No significant difference was found between the pre-test scores of the groups receiving instruction based on procedural knowledge ($n = 24$, $M = 7.00$, $SD = 1.72$) and those receiving instruction based on conceptual knowledge ($n = 24$, $M = 7.21$, $SD = 2.08$), $t(46) = -0.38$, $p = .707$. Accordingly, the groups were considered equivalent in terms of analytical thinking skills at the outset.

Table 1. Descriptive Statistics of Pre-test and Post-test Scores by Group

Types of Models	Test Type	Mean	Standart Deviaton
Procedural ($n = 24$)	Pre-test	7.00	1.72
	Post-test	7.54	1.86
Conceptual ($n = 24$)	Pre-test	7.21	2.08
	Post-test	10.75	1.96
Total ($n = 48$)	Pre-test	7.10	1.89
	Post-test	9.15	2.49

To examine the effect of instructional processes supported by procedural and conceptual knowledge on analytical thinking skills, a mixed-design ANOVA was conducted. Prior to the analysis, the assumptions were tested. The skewness and kurtosis coefficients of both groups' pre-test and post-test scores were found to be within the acceptable range of -1.5 to $+1.5$, and the Shapiro-Wilk test was not significant ($p > .05$), indicating approximately normal distributions. Levene's test confirmed the homogeneity of variances ($p > .05$), and Box's M test verified the equality of variance-covariance matrices ($p > .05$). Since all assumptions were met, the mixed-design ANOVA was performed. First, the interaction between instructional process and time was examined and found to be statistically significant ($F(1, 46) = 29.59$, $p < .001$, $\eta_p^2 = .391$). This result indicates that the change in scores from pre-test to post-test differed significantly between the groups. As illustrated in Figure 1, the post-test improvement among students who received instruction based on conceptual knowledge was greater than that of those who received instruction based on procedural knowledge.

Figure 1. Changes in Pre-test and Post-test Scores by Instructional Groups



After identifying the interaction effect, simple main effects were analyzed to examine the differences between the groups' pre-test and post-test scores. Paired samples t-tests were conducted for each group. For the procedural group, the difference between the pre-test ($M = 7.00$, $SD = 1.72$) and post-test ($M = 7.54$, $SD = 1.86$) scores was not statistically significant ($t(23) = -1.67$, $p = .108$). However, for the conceptual group, the difference between the pre-test ($M = 7.21$, $SD = 2.08$) and post-test ($M = 10.75$, $SD = 1.96$) scores was statistically significant in favor of the post-test ($t(23) = -7.94$, $p < .001$). Finally, the post-test scores of the two groups were compared using an independent-samples t-test. The results showed that the scores of the conceptual group ($M = 10.75$, $SD = 1.96$) were significantly higher than those of the procedural group ($M = 7.54$, $SD = 1.86$), ($t(46) = -5.81$, $p < .001$).

Results and Discussion

The analysis addressing the hypothesis "There is no significant difference between the pre-test scores of students taught with the conceptual and procedural knowledge models" confirmed that the groups were equivalent in terms of analytical thinking skills before instruction. These findings support the hypothesis, indicating that no significant difference existed between the groups' pre-test scores (Figure 1). This result aligns with the findings of Borji et al., (2021), who also emphasized cognitive equivalence between groups before instruction. Similarly, Baroody and Johnson (2007) stated that initial equivalence enhances the validity of research findings. Newton, et al., (2010) also highlighted the importance of comparable baseline levels to evaluate the impact of procedural and conceptual instruction. These findings are consistent with the literature and confirm the equivalence of groups prior to the intervention. In experimental and quasi-experimental research, initial equivalence is essential to validly assess the effects of instructional practices (Tabachnick & Fidell, 2013). Accordingly, the pre-test results ensured group homogeneity and allowed for an objective evaluation of the instructional impact on analytical thinking skills.

Analyses addressing the hypothesis “The change in pre-test and post-test scores significantly differs between students taught with conceptual and procedural knowledge models” revealed a statistically significant difference in the development of analytical thinking skills between the two instructional approaches. Notably, students in the conceptual knowledge group showed a more pronounced improvement in their post-test scores, supporting this hypothesis. Hussein and Csikos (2023) stated that instruction based on conceptual knowledge enhances mathematical achievement, reduces anxiety, and fosters positive attitudes. Similarly, Samad et al., (2022) identified a significant correlation between conceptual understanding and analytical thinking skills. In a microlearning-based study by Alptekin (2025), students demonstrated high levels of achievement in understanding algebraic concepts. Anderson et al., (1999) emphasized that conceptual instruction promotes deeper understanding and critical thinking. The mixed-design ANOVA results revealed a significant interaction effect ($F(1, 46) = 29.59$, $p < .001$, $\eta^2_p = .391$), further supporting the research hypothesis by demonstrating that the instructional process plays a critical role in the variation of student achievement over time. Brown and Coles (2010) also stressed the importance of instructional strategies that consider individual differences for effective learning. In this context, the findings suggest that different instructional approaches produce varying levels of academic development among students.

The hypotheses “There is a significant difference between pre-test and post-test scores among students taught with the conceptual knowledge model” and “There is a significant difference between pre-test and post-test scores among students taught with the procedural knowledge model” were tested. The analyses indicated a significant and substantial increase in the post-test scores of the conceptual instruction group, whereas the procedural instruction group did not exhibit a similar improvement. These results support both hypotheses and confirm the effectiveness of conceptual knowledge in enhancing analytical thinking skills. Similar findings have been reported in the literature. Hiebert et al., (2002) emphasized the pivotal role of conceptual knowledge in problem-solving and critical thinking. Similarly, Booth et al., (2013) highlighted that conceptual instruction helps students understand the rationale behind procedures and fosters higher-order cognitive skills. In mathematics education, conceptual knowledge facilitates understanding of mathematical structures, while procedural knowledge focuses on the application of rules and algorithms (Star, 2005). Although a balanced integration of both types of knowledge is recommended, the present study found that conceptual knowledge is more effective in developing analytical thinking. Rittle-Johnson and Lefevre (2013) noted that analytical thinking supports understanding of relationships between mathematical concepts and promotes flexibility in problem-solving. Conversely, procedural instruction does not appear to foster this skill, and its sole focus on procedures may hinder students' ability to form conceptual connections (Hiebert & Carpenter, 2002). In a study conducted by Uz (2022) with middle school students, it was observed that students predominantly used procedural strategies in problem-solving, while their mathematical modeling competencies remained low. This finding suggests that lacking conceptual grounding in procedural knowledge can impede knowledge transfer to new situations. Therefore, it is recommended that instructional approaches grounded in conceptual knowledge be prioritized to develop students' analytical thinking skills. Activities should be designed to enable students to understand mathematical structures and apply their knowledge to novel problems. Furthermore, instructional programs that integrate both conceptual and procedural knowledge in a balanced manner can enhance students' progress in both fundamental skills and higher-order thinking (Rittle-Johnson & Lefevre, 2013). Yarka (2024)'s study revealed that modeling activities significantly improved students' levels of conceptual and procedural knowledge, particularly in operations with fractions.

In both everyday life and learning processes, many challenges or tasks cannot be addressed solely through possessing knowledge; rather, they require meaningful interpretation and effective application of that knowledge. This highlights the importance of critical thinking, analytical reasoning, and creative problem-solving skills. Making knowledge meaningful involves not just memorizing information obtained from one's environment, but also analyzing, connecting, and evaluating it within context. For instance, a student does not merely need to know a mathematical formula; they must also understand when, where, and how to use it. In this process, individuals activate prior knowledge, relate new information to existing knowledge, establish conceptual connections, and organize information into mental schemas. This cognitive organization transforms knowledge into long-term learning and supports effective problem-solving. Meaningful knowledge becomes a tool for generating solutions. The student or individual utilizes their knowledge to propose alternative solutions, compare these alternatives, and choose the most appropriate one. Once the solution is determined, it is implemented. However, the problem-solving process does not end here. The individual evaluates whether the solution is effective and sufficient. If necessary, they experiment with alternative approaches. This iterative process fosters the development of self-evaluation and self-regulation skills.

Result

Based on all these findings, it can be concluded that instructional processes grounded in conceptual knowledge are more effective in enhancing students' analytical thinking skills compared to those based on procedural knowledge. Conceptual instruction enables students to comprehend the relationships among mathematical concepts, resulting in significant improvements in their problem-solving and critical thinking abilities. In contrast, instructional approaches focused primarily on procedural knowledge appear to have a limited impact on the development of analytical thinking, often leaving students confined to procedural understanding alone. These results highlight the need to prioritize conceptual understanding in mathematics education and underscore the importance of designing curricula that integrate conceptual and procedural knowledge in a balanced and complementary manner.

Limitations and Recommendation

This study has several limitations that should be acknowledged. First, the sample was limited to 48 fourth-grade students from a single primary school, which restricts the generalizability of the findings. Future research should include a larger and more diverse sample across different educational settings to enhance external validity. Second, the study employed a quasi-experimental design without random assignment, which may limit the control over confounding variables. Employing randomized controlled trials in subsequent studies could strengthen causal inferences. Third, the measurement of analytical thinking was confined to a multiple-choice test developed by the researcher. While the test was aligned with the core components of analytical thinking, the inclusion of open-ended or performance-based assessments could provide a more comprehensive understanding of students' cognitive processes.

Based on these limitations, several recommendations are proposed. Researchers should consider implementing longitudinal studies to examine the long-term effects of conceptual and procedural instruction on analytical thinking. It is also recommended that future studies explore the impact of blended instructional approaches that integrate both knowledge types within authentic learning environments. Finally, teacher training programs should emphasize the importance of conceptual knowledge and equip educators with strategies to foster analytical thinking through meaningful classroom practices.

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Referance

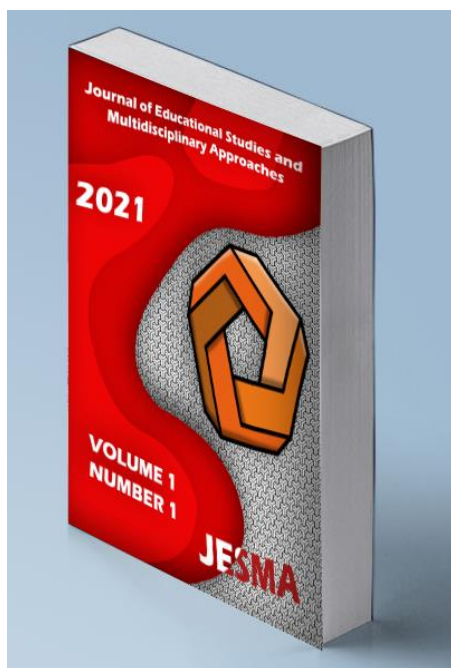
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“I prefer any change to stagnation”: A Discourse Analysis on Teachers’ Voices about their Evaluation, Emotions, and Readiness for Change

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“I prefer any change to stagnation”: A Discourse Analysis on Teachers’ Voices about their Evaluation, Emotions, and Readiness for Change

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ABSTRACT This qualitative study investigates the relationship between teachers’ readiness for change and their emotional responses to the implementation of teacher evaluation reform in Greece. Using mini focus groups comprising 39 in-service teachers and principals, the research explores how emotional dynamics influence educators’ acceptance or resistance to educational reform. Data was analyzed through discourse analysis, revealing a spectrum of emotional responses, including fear, anxiety, anger, and pride. Resistance to change was commonly associated with concerns about job security, lack of trust in evaluators and criteria, and an absence of an evaluative culture. Conversely, some participants demonstrated pride and a willingness to engage in reform, highlighting variability in readiness. The findings emphasize that emotional responses are not merely consequences but integral components of teachers’ professional identities, significantly shaping their engagement with reform processes. A key outcome of the study is the identification of emotional and cultural barriers that inhibit reform implementation. The study concludes that successful educational change depends on inclusive approaches that respect teachers’ emotional realities, promote self-reflection, and foster internal motivation. These insights have implications for policymakers and educational leaders seeking to implement sustainable reforms that are responsive to the needs and dispositions of educators.

Keywords: Emotions, focus groups, discourse analysis, readiness for change, teacher evaluation, educational reform, qualitative inquiry



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Introduction

Educational reforms

The literature on educational reforms is rife with examples of attempted improvements at all levels of the education system (e.g., Holmes et al., 2013; Terhart, 2013; Van Veen & Slegers, 2006); yet most remain unfinished. Earlier reports have alleged that organizational change failures are estimated to occur at 70% rate (Miller, 2001) or even 80-90% (Cope, 2003), even though this has been questioned more recently (Hughes, 2011), especially given that the categorization of an attempted change as a success or failure is highly context-specific (Nilsen et al., 2020). Nevertheless, despite our inability to pinpoint a more accurate rate, the failure of the introduced changes is of major significance due to the severe long-term effects on the entire educational process. More specifically, historically, reforms have been pursued without securing the agreement of teachers, and, moreover, there were no supportive mechanisms for the intended changes (Elmore & City, 2007; Trombly, 2014). Often, previously failed reform initiatives are reintroduced under different names (Goh et al., 2006), proving equally ineffective. The aforementioned observations are similarly relevant to the Greek education system, which has experienced multiple reformative initiatives during the last decades, the most recent of which focuses on establishing school and teacher evaluation systems.

One of the most notable proposed causal factor for educational reform failures is that the execution of most reforms was solely the result of decisions and actions taken by policymakers and bureaucrats, who lacked understanding of school and classroom dynamics, while the perspectives of teachers were overlooked (Moran, 2015), a statement that clearly explains the resistance fostered by a major portion of the teaching community. Generally, education policymakers adopt a top-down strategy in administering the proposed reforms, with the school principals acting as mediators (Ittner et al., 2019; Shaked & Schechter, 2017), anticipating that the entire system will adhere to the specified directives and subsequently undergo the intended change, an expectation that does not often manifest.

This top-down approach in imposing the reforms usually intensifies teachers' resistance and could be evident not only in an organized way, i.e., via the teachers' union associations reactions (Pogodzinski et al., 2015; Young, 2011), but also manifest in teachers' everyday enactment of what is mandated, effectively redefining the reform (Imants et al., 2013). Even though the familiarization with the reform guidelines might result in adjustments in their demeanor (Donaldson, 2012; Fredriksson, 2009), their initial response might significantly influence the implementation of the reform (Ma et al., 2009). Therefore, comprehending the interaction between educators (i.e., their perspectives, emotions, and needs) and the imposed reform demands, may be the crucial element required to enhance the implementation (L. K. Smith & Southerland, 2007).

Resistance to change

Planned top-down organizational changes typically elicit strong protests, primarily from union associations, voicing concerns regarding the potential impact on employees (Bateh et al., 2013). The reactions manifest as resistance to change, mostly fueled by the anxiety and apprehension of organizational members concerning the stability of their employment and professional advancement. In addition to fear, certain employees exhibit a reluctance to engage in learning and skill development (Marsh, 2001). In educational institutions specifically, individuals require compelling justification for changes, which are only occasionally supplied.

Given that resistance to change signifies a breach of trust among the parties involved, it is usually addressed through extensive discourse (Ford et al., 2008). The primary approach to mitigating polarization is the enforcement of change by leadership, which almost invariably results in significant disagreement and subsequently the failure of the proposed policy (Michiotis & Cronin, 2011; Vakola, 2014). Transformations in educational institutions may be realized easier if they align with the local characteristics and represent the educators' perspectives, dispositions, and needs (Kim, 2024; Terhart, 2013).

Research examining the factors influencing educational transformation processes undoubtedly encompasses psychological variables, attitudes, personality traits, and broader organizational issues, the

interplay of which becomes increasingly intricate (Hayward & Spencer, 2010). Thus, it is evident that attempts for reform consistently encounter resistance to change, a deliberate and active stance of employees opposing planned changes (Oreg et al., 2011) linked to social-psychological elements, including fear of the unknown, biases due to previous experience, and social influences (DiFonzo et al., 1994). Conversely, readiness serves as an indicator of people comprehending the significance of change, thus supporting the suggested actions related to it (Teece et al., 1997). The theory in conflict resolution advocates for a transition from the concept of resistance to change to the concept of readiness for change (Armenakis et al., 1993).

Teacher evaluation

Teacher evaluation is a highly contentious issue in education. The rationale for its implementation centers around the pivotal role of educators in the learning process and the pursuit for professional development. The evaluation process involves significant challenges in design and implementation, with a long-term objective of establishing a dependable evaluation system grounded in robust theoretical principles (Kyriakides et al., 2006). It is notable that the policymakers have gradually started to include accountability measures in their evaluation models, in order to enhance the success rate of their implementation (Donaldson & Firestone, 2021).

Depending on the intended aim, the evaluation can be summative or formative. Summative teacher assessment methods are designed for decision-making regarding personnel (i.e., selection, promotions, or terminations) and utilized for accountability to assure teachers' effective performance based on defined standards. On the other hand, formative teacher evaluations emphasize skills development by offering feedback regarding instructional efficacy and highlighting areas for monitoring and improvement, targeted to their specific needs (Bell & Kane, 2022). Even though these types of assessment have distinct and incompatible goals, there have been attempts to combine them in a holistic evaluation system (Buchholtz et al., 2018).

Despite educational researchers expressing a willingness to implement a comprehensive evaluation system, the educational community seems less inclined. Focusing on the Greek educational system, there is a considerable resistance to every attempt to introduce an evaluation system during the past five decades due to various political and ideological factors. Notably, only in 2011 did the Ministry of Education introduce the school self-evaluation as a precursor of teacher evaluation. Teacher assessment gained significant public attention and extensive media coverage due to several factions expressing conflicting ideologies and advocating contrasting viewpoints, employing various measures such as strikes, school closures, and demonstrations.

Educational change and teachers' emotions

Change should not be regarded as an organizational issue, but rather as a circumstance to which organizations need to adeptly respond to (Kiel, 1994), and this is a stance that can refer to educational organizations, as well. What is of paramount importance is that changes in status and emotions are interrelated and co-occurring, in a perpetual flux, denoting the crucial role of the latter. Indeed, the numerous changes that educators undergo throughout their careers, though not always major, may lead to emotional cost (Schutz et al., 2006), with extensive educational reforms inducing the most profound psychological distress (Hargreaves, 2004, 2005).

Uncovering the workplace emotions of educators about their profession and reforms is essential for understanding their attitude towards change. Teachers often demonstrate significant excitement for various aspects of their work environment, including pupils, the educational institution, and other pertinent individuals, substantially influencing their professional effectiveness and development. Furthermore, the workplace emotions are primarily rooted in cognition; therefore, emotional reactions are inextricably linked to associated perceptions and value judgments as well as to the social and cultural framework, affecting the social environment (Nias, 1996).

Educational reforms are primarily articulated in technocratic language, focusing on their logical dimensions while neglecting the intricacies of emotional factors. Emotions are frequently sidelined and often excluded from comprehensive planning, perpetuating the prevalent, albeit misguided, notion that

they are uncontrollable and detrimental, and juvenile, while the attainment of professional objectives necessitates solely logic, knowledge, and mature conduct (Sutton & Wheatley, 2003). Teachers, although being the crucial element for successful reforms, hardly participate in the formulation processes. This has consistently resulted in impasses as it fails to foster the requisite trust for implementing reform; instead, it exacerbates suspicion and undermines professional values, particularly in contexts where hierarchical evaluation relies solely on quantifiable metrics (Levitt et al., 2008). Thus, educational reforms may result in sentiments of loss, disappointment, dissatisfaction, and confusion about their scope (Goodson, 2001; Hargreaves, 2004; Walland & Darlington, 2021). Those feelings may be intensified by the perception of changes as something temporary and transient, thus unworthy of the investment of time and effort for successful implementation (Clement, 2014). On the other hand, negative emotions are also prevalent when the teachers predict that the changes will lead to long-lasting damaging effects (Walland & Darlington, 2021).

The emotions encountered by teachers, arising from their work environment, are typically characterized as positive and negative. The predominant positive emotions include love, joy, satisfaction, pleasure, and pride, whereas the negative emotions encompass fear, rage, disappointment, anxiety, and humiliation (Darby, 2008; Sutton & Wheatley, 2003). As to the positive emotions, the sense of pride is associated with educators' perceptions of their self-efficacy, their rapport with students, mental well-being, and emotional fatigue (Taxer & Frenzel, 2015). Teachers derive significant pride from outcomes associated with their instruction, including improvements in student performance, acknowledgment of their pivotal role (Darby, 2008), and the attainment of educational objectives (Schutz et al., 2006).

Regarding reforms, a certain level of apprehension is anticipated (James, 2010); however, elevated levels of anxiety and intense reactions frequently arise when educators are displaced from their instructional responsibilities and required to address external factors, such as teacher evaluations, which are considered as threatening (Nias, 1996). Their response is contingent upon the opinion they will develop, i.e., when deemed positive it pertains to the generation of pleasant emotions; conversely, if the circumstances are perceived as threatening, negative emotions such as worry are expected to arise (C. A. Smith & Lazarus, 1993). Teachers experiencing significant emotional stress may respond to reforms in counterproductive manners if timely management measures are not implemented. The strategies typically employed to address the stress associated with reforms do not directly address the issues at hand, but, instead, they mainly aim to comfort, ultimately affecting the teacher's efficiency and hinder the attainment of reform objectives (McCormick et al., 2006; Zembylas, 2010).

When reforms are implemented without prior consultation, teachers respond with significant feelings of disruption and anger, as they perceive the imposed implementation as a sign of lack of respect from the central administration's part and believe that these changes divert their focus from the primary responsibility of teaching (Hargreaves, 2004). To mitigate negative emotions, it is essential to establish a supporting network in the workplace, foster collectivism, and cultivate a secure working environment (Tuytens & Devos, 2010).

Methods and Materials

Objective and Research Questions

The aim of this paper is to contribute to the ongoing debate on the importance of the readiness of recipients with regards to the implementation of changes. Specifically, the change studied concerns the teacher evaluation reform. The choice of this specific change was made because, in the Greek educational system, multiple reform attempts in the last decades have failed, where the degree of readiness of teachers and their emotions have been totally ignored by the planning of political strategies. In this context, the focus is to examine teachers' readiness for change, particularly regarding teacher assessment, by exploring their ideas and emotions, acknowledging their critical role in implementing changes. The research questions were:

- What specific emotional traits indicated teachers' readiness or resistance to change and evaluation?
- How are they expressed and communicated in their discourse regarding the teacher evaluation?

- Do they convey a need for change or rather maintain the status quo?
- Do they reflect upon their personal and collective actions regarding their readiness for change?

Research context and participants

The teachers' attitudes and emotions regarding the change in assessment were probed in a crucial period, just a few years after the implementation of a new generalized evaluation system. Therefore, it was deemed the proper time to get suitable feedback from teachers in order to understand, in depth, their experiences, provided them with the opportunity to talk about them at length and share them with others. In this context, we chose to conduct small groups interviews (mini focus groups; see section Data collection) so that participants would adequately express themselves by interacting with a small number of people.

The mini focus groups comprised in-service, tenured teachers and school principals who engaged in the recent evaluation process. Thirty-nine teachers (13 men and 26 women) participated, with an average of 17 years of experience. Twenty-three of them hold a bachelor's degree, 16 a master's degree and 1 a doctorate degree. Six were school principals, averaging 9 years of experience in leadership roles. Our mini focus groups are homogeneous (Flick, 2006), comprising public in-service teachers who share same evaluation experiences from recent years. The typical group size for each session was 3 and the maximum was 5.

Data collection

Our research focuses on teacher evaluation, which encompasses political, pedagogical, and educational elements that educators, both individually and collectively, engage with in diverse manners (de Ibarrola, 2018) that influence the extent of their readiness to embrace or respond adversely to any evaluative procedure. To facilitate interaction and uncover both the personal and collective opinions and emotions, we chose focus group method. Focus groups facilitate interaction and engagement, enabling the dynamics within groups to reveal elements and views about the issue under investigation that would be challenging to uncover through alternative approaches, as they allow collective memories and aspirations to surface (George, 2013).

The organization of focus groups must be guided by research inquiries and methodological framework. Typically, the number of participants in focus groups addressing non-commercial objectives is 6-8 individuals. Nevertheless, for subjects of particular interest or when a significant degree of specialization is required, mini focus groups are more advantageous. Mini focus groups are characterized by having fewer than six participants to enhance engagement in the discussion compared to traditional larger focus groups (Greenbaum, 1998). In literature, mini focus groups of experts have been conducted in various research fields, particularly within various scientific disciplines requiring high specialization, such as pharmaceutical interventions (Meurer et al., 2016), software architecture (Bonnington & Rose, 2014; Galster & Avgeriou, 2011), and mental health (Bonnington & Rose, 2014; Gibbs et al., 2002).

Prior to the commencement of the mini focus groups, we briefed the participants with the objectives and anticipated benefits of the research. Previous contacts provided clarifications on all matters pertaining to the study that may affect the participants, and logistical details regarding the timing and location of the meetings were also organized. The initial pilot mini focus group convened to ascertain the discussion topics, highlight aspects of the process requiring attention, and determine the transcription methodology. The subsequent 12 meetings were conducted at venues accommodating the participants, i.e., some occurred on the University premises, others in their schools, and one took place in a library, empty during our visit. We made provisions to guarantee that the discussions occurred with minimal external noise, and the likelihood of any external interruptions being negligible (in fact, none occurred during any of the meetings). Moreover, all venues possessed a recognizable atmosphere

familiar to the participants, which we believed would facilitate their comfort in expressing themselves freely. One or more weeks elapsed between the meetings to permit adequate time for transcription.

The average duration of our meetings was 62 minutes. To define the conversation topics, we provided the dimensions of the research interests, a strategy that we favored over specific questions to promote immediacy and minimize formality, while mitigating the possibility of discussions diverging into other issues. The recording devices were positioned throughout the venue to mitigate the risk of technological malfunctions or inadequate capture of dialogue. The limited number of participants and the subdued environment enhanced the clarity when the discourse overlapped.

The method of transcribing audio recordings into text affects the emergence of first concepts and the level of comprehension of the spoken content (Gibbs et al., 2002). The transcription was conducted by the first author with meticulous efforts to achieve the highest level of correctness. The final written transcriptions were verified by the second author, who listened to the recordings while concurrently reviewing the transcripts. The level of consensus was exceptionally high, with disagreements being few, primarily occurring during simultaneous remarks by two individuals.

The study was conducted according to the guidelines of the Declaration of Helsinki and involved adult participants. During the recruitment stage, a cover letter was provided explaining the purpose of the study, that participation was voluntary, and that the data would remain confidential. The participants signed an informed consent form and were given the option of removing themselves from the mini focus groups at any time. During the data transcription, a unique code was assigned to each participant so that they would remain anonymous.

Data analysis

The preliminary organization of the transcript data, encompassing the speaker's demographic attributes (gender, specialization, experience, educational level, and leadership position), was conducted concurrently with the input of the final texts into Atlas.ti9.

The initial phase involved the preliminary analysis of the data, which should be conducted not just in the linguistic component of the text but also the connotations (Mason, 1996). The objective was to understand the significance of specific remarks, examining any nuances in the dialogue process. To make sure we adequately captured the tone, pauses, and overlaps, we concurrently listen to the meetings. The codes were developed and revised with their annotations in a lengthy process. In every instance, the fundamental provision was that each code originated from specific data, by being consistently linked to a collection of excerpts (Mason, 1996). To further clarify this process, each of the four research questions explicitly guided the coding framework: for example, RQ1 ('What specific emotional traits...') informed codes under Theme B (fear, anger, pride), while RQ3 ('Do they convey a need for change...') aligned with Theme A (status quo vs. renewal). This ensured that codes were not only inductively derived but also systematically anchored in the research questions. Furthermore, to move beyond description, the coding process also involved iterative comparison between excerpts and emerging categories. This analytical step required us to ask how teachers' statements not only described experiences but also revealed underlying assumptions about evaluation and change. By clustering codes according to these interpretive connections, we were able to justify the transition from raw textual data to broader themes such as "Maintaining the status quo" and "Emotions about change," consistent with the emphasis on meaning-making in qualitative analysis (Gibbs et al., 2002; Guba & Lincoln, 1982).

The rigor of this research was evaluated for its trustworthiness using the criteria of credibility, transferability, and dependability (Lincoln & Guba, 1985), by conducting mini focus groups that developed organically between the participants with minimal interruptions by the researcher, employing theoretical sampling, implementing synthesized member checking, overseeing the researcher's subjectivity during the research process through memoing, debriefing with the research group, reflective notetaking, and recognizing preconceptions prior to the initiation of the study. Moreover, Atlas.ti9 software was utilized to code the data obtained. The "Intercoder Agreement" function was carried out to assess dependability, utilizing Krippendorff's α analysis approach, subsequent to the completion of coding all 12 transcripts. The two authors applied the established coding system, supplemented by comprehensive comments elucidating each code and sub-code, to three of the twelve transcripts. The

outcomes were satisfactory, as the overall Krippendorff's α was .807. The decision to select three transcripts (i.e., 25% of the total number of transcripts) was made to balance breadth and feasibility, ensuring diversity of groups while avoiding redundancy. This approach is consistent with recommendations in qualitative reliability testing, where a subset can provide robust evidence of coding dependability (Campbell et al., 2013; O'Connor & Joffe, 2020).

Results

The data and code processing were nonlinear, often requiring revisiting specific points and codes and discussion among the researchers. Despite a foundational categorization of the main themes assigned to the mini focus groups, the approach was predominantly inductive. Ultimately, 5,867 snippets were generated from the 12 transcribed papers, categorized into 189 codes (including the software's automatic categorization of mini focus groups) and 208 memos. The data resulted in two themes relevant to the purpose of this study, i.e., A. Maintaining the status quo and B. Emotions about change and teacher evaluation. The data were categorized within each theme to aggregate comparable information, discourse, and experiences. A summary of themes and categories is presented in Table 1.

Table 1. Summary of themes and categories

Theme A: Maintaining the status quo	Category A.1: Maintaining the existing professional status Category A.2: Maintaining the existing evaluation framework Category A.3: Versions of change Category A.4: Self-reflection
Theme B: Emotions about change and teacher evaluation	Category B.1: Emotions about change Category B.2: Concerns about evaluation methods Category B.3: Fear Category B.4: Anger Category B.5: Pride

Note that, in presenting results, we explicitly connect quotations to the two overarching themes, thereby illustrating how interpretations directly emerged from the data.

Theme A: Maintaining the status quo

This theme included excerpts that related to participants' perceptions of maintaining their existing employment status and the absence of generalized evaluation.

Category A.1: Maintaining the existing professional status

Participants in nearly all sessions recognize the significant hesitation of themselves and/or all educators to implement changes in their career. Preserving the existing status quo provides stability and consistency in their everyday lives, alleviating emotional strain and the associated negative repercussions in both professional and personal domains.

[P12, Female, 30-35 y.o., Bachelor's, Greek language, Experience: 9 years]

We are wary of the new, of the different; we want the usual, what we [already] have, [which] doesn't take us out of our routine.

[P15, Female, 41-45 y.o., Bachelor's, Greek language, Experience: 16 years]

That is, when you see that someone is a person of routine and anything that slightly deviates from the routine, they go crazy, for example, they don't know what to do, from there on they carry this over into everyday life, into their professional life.

Their justification for the aforementioned include an unwillingness to embrace different pedagogical approaches due to the increasing amount of workload. The tension between the inclination to preserve

the familiar and the necessity for renewal, which demands effort and time for preparation and execution, is highlighted.

[P09, Female, 46-50 y.o., Bachelor's, Elementary school teacher, Experience: 17 years]
They favor strictly adhering to the content of the textbooks, as it necessitates a considerable effort to prepare project-based activities and implement alternative teaching methodologies, such as collaborative learning, which may lead to conflicts.

This is attributable to a general skepticism regarding reforms and their reliability, since their viability over time remains uncertain.

[P17, Female, 46-50 y.o., Bachelor's, Greek language, Experience: 17 years]
But it's what you hear every year, the scaremongering, let's say this, and then everyone forgets about it and the story ends there. There was a lot of fuss, let's say, about something that [in the end] doesn't apply and doesn't last.

Inactivity, stemming from the aforementioned factors, has become an integral aspect of teachers' professional identity, which is notably apparent and, to some degree, arguably anticipated. The lack of evaluation discourages them from doing new things, as they find comfort in their current circumstance, which further entrenches their work routine.

[P21, Female, 41-45 y.o., Master's, English language, Experience: 16 years]
I believe that it's tiresome to change; since I've learned it this way now, why would I go through the process of changing anything I do in my daily life. [ironic]

[P22, Male, 46-50 y.o., Master's, Physics, Experience: 19 years]
[...] but we are on the safe side, because no one bothers us to do it that way, that is, essentially, it is not imposed on us, nor do we participate and that's how we get comfortable.

[P29, Female, 36-40 y.o., Master's, Greek language (Sp. Ed.), Experience: 5 years]
Based on my own experience teaching to many schools, change is difficult for teachers who have been well-rooted in their schools for years; they cannot accept it.

Category A.2: Maintaining the existing evaluation framework

More specifically, the perceptions they articulated regarding the reasons for the persistence of the current situation align with their positions on the evaluation. The challenge of preserving the existing status quo is closely tied to the assessment and upkeep of their professional standing. Specifically, it is expressed that a potential job transition following evaluation may result in a new status devoid of work benefits, such as selecting the subjects to teach. This notion is also associated with potential teacher terminations, based on a ranking of schools depending on the evaluation results.

[P11, Female, 41-45 y.o., Bachelor's, Greek language, Experience: 16 years]
The issue is the second thought that comes to us afterwards, will I lose my permanent position; will I rank last [in the evaluation results]; if I am the last one placed in a school unit, I will have to teach the subjects that will be left for me by my colleagues; I will have to teach subjects that I don't want to. Then all these things, that are not unfair per se, add up, because, as the years go by, the truth is that our own decline also comes, both biological and from everything else. Thus, I start thinking 'I'm fine here, let someone new come'!

[P11, Female, 41-45 y.o., Bachelor's, Greek language, Experience: 16 years]

Why bother, I'm fine, I'm here, let a substitute come, a Greek language teacher for example, to whom we'll leave whatever [subject] we don't want and that's fine. It takes courage, it takes generosity. We're not giving in general; we're not giving in our work.

[P32, Female, 36-40 y.o., Bachelor's, Elementary school teacher, Experience: 8 years]

I believe that because we don't want to look at reality a little, to understand if we are good or not, we avoid it and it is in our best interest to say: "Oh, it won't happen because I will lose my job." No one has lost their job in the rest of the public sector that is being evaluated, I think.

Alongside issues over the preservation of tenured positions, the lack of evaluation is a serious issue, as it fosters the perpetuation of the status quo, which educators uphold either directly or indirectly. Their reactions are specifically situated within this context, and the hindering factors they reference, such as the distrust for the evaluator, obscure their genuine need for their circumstances to remain unchanged.

[P02, Female, 46-50 y.o., Bachelor's, Greek language, Experience: 12 years]

I get the impression that we start with an attitude that we don't want an evaluation; and when we don't want an evaluation, we don't like this, we don't like that, we don't like the other; I have this feeling. We are comfortable, as we have now proceeded without an evaluation and nothing bad happened, so why shouldn't we continue like this? Thus, we create obstacles; that is why there is always the bad evaluator; whoever he is, he will be bad.

The lack of evaluation has led to instructors, even if they are not numerous, resisting any change that may reinforce the qualitative distinction between competent and less competent educators. This stance, while acknowledged, does not appear to be universally accepted, and despite the absence of an evaluation culture, there is support for the notion that it should be associated with work-related repercussions. Participants assert that culture is a mutable quality, which can consequently facilitate the acceptance of evaluative outcomes, thereby prompting the most appropriate responses from educators to their professional responsibilities.

[P20, Female, 36-40 y.o., Master's, Greek language (Sp. Ed.), Experience: 8 years]

I think there is another reason because after all, all these years there was no real serious evaluation and we have learned that we are appointed; and then, even if I drink coffee during class, or rather if I am useless, I have no penalty and I get paid the same as the colleague who does a very good job. This is a fact, look, so I continue like this; why should I accept anything to change?

[P05, Female, 56-60 y.o., Bachelor's, Greek language, Experience: 28 years]

It is very deeply rooted, what I said; we do not have an evaluation culture. This must be uprooted and replaced with something else.

They recognize that the evaluation culture has not been adequately developed or is entirely absent among educators who are reluctant to embrace any changes in their professional circumstances. Ultimately, it is something that is deeply rooted both as practice and as an idea. Their concerns center on the methods by which any assessment might be implemented.

[P05, Female, 56-60 y.o., Bachelor's, Greek language, Experience: 28 years]

We don't have an evaluation culture, that's what scares me; that is, because we haven't been evaluated and those who evaluate haven't been evaluated either, who will evaluate me? We haven't learned to evaluate or be evaluated in general; not only as school life, in general as a society. This is automatically very difficult to change, to go from no to yes, to go abruptly to yes. That is where my fear starts. It is not the evaluation itself that scares me; it is how it comes about.

[P30, Male, 56-60 y.o., Master's, Elementary school teacher, Experience: 18 years]

Let me tell you why. Because they have learned to operate in a certain way and that stresses them out, it makes it difficult for them. They haven't learned to evaluate themselves. Evaluation requires a culture; [requires] learning evaluation; they haven't learned it.

The rejection of evaluation also highlights disparities due to age and proximity to retirement. Nonetheless, regarding age, the participants' stances seem rather ambiguous, and the anticipated work tiredness typically associated with teachers with many years of experience is also observed in younger educators who exhibit a degree of sluggishness. Moreover, progressiveness is not inherently bestowed upon younger educators, a fact that seems to astonish the participants as it deviates from conventional expectations.

[P28, Male, 51-55 y.o., Bachelor's, Informatics, Experience: 12 years]

[An obstacle is that] some people are close to retirement, and they don't want to do anything else.

[P39, Female, 41-45 y.o., Master's, Greek language, Experience: 10 years]

If I had to say from my experience who fears it the most, it's the elderly who are approaching retirement age and don't even want to think about it; the older they get, the more... Most of the people I've met, it kind of stresses them out!

[P13, Female, 41-45 y.o., Bachelor's, Greek language, Experience: 15 years]

I mentioned age, given that, if you are younger, and I don't know if you will disagree, you are more receptive because you have the a lot of years ahead of you and you can say "I have to work, I will make these changes"; while an older colleague, [and this is something that] I have heard them in various meetings, say: "Oh boy now I have a few years ahead of me!"

[P37, Female, 46-50 y.o., Master's, Greek language, Experience: 17 years]

From what we see, sometimes it impresses me that I find them [younger teachers] very bored, for their age. We are 45–50-year-olds and we have more desire to do [new] things, to educate ourselves for what can we do. These children...; I find them somewhat sluggish for their age. And it is also the opinion of other colleagues I have discussed it with.

Category A.3: Need for change

The many interpretations of change are examined in relation to its significance for participants, with a primary emphasis on educational reforms, specifically evaluation. These viewpoints encompass a broad conceptual range, beginning with a favorable disposition towards change, regarded as a facet of renewal, and as an internal process that initiates at the individual level, subsequently extending to the school unit and, from there, to the educational system as a whole.

[P14, Female, 56-60 y.o., Bachelor's, Greek language, Experience: 29 years]

I prefer any change, it's hard to deal with change, but I prefer any change to stagnation.

[P30, Male, 56-60 y.o., Master's, Elementary school teacher, Experience: 18 years]

It is possible for change to happen. People go through internal change, which takes shape over time. This change also affects school and education in general.

The defining characteristic for approving reform is if it is considered positive, i.e., if it aligns with progress. Although this is not always self-evident in the context of education, for a change to be deemed acceptable, it requires to be backed up by science.

[P16, Female, 46-50 y.o., Bachelor's, Greek language, Experience: 20 years]

When I ask you if you want to change, it's obvious that I'm not asking you to become worse. Because if it's about becoming worse, losing something, you'll say no. So, change has to do with something different, it has to do with progress.

[P38, Male, 41-45 y.o., Master's, Greek language, Experience: 10 years]

They are in line with new scientific data, of everyday life theoretically, at least.

The participants consistently agree that change needs to have a beneficial impact on educational growth. The fundamental aspect of the changes is their internal origin; no substantial transformation can take place without stemming from the individual's intrinsic desire for change, and in this context, official regulations wield limited influence.

Category A.4: Self-reflection

Participants articulated their views on the lack of acceptance of changes. The predominant response to the changes, they contend, is the instructors' unwillingness to acknowledge them, even as a foundation for discourse, a phenomenon they ascribe to distinctive traits that have emerged within the educational community. Moreover, the replies occasionally appear to suggest that teachers' initial response is that no change can occur, before even acquiring a comprehensive understanding of the reforms.

[P16, Female, 46-50 y.o., Bachelor's, Greek language, Experience: 20 years]

In the educational community, as a whole, we tend to complain!

[P17, Female, 46-50 y.o., Bachelor's, Greek language, Experience: 17 years]

We complain without knowing all the facts!

[P13, Female, 41-45 y.o., Bachelor's, Greek language, Experience: 15 years]

On the one hand, it caught us unprepared, but on the other hand, our first reaction was, "It won't go ahead, it won't go ahead." Always; [...] So, we too operate with a childish mentality, initially with "no, I don't want it..."; perhaps we should be a little more receptive; perhaps less skeptical.

The self-reflection disposition is evident in their professional roles and in their decisions on job-related personal development. They acknowledge that they do not fully use all opportunities for personal development and the advancement of their knowledge and abilities. They also perceive that professionalism is deteriorating.

[P10, Male, 46-50y.o., Bachelor's, Physics, Experience: 14 years, Leadership experience: 2 years]

I think we are not professionals. We, teachers, are amateurs. Take a professional, a plumber for example. If the plumber doesn't get the new machine, doesn't learn the new idea, he will be out of a job; you won't call him back. We are there; they have hired us and everything is fine; it's unbelievable. We are not professionals; [...] nor do we want to search, to find something new, nor do we like it!

[P11, Female, 41-45 y.o., Bachelor's, Greek language, Experience: 16 years]

[Many teachers think] It's just forty-five minutes, they'll fly by. I can handle it.

The reasons for teachers' resistance to change are attributed to the fact that the educational community is conservative and they do not intend, as a formed culture, to make changes, even if they are deemed necessary.

[P08, Female, 46-50 y.o., Bachelor's, Elementary school teacher, Experience: 17 years]

I generally think that teachers are more conservative and don't really want changes.

[P33, Male, 41-45 y.o., Bachelor's, Mechanical engineer, Experience: 13 years]

The concept of change for teachers? The teaching profession is conservative; the concept of change is not easy. Basically, it is conservative to ultra-conservative... Even those who behave and lead in schools as progressives; I believe that they are pretending; in essence they are the most conservative. Why? Because they simply express the opinions that will make them likable, not what is necessary.

Participation in dialogue and co-decision on educational changes in general is not mandatory, because the participants acknowledge the substantial input from authorities that offer guidance on changes, while allowing considerable margins of flexibility in implementation. Conversely, evaluation has not been afforded the same consideration, because the "top-down" methodology is regarded as imposition, and the educators' stance lacks coherence between rhetoric and practice.

[P30, Male, 56-60 y.o., Master's, Elementary school teacher, Experience: 18 years]

No, not necessarily, the evaluation will be enforced. [...]

Because teachers are not mature; because they say we are all in favor of evaluation, but they don't want it. [...]

Everyone says that; if you ask them, they will tell you: "Yes, of course, we are in favor of evaluation". But why do they say that and not do it?

Participants assert that factors deterring the acceptance of changes, such as the absence of a reflection culture and collaboration, ought not to serve as impediment. Moreover, the importance of collectively addressing hesitation to implement necessary reforms is underscored.

[P35, Female, 36-40 y.o., Master's, Greek language, Experience: 12 years]

This is my opinion; we are not ready for change because we do not have a culture of collaboration; because we do not have a culture of reflection; because we do not have a culture of self-evaluation. This is what I believe.

[P34, Male, 56-60 y.o., PhD, Elementary school teacher, Experience: 33 years, Leadership experience: 21 years]

All this that [P35, above] says should not be; this reasoning should not be a deterrent to moving towards a change. The fact that we are afraid, that we do not trust, that we are not ready should not be a deterrent. In other words, the move forward must be made.

The maintenance of the existing status quo and the reluctance to accept changes in education are recognized by the participants as an already established reality. They take a self-critical perspective, asserting that the familiar is distinctly preferred and that a conservative ideology is established, serving as a barrier to the acceptance of change.

Theme B: Emotions about change and teacher evaluation

This category encompasses excerpts pertaining to participants' stated emotional responses to teacher evaluation. Emotional responses extend beyond this category, coexisting in nearly all others, with emotional declarations and connotations enhancing the meaning of other passages.

Category B.1: Emotions about change

The emotional ramifications of change, as indicated in the participants' accounts, are profoundly powerful and predominantly unfavorable. The extensive breadth and multitude of changes in recent decades, which have neither enhanced education nor consistently been appropriate, have fostered an atmosphere of skepticism and apprehension over new suggested reforms. The tone of the statements and the rather definitive nature of the opinions reflect a degree of self-assurance and conviction in the critique they convey.

[P25, Female, 46-50 y.o., Bachelor's, German language, Experience: 16 years]

I don't see them in a good light. [...]

Because my experience has shown that they are never done for a good reason.

[P24, Female, 56-60 y.o., Bachelor's, Greek language, Experience: 26 years]

Nothing is happening, nothing has changed for the better in the last 30 years. Good books have been abolished; good courses have been abolished; what has it brought us?

As discussions advance, discrepancies from the original favorable perspectives arise in various instances, exacerbating problems, particularly when considering the emotional toll associated with these changes. The abrupt nature of them, coupled with the lack of preparation of teachers for their implementation, stimulates profound unease and apprehension. The emotional stress also leads to a degree of bewilderment concerning the beliefs about the participants' professional competence.

[P17, Female, 46-50 y.o., Bachelor's, Greek language, Experience: 17 years]

I remember that I was... while before I stated that I believed in changes, I was very afraid of changes; and because I had to work...; because, not to fool ourselves, you sink or swim in the system.

Concerns and apprehensions regarding changes in educational are multifaceted, originating from several dimensions, such as political accountability for sufficient information, individual insecurities, the inclination to preserve the status quo, the conservative ethos of the field, and the influence of trade union entities. Despite emotions, primarily articulated or unarticulated fear, they cultivate a disposition of profound self-criticism regarding their individual and communal contributions to this predicament, coupled with a drive to surmount challenges.

Category B.2: Concerns about evaluation methods

The emotional responses, particularly the level of anxiety stated by participants regarding the evaluation and its processes, complement those concerning the changes in general. Diverse components of the evaluation serve as catalysts for the issues, and the professional dimensions they address are multifaceted. The primary concern is the professional identity of the participants, but, if emotional barriers are surmounted, there is the potential to enhance both the teachers' self-perception and the societal esteem of the teaching profession.

[P04, Female, 46-50 y.o., Bachelor's, Economics, Experience: 12 years]

I agree, as well, as much as this scares us, it is not pleasant for anyone to be evaluated, at any level and sector of their life, but it must be done and I believe that it is good for [themselves] and for the local community and for the educational system to ... give a reason; because in this way we all believe that work is not being done; [because lots of people express] "you have filled your positions, you don't care, only in the private sector is work being done and in the public sector nothing". As much as it scares someone, the evaluation must be done.

The discomfort due to evaluation is also associated with the observation of instruction. The sentiments of unease associated with observation do not arise directly from the notion of evaluation but rather stem from the lack of prior observational experiences. These emotions are deemed tolerable, provided that appropriate settings are established or pertinent experiences are obtained. The primary insecurity linked to such evaluative techniques appears to be the potential connection to termination.

[P03, Male, 61-65 y.o., Master's, Greek language, Experience: 25 years, Leadership experience: 5 years]

If there are ten meetings, my unease will go away, and if I'm sure I'm not in danger of being fired, let's face it, my unease will go away again.

Throughout the mini focus groups, participants proposed recommendations for every facet of the evaluation. This signifies their readiness to embrace changes and assessment, indicating that conversations and the potential collaborative development of an evaluation framework should not be inherently dismissed. It is crucial that the needs assessment and pertinent training - especially for individuals lacking prior experience with the relevant processes - are identified as essential components.

Category B.3: Fear

In the discussions, particularly when addressing institutional texts or specific evaluating situations, the prevailing feeling was fear. It manifests with varied intensity, either explicitly or implicitly, and is predominantly associated with the preservation of employment status (both position and conditions). The emotion of fear is multifaceted and manifests across all analytical categories, where factors that generate or exacerbate it are identified, according to educational changes in general and in evaluation. Educational reforms and evaluation cause cognitive and emotional responses, mainly the fear of termination or stagnation in salary progression, thus exacerbating the pre-existing sentiment of chronic anxiety. This combination serves as a catalyst for resistance to change and is so robust that it diminishes the perception of any potential improvement, even in the long term. Thus, teachers seem reluctant to embrace the notion that evaluation can facilitate improvements in the educational system.

[P02, Female, 46-50 y.o., Bachelor's, Greek language, Experience: 12 years]

Here another issue arises; we are open to the concept of termination?

[P03, Male, 61-65 y.o., Master's, Greek language, Experience: 25 years, Leadership experience: 5 years]

To play the role of, let's say, union advocate; it's when the evaluation brings the bogeyman of termination or wage stagnation; [then] it creates a, how should I put it? A defense trench; "no to the evaluation."

[P11, Female, 41-45 y.o., Bachelor's, Greek language, Experience: 16 years]

How will we help ourselves and how can we help both colleagues and students in this unclear landscape; and because in Greece we have a permanent phobia when we hear the word "evaluation"; because we associate it with salary developments, with whether or not I will have a job tomorrow; [thus,] ultimately, we reject anything that can take us a little further.

Fear primarily pertains to the preservation of one's occupational status. Nonetheless, certain aspects of the working environment may vary following the evaluation's implementation, eliciting a response characterized by a potentially diminished apprehension. One concern is that the evaluation may induce friction in colleague relationships. This scenario reveals the adverse consequences of teachers striving to fulfill the institutional self-evaluation criteria due to concerns about disturbing the existing cooperative atmosphere.

[P03, Male, 61-65 y.o., Master's, Greek language, Experience: 25 years, Leadership experience: 5 years]

We'll stick to that and not get into the gist. A colleague won't dare say "I do five things and you do two" because he won't have any reason to start a fight.

The intricacy of the factors that induce or contribute to sentiments of fear regarding evaluation extends beyond the lack of prior experiences; the ambiguities of the methods are also very influential. The lack of a well-defined evaluation culture affects not only teachers but, more significantly, the evaluators, expressed as a questioning if they have undergone evaluation themselves. The pervasive distrust and the overall deficiency of assessment at all levels also contribute to this issue. Thus, the adjustment is very challenging, and the emotions it elicits serve as an additional deterrent.

[P05, Female, 56-60 y.o., Bachelor's, Greek language, Experience: 28 years]

We don't have a culture of evaluation; that's what scares me [...] and those who evaluate haven't been evaluated either! Who will evaluate me? [...] So, my fear starts from there; not the evaluation itself, I'm afraid of the way of evaluation.

In conjunction with the evaluator, they also highlight the contribution of the relevant criteria that will be utilized in the assessment on their fear development. The belief that educational work is immeasurable serves as a source of both anxiety and apprehension. The emphasis on formal or quantifiable qualifications acted as a deterrent, as participants express fear about being terminated due to lack of official documents to prove skills they obtained in practice or through non-institutional means.

[P02, Female, 46-50 y.o., Bachelor's, Greek language, Experience: 12 years]

Another reason that it is scary, and many are against it, is what exactly will be evaluated, that is, the measurable [i.e., official documentation] and the non-measurable. Is it possible that most of our work is non-measurable?

Fear may be exacerbated by the necessity to uphold routine, the perceived professional inadequacy stemming from significant emotional strain, insufficient mastery of the subject matter, and the insecurity linked to the "opening" of the classroom to external scrutiny during observation.

[P29, Female, 36-40 y.o., Master's, Greek language (Sp. Ed.), Experience: 5 years]

Assessment is scary and do you know why it is scary? Because, unfortunately, when there are teachers who have been in education for many years and learn in a routine, they come in, complete their lesson, and leave.

[P02, Female, 46-50 y.o., Bachelor's, Greek language, Experience: 12 years]

A group gets scared when they don't do their job properly.

[P07, Male, 46-50 y.o., Bachelor's, Mathematics, Experience: 15 years]

I believe that someone doesn't want an evaluation when they feel they are inadequate. If they feel they are not, there is no problem there, as long as the right grounds are in place. And so, if I feel inadequate...; those who aren't [adequate] feel it, know it, don't you assume that they don't know it. I am sure, in other words, that those who feel that they don't do their job well know it very well.

Fear, as indicated in the participants' accounts and connotations, was the predominant emotion, significantly influencing the emotional atmosphere. The factors contributing to varying intensity of fear appear to be associated with the uncertainty surrounding procedures, a deficiency of trust in evaluators and criteria, and educators' subjective perception of inadequately fulfilling their professional responsibilities.

Category B.4: Anger

In the context of anger, a notable observation emerged: while the cognitive and emotional responses of participants to the changes and the more abstract notion of evaluation were predominantly positive or mildly negative, there was a complete absence of anger. Conversely, anger, at times intensely, is associated with specific evaluative processes, such as making it mandatory to declare 10% of the teachers in a school unsatisfactory. Participants' anger targets the institutional texts and the implementation processes, expressing concerns of professional insecurity and the distinctive behaviors of various agents responsible for the evaluation.

[P34, Male, 56-60 y.o., PhD, Elementary school teacher, Experience: 33 years, Leadership experience: 21 years]

I think, that is, given that I am also in favor of the evaluation, we were scared by the evaluation that was proposed, which had a quota. I think that this method of evaluation made them treat the evaluation as the worst thing that could happen, because it seemed that it was not intended to provide feedback to the teacher but how to terminate some. [...] That is when we reacted. So, I, who am in favor of the evaluation, was the first to be against this type of evaluation [...] and of course the teachers were against it, as well! And, at that time, I was a principal, and I was worried. Is it possible for something like this to happen? In other words, do I mandatorily have to declare one teacher unsatisfactory out of the 10 in my school? If the school next door has two [unsatisfactory] and I don't have any, how will it be done?

The school self-evaluation involved aspects that, with other emotions, also elicited anger. The implementation was characterized by pretentiousness, prioritizing logistical infrastructure over fundamental instructional aspects, which were thus diminished. The administration's conduct incited outrage, as it relinquished its obligations and opted, in certain instances, for favorable yet superficial implementation of the evaluation process.

[P07, Male, 46-50 y.o., Bachelor's, Mathematics, Experience: 15 years]

[When the school unit's self-evaluation was done, the criteria] were building-related; they were sports facilities; they were a bunch of nonsense; and I saw them and my hair stood on end. What can I tell you now? They weren't the essence of education, which was the lesson, the collaboration between the teacher and the student.

[P36, Male, 51-55 y.o., Master's, Greek language, Experience: 29 years]

An example was when this self-evaluation was implemented; there were some questionnaires where the deputy principal handpicked five students who would write positive comments; I got furious, I started shouting in there. But this is the situation...

Anger, at times fiercely, is linked to certain evaluative processes. They focus on the pretentious nature of the procedures, emphasizing issues of professional insecurity and the unique behaviors of different agents involved in the evaluation.

Category B.5: Pride

The participants indicated through their reports that they experienced an additional emotion, namely pride, during the evaluation processes. This pertains to their overall disposition on the assessment as well as their behaviors, which they deem significant. Their reactions, highlighting the distinct attitude they exhibited compared to their coworkers, were deemed noteworthy.

[P10, Male, 46-50y.o., Bachelor's, Physics, Experience: 14 years, Leadership experience: 2 years]

So, a personal story that is for me an excellent example of this process is that we were called upon as the School's Teachers' Association of our school to decide whether we would implement self-evaluation. Well, in a total of 45 people, maybe even 50, the only hand that was raised to declare that they want to do a self-evaluation was mine; meaning 45 people and no one said anything; not the principal; not anyone.

Alongside their theoretical perspective on evaluation, some participants emphasized the practical aspect of their difference. They articulated the practical manifestation, at an administrative level, of embracing evaluation as an occurrence that reinforced their professional identity.

[P12, Female, 30-35 y.o., Bachelor's, Greek language, Experience: 9 years]

I had a similar experience [with P10, excerpt above]; with 45 people in the School's Teachers' Association, a statement was made that we refuse to implement [self-evaluation], to evaluate the school unit; except for five colleagues, including me, who refused to sign the statement, and it was noted [in the end of the document] that we refused to sign it.

Reports indicating pride in their distinct approach to self-assessment also suggest that a portion of teachers exhibits a higher readiness for change. This is also connected to their refusal to conform to something they do not endorse, even inside a collective that advocates for an opposing professional decision.

Discussion

Teachers' attitudes towards change imposed by reforms are influenced by various factors, including age, career stage, and professional identity (Hargreaves, 2005). For example, novice teachers are typically energetic, optimistic, and more inclined to embrace changes, while, conversely, senior educators closer to retirement age are more prone to experience stress, anxiety, or exhaustion, rendering them less adaptable to new circumstances, which may therefore heighten their resistance to change (Alonso-García et al., 2022; Goodson et al., 2006). This means that the extent of readiness for change is influenced by the emotional impact of the changes, which, consecutively, serves as a significant predictor of resistance to change (Oreg, 2003; Vakola, 2014), especially given that teachers demonstrate higher risk aversion regarding occupational career compared to other professions (Ayaita & Stürmer, 2020).

This study examined instructors' readiness for educational changes, and particularly regarding the introduction of teacher evaluation. The effectiveness of any change initiative is contingent upon how its beneficiaries interpret it both cognitively and emotionally and whether they view it as advantageous for both the present and future (Armenakis & Harris, 2002; Rafferty et al., 2013; Vakola, 2014; Van Veen & Slegers, 2006). To gather data on the aforementioned factors, 12 mini focus groups were conducted, involving 39 principals and teachers. Their perceptions of teacher evaluation, particularly their readiness to change versus their inclination to preserve the status quo, as well as their emotional responses to the changes, were examined. Participants' explicit perspectives on their evaluation perceptions reveal how they comprehend the specific shift and reflect their opinions about the gap between the existing and intended states (Armenakis & Harris, 2009). It is essential to highlight that numerous perceptions and ideas were articulated in manners that demonstrated semantic overlap among the different categories and subcategories of the coding. This illustrates the intricate nature of readiness for change, as beliefs, perceptions, and emotions are articulated in a highly interrelated fashion, often with indistinct borders.

The acknowledgment of the divergence between the existing educational reality and their perceived ideal or, at the very least, suitable standard was evident from the outset of the sessions and their initial stances. Within the broader framework of educational changes, they frequently articulate significant concerns regarding the quality of planning. In this context, resistance often serves as an indicator to decision-makers regarding the unsuitability of those specific changes (Ford et al., 2008; Osborn, 2006). The participants firmly assert that teacher evaluation initiatives failed to deliver education

constructively or enhance its quality; instead, they fostered attitudes and behaviors that were antagonistic to both the legislation and the evaluation process. The end results align with findings from prior studies concerning educators' apprehensions about the efficacy of a mandated implementation (Osborn, 2006).

The emotionally charged references in our mini focus groups were prevalent and pertained to all facets of the changes and evaluation. Educators engage both cognitively and emotionally in their profession, forging strong connections with the educational environment, which account for their occasionally fervent responses to perceived factors that enhance or undermine their professional life. The majority pertained to either emotions themselves or behaviors originating from an emotional basis (namely those expressing fear or anger) or were associated with the development of perceptions of the proposed reforms (mostly the concerns identified in both the changes and the assessment). It is important to note that emotions frequently manifested concurrently, being interconnected and interdependent.

The negative emotional burden, often directed against reforms, is ascribed to the coercive nature of their execution and the inadequate preparedness of teachers by political leaders. They express, in straightforward terms and without embellishment, the cognitive and emotional challenges they encounter in interpreting the ongoing reforms and the minimal effect these reforms have on their professional growth, which is disproportionate to the emotional toll they impose. These results align with previous studies (Geijsel et al., 2001; Van Veen & Slegers, 2009). The effort is evident, even emotionally, to equitably distribute the accountability for the rejection of reforms and the reluctance exhibited by educators. They perceive the reluctance via emotional and sentimental lenses, rooted in the qualities adopted over the years and the established conservative culture they believe defines the educational community. Within this context, the sense of job stability and the inclination to preserve the established professional routine also exert a significant influence.

Teachers' self-esteem elevates when they align their actions with their values and beliefs. The participants readily articulate their perceptions and openly communicate their emotions regarding the impact of evaluation on their professional identity. The most surprising emotion conveyed was pride in their attitudes and behaviors, indicating that a portion of instructors possess a heightened readiness for evaluation. Undoubtedly, these participants regarded the endorsement of their stance as an event that reinforced their professional identity. The emergence of pride from surmounting initial uncertainties aligns with findings from additional studies (Hargreaves, 2004).

The dominance of negative beliefs and, thus, emotions, i.e., fear, anger, and anxiety, created the conditions for the intense and/or passive resistance to change that was manifested by most participants during the implementation of the evaluation was expected (Baş, 2021; James, 2010). The strong emotional load permeated all the categories and co-shaped the perceptions of not only the ways in which they reacted but also of the attribution of responsibilities. Therefore, there are elements of the evaluation that seem to cause a degree of anxiety among teachers, a phenomenon anticipated in any change process that is also reinforced, to a significant extent, by the lack of relevant experiences. Beyond reporting these emotions, it is important to critically consider their implications. For example, while fear and anger were commonly expressed, they did not always translate into outright resistance; in some cases, they coexisted with openness to reflection or even pride in professional identity. Moreover, what is noteworthy is that negative emotions, such as anger and anxiety, are not necessarily predictive of readiness (Ittner et al., 2019), a suggestion that highlights their unique interplay with the other cognitive and emotional conditions. This ambivalence suggests that emotions should not be treated only as barriers but also as potential catalysts for dialogue and growth within the teaching community, echoing the perspective that resistance can serve as an indicator of reform unsuitability and as a trigger for constructive discourse (Ford et al., 2008).

A key indicator of the participants' readiness to embrace changes and, more specifically, evaluation is their capacity for self-reflection concerning their attitudes and behaviors towards reforms and evaluation. Indeed, it was previously shown that self-reflection is related to professional development and enhanced appreciation of specific professional standards as guidelines for teacher evaluation (Pedaste et al., 2019). The participants' acknowledgment of the disparity between the existing and ideal educational state, along with their recognition of shared responsibility and of the effect of their typically unfavorable disposition towards reforms, can serve as a foundation for conversation in order to facilitate and achieve the improvement of the educational system.

Based on the above, it is evident that, for educational changes to be successfully implemented, the reforms need to center around the people involved in the process, as it is imperative to engage them in the decision-making process, taking into consideration their emotions and providing them with autonomy and authority, creating internal motivation. Although this study is situated in the Greek educational system, the findings may be transferable to other centralized contexts where evaluation reforms are introduced top-down. Nevertheless, transferability should be approached cautiously, since local institutional norms and professional cultures mediate teachers' emotional responses.

Thus, finally, our position is that transformation in education should rely not on the imposition of legislative reforms, but on the initiatives and collaborative efforts of the educators. Given that the people implementing a newly introduced change are the key factors for its success, highlight its value and communicating clearly the expected benefits with the teaching community may result in uncontroversial acceptance leading, hopefully, to educational transformation. Concretely, this suggests that policymakers should move beyond general encouragement and implement actionable strategies such as piloting reforms through co-design workshops with teachers, providing structured forums for emotional expression, and ensuring that evaluators themselves undergo transparent training and evaluation. These steps would more directly address the cultural and emotional barriers identified in our findings and create the conditions necessary for genuine educational change. In this way, reform is not only implemented but sustained, as teachers are more likely to perceive themselves as active agents rather than passive recipients of policy.

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Data Availability Declaration

Data Availability Upon Formal Request:

While the primary datasets utilized in this study are not publicly accessible due to certain constraints, they are available to researchers upon a formal request. The authors have emphasized maintaining the integrity of the data and its analytical rigor. To access the datasets or seek further clarifications, kindly reach out to the corresponding author. Our aim is to foster collaborative academic efforts while upholding the highest standards of research integrity.

Author Contributions

Both authors, Evgenia Tsiouplis and Julie Vaiopoulou, contributed equally to this work. They collaboratively handled the conceptualization, methodology design, data acquisition, and analysis. Each author played a significant role in drafting and revising the manuscript, ensuring its intellectual depth and coherence. All authors have thoroughly reviewed, provided critical feedback, and approved the final version of the manuscript. They jointly take responsibility for the accuracy and integrity of the research.

Authors' statements on ethics and conflict of interest

Ethics statement: The study was conducted according to the guidelines of the Declaration of Helsinki and involved adult participants. During the recruitment stage, a cover letter was provided explaining the purpose of the study, that participation was voluntary, and that the data would remain confidential. The participants signed an informed consent form and were given the option of removing themselves from the mini focus groups at any time. During the data transcription, a unique code was assigned to each participant so that they would remain anonymous. We declare that research/publication ethics and citing principles have been considered in all the stages of the study. We take full responsibility for the content of the paper in case of dispute.

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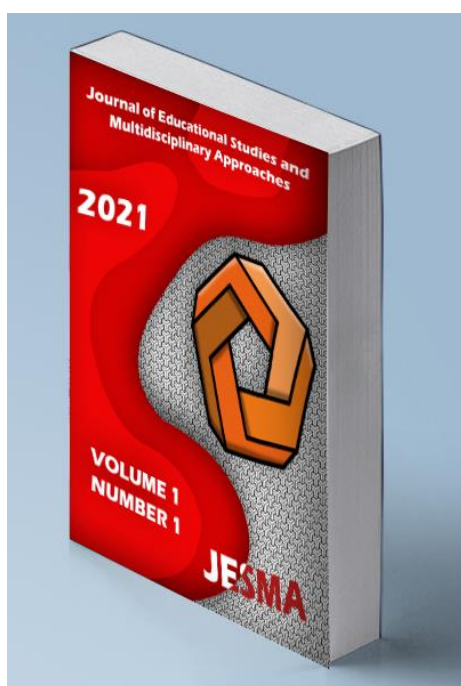
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Metacognition in Teams: Thematic Analysis of an Interprofessional Healthcare Simulation

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Metacognition in Teams: Thematic Analysis of an Interprofessional Healthcare Simulation

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ABSTRACT

Metacognition refers to a person's ability to understand and regulate their thinking and learning. For students, metacognitive skills increase awareness of their thought processes. These skills can impact how new and old information is processed, stored in memory, accessed, or applied.

Teams of health professional students from eight disciplines collaborated to assess and care for a standardized patient in a simulated environment. Following each simulation session, student teams debriefed their experiences and learning outcomes. Debriefing conversations from four independent teams were transcribed, and common metacognitive themes were determined by consensus.

The themes that emerged were 1) Collaboration, 2) Peer-to-peer Learning, 3) Problem-solving, and 4) Self-reflection. Together, these themes suggested that participating students applied metacognitive processes during the team-based simulation session debriefs.

Metacognition and metacognitive ability are important learning tools that can be incorporated into interprofessional learning environments through instructional and facilitation strategies. Interprofessional team simulations with standardized patients provide an optimal activity for encouraging critical discourse and other metacognitive processes.

Keywords: Interprofessional, Critical discourse analysis, Graduate healthcare curriculum



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Introduction

Metacognition refers to a person's ability to understand and regulate their thinking and learning. These processes allow individuals to become aware of their thought processes (Schraw, 2001). This awareness impacts how new and old information is connected, processed, and stored in memory and therefore opens possibilities to absorb new knowledge (Schraw, 2001). Metacognition facilitates the understanding of how a given task was approached and completed and is distinct from cognition, which facilitates task performance (Schraw, 2001).

Metacognition and metacognitive ability are important learning tools that can be incorporated into learning environments through specific instructional strategies that prioritize critical thinking and problem-solving skills (Schraw, 2001). Simulated learning environments in health education are fertile venues for students to develop metacognitive skills because these activities require discernment, differential diagnosis, and team debriefs. Such activities demand that students plan using self-regulated cognitive strategies, such as setting goals, selecting and implementing strategies, while monitoring their thought process throughout (Schraw, Kauffman, and Lehman, 2006).

According to Chao, Chiu, Tsai, Lin, Yang, Ho, ... & Chen (2025), simply collaborating in activities does not necessarily facilitate new learning. However, metacognitive strategies, such as peer-to-peer learning, do support new knowledge being gained. Interprofessional Education has foundationally incorporated peer-to-peer learning within curricula (Romito, Daulton, Stone, & Pfeifle, 2020). Simulation has built-in components of peer-to-peer learning by design. When undertaken as a group, it is expected metacognitive strategies at the individual and group levels would be utilized.

Studies have shown that students who gain metacognitive self-regulatory skills are more academically satisfied and better at learning and retaining knowledge than students who do not have good self-regulatory skills (Zimmerman, 2000). This is particularly important in healthcare as better metacognitive skills result in reduced clinical errors (Church & Carroll, 2023). Metacognitive strategies must be woven into curriculum and instructional design to be accessible to healthcare professional students. Self-regulated learning theory combines metacognition and social-cognitive theory (Schraw, Kauffman, & Lehman, 2006; Schunk, 1996; Bandura & Wessels, 1997). These theories explain how cognition, metacognition, and motivation are necessary in metacognitive self-regulatory ability (Zimmerman, 2000). Healthcare simulation experiences can incorporate essential components of metacognitive skills. Students participating in simulations are required to have a level of knowledge suitable to the task (cognition), the ability to process information at a conscious level to make a diagnosis (metacognition), and finally, motivation to use both of these abilities to reach their goal (differential diagnosis).

Toth et al. (2002) assert that metacognitive ability is crucial for any inquiry-based learning. Healthcare simulation allows teams of students to use inquiry-based learning to assess a scripted standardized patient encounter. Intentionally pairing healthcare simulation with metacognitive abilities provides an advantageous opportunity for clinical educators to understand and assess learning processes and learning outcomes while providing quality educational content.

Schraw and Moshman (1995) updated Flavell's model of metacognition by including not only the regulation of individual knowledge but also a second component, that of team regulation (Schraw and Moshman, 1995). Unlike metacognitive self-regulation, which requires the learner to monitor and evaluate their own learning, team regulation places learners in a collaborative inquiry-driven environment. Self-regulated learning demands that the learner already has high abilities in cognition, metacognition, and motivation, which does not apply to all students. In contrast, teams of students participating in a healthcare simulation activity can accommodate all levels of student learners. In a

simulated activity, students can ask each other questions and exchange thoughts, hypotheses, and diagnoses through communication and negotiation, ultimately learning with and from each other to improve their metacognitive thinking skills (Saab, van Joolingen, & Hought-Walters, 2011; Chi, et al, 1989; Rivas, Saiz, Ossa, 2022).

There is a significant body of research that supports collaboration in healthcare teams as a best practice which may contribute to positive patient outcomes (WHO, 2010) . Collaboration among learners is similarly crucial for positive learning outcomes (Saab, van Joolingen, & Hought-Walters, 2011; Chi, et al, 1989). Simulation activities provide optimal opportunities to enable healthcare students to gain self-regulatory and team-regulatory metacognitive skills that readily transfer into collaborative healthcare practice, thus preparing students to be thoughtful, aware, and deductive practitioners.

This qualitative study focuses on a debriefing session by a team of interprofessional healthcare students, following a team-based simulated patient encounter. The debriefing session provides a robust inquiry-based collaborative learning environment where students can safely practice and hone their regulatory learning collaboration skills. Furthermore, by utilizing a thematic analysis, we may be able to learn more about the possible dynamics between collaborative team practice, metacognition, and patient care through metacognitive strategies such as peer-to-peer learning (Nonose Kanno & Furuta, 2014; Chao, C. T., Chiu, Y. L., Tsai, C. L., Lin, M. W., Yang, C. W., Ho, C. C., ... & Chen, H. L. (2025)..

Methods and Materials

This research used recorded video from a debriefing session following a simulation activity conducted by a team of interprofessional healthcare students. A description of the simulation activity is provided for context. Note, however, that only the debriefing session was analyzed using a thematic analysis to focus on how the students experienced their roles and interactions as a team during the simulation activity.

Simulation Participants:

Students and faculty facilitators participating in the healthcare simulation activity were recruited from two universities. Participants were recruited using broadcast and program-based email announcements. Participation by all participants was voluntary and not associated with a for-credit course. A team of 6-8 students was organized from a large cohort of students enrolled in a range of health professions to enhance interprofessional learning opportunities. Student participants came from Dentistry (5), Nursing (7), Pharmacy (25), Social Work (13), Physical Therapy (18), Occupational Therapy (11), Osteopathic Medicine (6), and Physician Assistant Studies (17), and ranged in academic year levels from first to third-year students. Student participants were required to attend an orientation session that included didactic content and team building activities.

Two faculty facilitators were recruited from a pool of volunteers that included experienced facilitators and advanced students, who were recently trained in facilitation techniques. All facilitator volunteers were recruited from representative universities. Standardized patients were hired from both universities. Facilitators and actors attended orientation and training sessions.

Simulation Activity:

The student team met with the standardized patient twice over the course of two weeks. The case scenario involved an unhoused youth who presented with both physical and behavioral symptoms. The goals of the student healthcare team were to interview the patient in session one, make decisions regarding a care plan, and present recommendations to the patient in session two. The final team session was a 40-minute facilitated debrief to review the students' learning experiences and takeaways. Further details of this simulation activity can be found in previous literature (Konrad et al., 2017).

All simulation activities and debriefing sessions were conducted and recorded on Zoom™. Although simulation activities were recorded, only the debriefing session was analyzed. Transcripts were created using Panopto™. A transcript of the final debrief session was transferred to an Excel spreadsheet for line-by-line coding and thematic analysis. Students and participating facilitators were identified only by their professional program; no identifying names were used.

Thematic Analysis of Debriefing Session:

Thematic analysis of the Debriefing Session focused on identifying patterns of meaning, or themes, that organically emerge from the data (Braun & Clarke, 2020; Naeem et al., 2023). Repeated themes reveal embedded ideas, concepts, and perspectives from the participants' narratives that contribute to new ideas and insights about a phenomenon. For the purposes of this study, thematic analysis allowed the researchers to gain a fresh perspective on elements of student discourse used during a healthcare simulation activity.

Each member of the analysis team individually coded the transcripts. Meetings of the analysis team were conducted via Zoom™ to compare and discuss individual coding results and reach agreement on emerging themes. Emergent themes had to have 100% agreement between the three coders for them to be finalized. Metacognitive theory drove the analysis from a top-down perspective. One member of the analysis team was experienced in metacognitive research, while the other two were naïve coders. This allowed a system of checks and balances approach to the coding and potential analytic bias.

Findings

Themes emerging in the Debriefing Session

Four themes reflected in discourse during the debriefing session emerged from the thematic analysis. These included the following:

- 1) Collaboration (working together as a team to provide patient care)
- 2) Peer-to-Peer Learning (students learning from and with each other)
- 3) Problem-Solving (the process of finding solutions to a difficult or complex issue)
- 4) Self-Reflection (meditation or serious thought about one's character, actions, and/or motives).

The next sections elaborate on these emergent themes and offer examples of how they were represented in the transcripts.

Collaboration

Students expressed interest in learning about each other's scopes of practice and how together they would intersect in future patient care. Most students had been primarily exposed to single-discipline curricula interacting with other programs sporadically throughout the didactic years.

The concept of team collaboration brought to light that, while there are differences in scopes of practice, there are also many similarities and overlaps in professional knowledge and skills that can be used to improve patient care. Moreover, students observed collaboration in action, noticing how teamwork had better outcomes when members listened to each other speak and refrained from talking over one another. As one physician assistant student noted (see Table 1).

For students, collaboration entailed many factors, including listening, noticing, and being cooperative as opposed to being competitive. Additional examples of student statements are presented in Table 1.

Table 1: Collaboration

Profession	Transcript Line

Physician Assistant (PA)	I thought it was kind of interesting because a lot of the time we didn't end up, I mean it happened a couple of times, but we didn't end up like talking over each other. It kind of had a nice flow in the sense of like, OK, I knew I was finishing up. So I had some finishing up words or I was like, "Alright, does anybody else have anything to say?" It wasn't like people were trying to, like, rush over each other and talk over each other.
Physical Therapist (PT)	Yeah, I think that's a great idea. Do we want to also talk about her like? I know in the first session we all kind of like picked up . She was like really struggling mentally. So I don't know if anyone wants to come in at the tail end of that last session.
Occupational Therapist (OT) and Physical Therapist (PT)	OT: Do you want to go first, then maybe? PT: Yeah, I can go first, that's okay with me
Pharmacy (PharmD)	...and I'm not sure you could avoid it, but I think we did a good job of trying to explain and take questions throughout it. But I do feel like as we get better at presenting information, as we get better at seeing patients, that this will get better and we won't be just throwing information.

Peer-to-Peer Learning and Health Professional Roles

Students consistently noted the benefits of learning from one another. Peer-to-Peer learning included aspects of perceptions of team dynamics in which students realized the diversity of the team's skills and the extent of other providers' roles and responsibilities. For example, working alongside a social work (SW) student gave team members from other professions a better understanding of the breadth of skills that social workers bring to the healthcare team, and to patient care. The comments of this nursing student offer an example of how learning together expanded the student's previous understanding of the social work field (see Table 2).:

"I think [SW] was awesome at motivational interviewing and I definitely learned a lot from him in that aspect. Like [PT] was saying before, learning how many resources that social work can really apply to any situation. And, I really didn't know that there were different fields of social work also. I was kind of narrow focused on them in the hospital."

The importance of actively learning from classmates in other professions helped dispel misunderstandings and assumptions which if, unaddressed, could do a disservice to patients especially when it interfered with relationship building and patient outcomes.

Students also commented that learning from one another is challenging as it takes time, patience, and intention. As one occupational therapy student observed, knowing the challenges of interprofessional teamwork and facing students in the learning environment, better prepares students for what they will have to manage in the workplace. Learning how to utilize interprofessional activities contributes to more efficient and time-effective future patient care (see Table 2).

Participants appreciated the experiential aspect of learning from one another. They got the opportunity to see how teamwork was applied and observe what other professions did in practice, something many were unaware of so far and thought they would apply in their future practice. One pharmacy student remarked how after this team learning she was more likely to seek out a social worker in her future practice (see Table 2).

Therefore, learning about each other's expertise and scopes of practice was seen as valuable and was projected as having an influence on future collaborative practice.

Table 2: Peer-to-Peer Learning and Health Professional Roles

Profession	Transcript Content
Nursing (RN)	I think [SW] was awesome at motivational interviewing and I definitely learned a lot from him in that aspect. Like [PT] was saying before, learning how many resources that social work can really apply to any situation. And I really didn't know that there were different fields of social work also. I was kind of narrow focused on them in the hospital.
Occupational Therapy (OT)	I think for me, that kind of made me think about maybe the challenges about having an interprofessional team. Of course, We talk about the great aspects of it. But sometimes that might take a little bit more patience for us to converse more effectively and address things quicker in conversations, maybe get it down by the second session. But we didn't for. So I think that [SP] saying that and pointing that out, I think it's a good learning lesson in terms of working with a team like, Yes, we want to deliver the best care, but also being efficient with our time and with so many perspectives in the room, it sounds like we're kind of beating around the bush almost.... So It was a good learning experience.
Social Work (SW)	You both did an amazing job. I just want to recap quickly, because, [OT] I thought your transitions, and your ending and the fact that you did multiple scopes of practice in a short amount of time while actively listening to the patient and their partner was exceptional.

Problem-Solving

Changes in metacognitive processes brought about by challenges to previously held assumptions or the attainment of new knowledge were particularly evident in problem-solving. Participants reflected upon times during the simulation when, if they could, they would go back and change what they said or suggested. One social work student stated (see Table 3):

“So, once I did start clarifying these things that have happened and how they work, that seemed to kind of move things along in that direction. So, I wish I would have done that earlier.”

A challenge noted by students in problem-solving noted by students is the burden of responsibility felt by certain providers, mostly physicians. Working in teams offers students opportunities to experience the benefits of collaborative problem solving and how it can reduce burnout and promote resilience. An osteopathic medicine student reflected on how knowing that others can share the rigors of problem-solving can make a difference in reducing stress (see Table 3).

These statements illustrate how students' metacognitive processes clarified phenomena and initiated a shift in perspective that uprooted previously held beliefs or understandings, having the effect of bringing together a student's pre-knowledge and new knowledge in a recognizable pattern to advance knowledge and enrich problem-solving capacities. Such learning contributes to cognitive recall of new knowledge that can be applied to similar situations faced in the future.

Table 3: Problem-Solving

Profession	Transcript Content
Social Work (SW)	<i>“So, once I did start clarifying these things that have happened and how they work, that seemed to kind of move things along in that direction. So, I wish I would have done that earlier.”</i>

Osteopathic Medicine (DO)	I think I learned that even though my school's curriculum tries to cover as many of the aspects of caring for a patient as possible, and we do talk about like the softer side of medicine. We don't have infrastructure for actually directly dealing with those things. So, while I might know that someone would have issues transporting or their health care, I don't have a way of addressing that getting the resource for them and all of that. It was nice to see that there are other professions who focus on that. And I think I learned that my role in health care might not be to address all those things directly, even though they're super important.
Osteopathic Medicine (DO)	Well, initially, I don't think that we had a super clear process. We tried to create one virtually over a Google doc, but we kind of just went in, guns blazing, . And it was a little bit disjointed also because [SP],* didn't really know us and wasn't giving us much to work with. And I think Once we understood what each person's role was and we had the time to debrief over Zoom, we were able to figure out a flow that would make sense for the next meeting. I think that's why the next meeting went a little bit more smoothly.

*SP = Standardized Patient

Self-Reflection

Participants recalled instances during the simulations when their previous thoughts and assumptions were positively challenged and new learning took place. Comparing their thought processes to those of their teammates resulted in productive self-reflection and curiosity about how others learn and practice: For example, a dental student noted (see Table 4):

“...watching everyone else interact [with the patient] was really helpful in learning how other [professions] are asking questions, [and what] their kind of train of thought [was]. Their training is slightly different [than mine]. So, it's nice to see other [professional] train[s] of thought and how they ask questions.”

Other examples of self-reflection occurred during collaborative care planning. Students described the interplay of their existing and new knowledge when looking back on their approach to determining the patient's care plan. Alex prompted empathy and uncertainty because of the complexity of their situation. Students struggled with not knowing what the best next steps would be to serve them. Bias was an issue that surfaced in response to the case scenario. Not many students had worked with transgender patients, nor had they encountered content about their health and healthcare in the curriculum. This study provides examples of how the opinions of a nursing student and an allopathic medicine student changed throughout the simulation, dispelling prior bias (see Table 4).

The value of learning with and from one another, especially when uncertain, is reflected upon in an interchange between an osteopathic student and a physician assistant student, as shown in Table 4. Both students gained new knowledge by watching students from other programs interact with standardized patients.

Table 4:Self-Reflection

Dental Student (DS)	“...watching everyone else interact [with the patient] was really helpful in learning how other [professions] are asking questions, [and what] their kind of train of thought [was]. Their training is slightly different [than mine]. So, it's nice to see other [professional] train[s] of thought and how they ask questions.”
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Nursing (RN)	I was a little apprehensive. I remember starting with the motivational interviewing Zoom that we had about doing that over Zoom, and I just didn't know how that was gonna go. And big part of nursing is like developing a therapeutic relationship. I just really wasn't sure how that was gonna play out on Zoom. And definitely From our first interactions, and [PA] can attest, with our first picture of Alex, he was slumped down, on mute. I was thinking, oh, I do not know how to approach this. So we've definitely grown. And I think it definitely went well.
Allopathic Medicine (MD)	I think completely understandable to be in that position, like surrounded by so many health care professionals and trying to get an idea of what this is. I can understand that it's absolutely frustrating. And At the same time, I was trying to jog in my head, so what are our next steps like? How do you comfort a patient like this without knowing so much about the exact treatment process or what actually works for this patient? So I think it just showcased like a good challenge for us to kind of understand and delve in deep into our own professions and figure out how we can alleviate some symptoms without having a definitive answer.
Osteopathic Medicine (DO) and Physician Assistant (PA)	[DO]: I think all the tests were a little bit overwhelming, but there's really no nice way to do it. [PA]: That was really good. I really feel like I learned a lot just watching you guys do that. I like the flow of it. And yeah, there's a lot of tests. But it does need to be done and it actually goes by quicker than you think.

Discussion

Metacognition in Action

Flavell first described metacognition as “one’s knowledge about and regulation of one’s cognitive processes” (Flavell, 1979). It is often described as an individual’s ability to assess his or her thinking and actual skill level or understanding in an area (Stanton, Sebesta, & Dunlosky, 2021). Metacognition is an essential skill that encourages critical thinking and lifelong learning. Metacognition also helps students understand their comprehension and problem-solving skills (Medina, Castleberry, & Persky, 2017). Thematic analysis was used to identify emerging themes indicative of metacognitive processes that occurred during the debriefing sessions of the student team after a healthcare simulation activity.

In this study, students explicitly recalled instances when their team member used their professional knowledge and scope of practice to assist in understanding and making recommendations for the care of a standardized patient. Examples of metacognition in action were identified as participants engaged in meaningful and reflective discussion of the thought processes that emerged during their simulation experiences. The student participants moved from themes of communication to peer-to-peer learning, problem-solving and, finally, self-reflection, indicating a metacognitive flow. Throughout the debriefing session, participants could identify what they did not know and then communicate their new understanding, building on their old knowledge, applying new knowledge and critical thinking to the novel situation.

Providing opportunities for students to practice, build, and strengthen metacognitive skills throughout the course of their health professions education is important. Learners who use metacognitive skills gain a better understanding of how they learn and can capitalize on this knowledge, becoming better clinicians as well as better members of interprofessional healthcare teams working in collaborative settings. Emergent themes from this study discourse, (Collaboration, Peer-to-Peer Learning, Problem-solving, and Self Reflection) aligned well with identified components of metacognitive regulation (Zohar & Barzilai, 2013).

Limitations

Theme identification depends in part on whether participants feel safe enough to freely and candidly share their experiences. Development of psychological safety takes time and requires strong facilitation and guidance. The debriefing sessions used here were led primarily by the student members of the team, and participation was lively and informative. However, each debriefing session was necessarily unique. We believe that the research findings are valid and contribute to advancing knowledge of metacognition and metacognitive processes that occur in a team-based learning environment.

Future Research

Future research is needed to better understand the role of metacognition in interprofessional healthcare team-based learning and to develop strategies that improve students' capacities to reflect upon, recall, and apply their learning. Simulation debriefings provide opportunities to analyze the metacognitive components of student discourse. Future research can replicate such analysis using interprofessional healthcare simulations as well as other learning activities that engage interprofessional team debriefing to gain more knowledge about metacognitive regulation and processes in professional development.

Conclusion

Metacognition and metacognitive ability are important learning tools that can be incorporated into healthcare learning environments through instructional and facilitation strategies. Interprofessional healthcare team simulations with standardized patients provide an optimal activity for encouraging critical discourse and other metacognitive processes.

Critical thinking and knowledge comprehension are essential skills for healthcare practice. The development of metacognitive skills as an objective of health professions curricula appears to help students actively examine their knowledge, develop critical thinking, bolster self-reflection skills, and blend new knowledge into their learning process.

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Data Availability Declaration

Data Availability Upon Formal Request: The primary datasets utilized in this study are not publicly accessible due to certain constraints. The primary datasets are available to researchers upon a formal request. The authors have emphasized maintaining the integrity of the data and its analytical rigor. To access the datasets or seek further clarifications, kindly reach out to Ms. Batteson or Dr. Garber. Our aim is to foster collaborative academic efforts while upholding the highest standards of research integrity.

Author Contributions

Rayan Kamal Salih spearheaded the conceptualization, designed the research methodology, and supervised the entire project along with Tamzin J. Batteson and Sarah S Garber. Rayan Kamal Salih, Kaleia Collins, Imohimi Eboweme, Daniel Bassler, Susan Smock, and Zaria Price were responsible for the data collection, analysis, and interpretation, bringing analytical rigor to the study. Rayan Kamal Salih took the lead in drafting the manuscript, ensuring its alignment with scholarly standards, and revising it for intellectual depth. All authors collaboratively discussed the results, provided critical insights, and contributed to the final manuscript. All authors have read, approved, and take joint accountability for the presented work's accuracy and integrity.

Author(s)' statements on ethics and conflict of interest

Ethics statement: We hereby declare that research/publication ethics and citing principles have been considered in all the stages of the study. We take full responsibility for the content of the paper in case of dispute.

Although this was a study solely of the video-taped debriefing session of the simulation, The participants were, as part of the simulation activity, informed electronically of the nature of the simulation program and expectations. Participants were assured that there would be no ramifications if they decided to opt-out at any time. Participants consented to being recorded during simulation activities and debriefing sessions.

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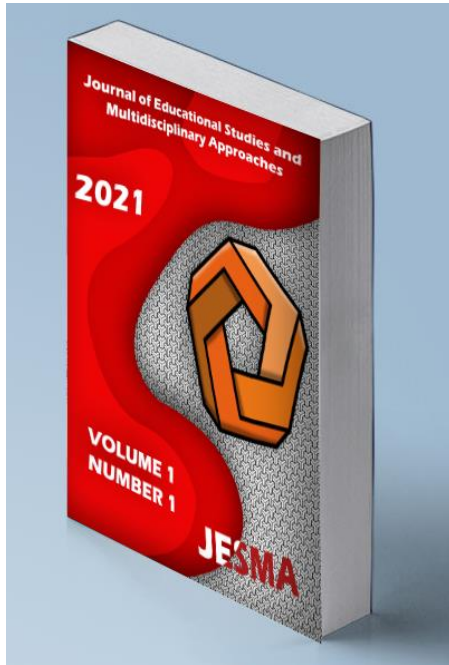
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Middle Grades in Southern Appalachia: Developing a Thanksgiving Themed Cross Curricular Approach to Teaching the International System of Units

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Middle Grades in Southern Appalachia: Developing a Thanksgiving Themed Cross Curricular Approach to Teaching the International System of Units

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ABSTRACT (Times New Roman typeface and 10 points)

In the United States, the continued reliance on non-SI (International System of Units) measurements presents a challenge for students in STEM-related fields. This disconnect can hinder conceptual understanding and career readiness. This study explores how a multidisciplinary, culturally grounded approach to teaching unit conversion can enhance student engagement and comprehension. Conducted in the Southern Appalachian region, the project integrated math, science, English Language Arts, and history through a cross-curricular lesson centered around a widely celebrated national holiday. By incorporating local recipes and cultural traditions, the lesson demonstrated the real-world relevance of SI measurements. The study was guided by three research questions focused on conceptual understanding, instructional opportunities, and the challenges of designing culturally responsive, interdisciplinary curriculum. This work contributes to the fields of STEM/STEAM education and interdisciplinary pedagogy and offers a replicable framework for integrating SI instruction into regionally relevant lessons.

Keywords: Interdisciplinary Education, STEM/STEAM Pedagogy, SI Units. Culturally Responsive Teaching, Southern Appalachia



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Introduction

Rational and Purpose of the Study

In an increasingly globalized world, it is essential for students to be familiar with the International System of Units (SI). The International System of Units (SI) is a system of standard measurements utilized by much of the world, but it “is now common knowledge that the U.S. is one of a handful of countries that still use non-SI measurements in our daily lives and in many commercial transactions.” (Lippa, 2025) This disconnect between systems of measurement that students use at home versus what they are expected to use in STEM fields can cause confusion and lack of career readiness.

This study addressed the issue by creating a multidisciplinary lesson incorporating the core subject areas of Math, Science, English Language Arts, and History. Multidisciplinary, or interdisciplinary, teaching creates a holistic, in-depth approach that engages students. (Mishra, N., & Aithal, P. S., 2023; PRASAD, N. N., 2024; Braskén, M., & Pörn, R., 2021; Cohen, E., Novis-Deutsch, N., Kashi, S., & Alexander, H., 2024) Traditional methods of teaching tend to isolate Math from other subject areas. This study adopted a STEM/STEAM pedagogical approach in order to address the International System of Units (SI) and incorporate the necessary mathematical concepts across the disciplines.

The United States’ use of non-SI measurements can also be viewed through a cultural lens. This study was conducted in the foothills of Southern Appalachia and made use of a popular national holiday to demonstrate the applicability of SI measurements in the students’ daily lives. Studies show that incorporating real-world projects in STEM/STEAM lessons – even in the digital age – have a positive impact on student learning. (Boss, S., & Krauss, J., 2022; Dare, E. A., Keratithamkul, K., Hiwatig, B. M., & Li, F., 2021) This study incorporated regional recipes associated with the national holiday of Thanksgiving to engage students, show respect to local traditions, and demonstrate the application of SI measurements.

Research Questions

The following questions guided this study:

1. How can a multidisciplinary approach to teaching unit conversion support deeper conceptual understanding across subject areas such as math, science, ELA, and history?
2. What instructional opportunities emerge when measurement and conversion skills are embedded in a culturally grounded, cross-curricular lesson?
3. What challenges and possibilities arise when designing interdisciplinary curriculum centered on real-world, seasonal, or regional contexts?

Significance of the Study

This study contributes to the growing field of multidisciplinary education and STEM/STEAM education. Of particular interest is this study's geographical location of Southern Appalachia, a region whose cultural traditions and seasonal practices provide meaningful opportunities to connect measurement and unit conversion to lived experience. While integrated STEM/STEAM models are not new, this study offers a unique contribution in several ways:

- **Regional and cross-cultural grounding:** The lessons connect Southern Appalachian/United States methods of measurement with Korean/International methods of measurement, creating a culturally responsive and globally aware context.
- **Food and holiday context:** By using recipes and holiday traditions as the entry point, students explore measurement in authentic, meaningful ways.
- **Human story origin:** The lesson emerged from a genuine dialogue between a Korean graduate student and a U.S. professor, embedding relational and experiential dimensions into the curriculum.
- **Replicable process:** The model can be adapted to other holidays, cultures, and regions, providing a generalizable approach for interdisciplinary, culturally grounded instruction.

By situating a cross-curricular lesson in these contexts, this research demonstrates how interdisciplinary design can create deeper conceptual understanding and richer instructional opportunities. This approach addresses both the possibilities and challenges of designing culturally responsive STEAM curriculum.

Literature Review

The purpose of this study was to contribute to the field of STEM/STEAM education in Southern Appalachia. The creation of a culturally relevant, cross-curricular lesson for middle grades students is no easy task. A review of the literature is presented here to provide a background on multidisciplinary curriculum design, the region of Southern Appalachia, use of the International System of units, and the importance of Thanksgiving as a regional holiday.

Cross curricular/Multidisciplinary Design

Multidisciplinary instruction is often referred to using related terms such as interdisciplinary instruction, integrated teaching, thematic instruction, cross-disciplinary teaching. It involves integrating multiple subjects into teaching to foster a deeper understanding of complex issues, offering students a holistic learning experience (Drake et al., 2004). This approach has demonstrated significant effectiveness in secondary education. For example, Stathopoulou et al. (2014) implemented interdisciplinary teaching in an 11th grade mathematics classroom by integrating language, social study, history and science. This study revealed that students not only enhanced their creativity in this process but also transformed their perceptions of mathematics. As a result, they developed a greater appreciation for the role of mathematics in society.

Multidisciplinary teaching often involves thematic instruction, which offers a number of advantages. Ye and Xu (2023) found that interdisciplinary thematic teaching enhanced middle school students' creativity, communication, and collaboration. By using real-world themes, students became more engaged and demonstrated improved problem-solving skills. This

approach has also shown effectiveness in boosting student academic performance compared to traditional teaching methods (Barancová et.al, 2024). Furthermore, learners integrate knowledge and modify their worldviews or perspectives as they engage in cross-disciplinary teaching. Billingsley et al. (2018) discussed how interdisciplinary teaching can develop children's epistemic insight-understanding the nature of knowledge, and how disciplines interact-and how this approach enables students to integrate knowledge across fields and reconsider their perspectives on complex issues.

Math

Multidisciplinary instruction in the math class was achieved by covering transformation between imperial and SI units, which is the central theme of this project. Goos, Carreira, and Namukasa (2023) pointed out that mathematics should not be used merely as a tool but should retain its disciplinary integrity in multidisciplinary instruction. In this math class, the integrity of mathematics is preserved by going beyond simple unit conversions and expanding to algebraic expressions and their substitution, which strengthens both procedural and conceptual understanding (Taylor & Hwang, 2021). Since unit conversion is usually expressed using variables, it is natural to connect algebraic expression to conversion between SI and imperial units, further supporting academic vocabulary and mathematical thinking for all learners, including those with learning disabilities (Cho & Kim, 2023). Additionally, the Universal Design for Learning (UDL) framework was applied throughout the curriculum to support diverse learners by incorporating multiple means of representation, engagement, and expression, in line with current best practices for STEAM education and inclusivity (Thoma et al., 2023).

Science

Integrating multidisciplinary learning in science education brings significant benefits to students' cognitive and emotional growth. Paugh and Wendell (2021) showed that adding disciplinary literacy to an elementary engineering unit, guided by Systemic Functional Linguistics (SFL), improved students' mechanistic reasoning and understanding of engineering concepts. This approach helped students make informed language choices, leading to deeper engagement with scientific content. Similarly, English (2023) found that sixth-grade students who engaged in multidisciplinary modeling during a tsunami investigation were able to effectively apply mathematics, science, and statistics to real-world problems. The study emphasized the importance of giving students opportunities to create their own models, which fosters creativity and a stronger grasp of STEM practices.

Additionally, Güven and Alpaslan (2022) explored how interdisciplinary science activities impacted fifth-grade students' creative problem-solving and 21st-century skills. Their research revealed significant improvements in students' ability to manage knowledge, solve problems, and apply what they had learned to everyday situations. The study highlighted the role of interdisciplinary teaching in enhancing students' cognitive, emotional, and socio-cultural skills. Together, these studies underscore the value of multidisciplinary learning in science, showing how it promotes critical thinking, creativity, and the ability to apply knowledge in various contexts. By implementing these approaches in elementary education, we can equip students with the essential skills to handle complex real-world challenges.

Social Studies

Research shows that providing students with a cross curriculum environment helps better them for the real world. Within the Social Studies classroom, lesson designs including ELA, Mathematics, or Scientific elements allow students to create stronger connections. Erie Team describes how cross-curricular integration "...is the process of connecting a topic which is traditionally taught as a stand-alone subject (EiE Team, 2023)." Lauren Chiangpradit explains how the combination of subjects within the classroom allow students to find interests in subjects they may not be as interested in by integrating it with a subject they do have interests in (2023). The combination of different subjects allows students to collaborate in the classroom. Students are gaining the necessary skills to be able to effectively work with others which will carry with them into the real world (2013). Cross-curriculum strategies in the classroom allow students to further knowledge in areas while combining with their subject. It allows for skills to be built that will follow students throughout their professional careers.

English Language Arts

Prior research shows that incorporating multidisciplinary learning into English Language Arts (ELA) classrooms can have positive impacts on student comprehension and engagement. Burke and Peterson (2007) found that through multidisciplinary units, students "developed a deeper appreciation...established a real emotional connection...[and] drew on and furthered their extensive knowledge of visual elements." In addition, Burke and Peterson also noted that the ability of students to read texts in secondary curricula was heightened by cultivating development of print and visual literacies. ELA curricula can incorporate visual and hands-on elements in order to connect student learning to other disciplines. Interdisciplinary learning is achieved through the implementation of real-world experiences and themes. Building upon concepts learned in different content areas enables students to make authentic connections.

Southern Appalachia

The Appalachian region has captured the attention of researchers since 1898. The historical, and unfortunately still prevalent, view of Appalachia has been that of a subculture of poverty (Walls, D. S., & Billings, D. B. 1977). While the "Appalachian context is often described through a deficit model approach," there are studies being conducted that celebrate the contributions and resilience of the region (Childers, G., & Elz, H., 2022). As a subregion, Southern Appalachia is unique in that it encompasses aspects of both Appalachia and the South, blending traditions, histories, and identities in ways that distinguish it from other parts of the region (Ulack, R., & Raitz, K., 1981; Griffin, L. J., & Thompson, A. B., 2002; Ford, T. R. (Ed.), 2014). This dual identity offers a particularly compelling lens through which to examine the issues and development of education in the region today.

International System of Units

The International System of Units (Système International d'Unités, SI) serves as the globally accepted standard for measurement, utilized extensively across scientific, industrial, and educational domains worldwide (Bureau International des Poids et Mesures [BIPM], 2019; BIPM, 2023). The SI system traces its roots back to the metric system established in France during the late 18th century. It was officially adopted by the 11th General Conference on Weights and Measures (CGPM) in 1960, aiming to unify and simplify the global measurement

standards (BIPM, 2019). Over the decades, the SI has undergone significant revisions to improve precision and universality, notably in 2019, when four of the seven base units—the kilogram, ampere, kelvin, and mole—were redefined based on fixed values of fundamental physical constants (BIPM, 2019). This landmark revision enhanced the stability and reproducibility of SI units, eliminating reliance on physical artifacts.

The SI system is built upon seven base units that correspond to fundamental physical quantities, which are combined to define derived units used across scientific disciplines (BIPM, 2023). The base units include:

Table 1. International System

Physical Quantity	Unit Name	Symbol
Length	meter	m
Mass	kilogram	kg
Time	second	s
Electric Current	ampere	A
Thermodynamic Temperature	Kelvin	K
Amount of Substance	mole	mol
Luminous Intensity	candela	cd

Also, derived units such as newtons (N) for force and joules (J) for energy are expressed in terms of these base units, facilitating consistent and coherent representation of all measurable quantities.

The adoption of the International System of Units (SI) plays a vital role in ensuring consistency, precision, and global interoperability in science, education, and industry. By offering a standardized measurement framework, the SI system reduces errors and miscommunication in international collaboration and facilitates a clearer understanding of scientific concepts among students. A well-known example illustrating the consequences of inconsistent measurement systems is NASA's Mars Climate Orbiter mission failure in 1999, which resulted from a conversion error between imperial and metric units, ultimately leading to the spacecraft's loss (Wilford, 1999).

Despite these risks, the United States remains one of the few countries that has not fully adopted the SI system in everyday life, continuing to rely on customary units such as inches, pounds, and Fahrenheit in commerce and daily activities. This dual-system environment poses educational challenges, as students must navigate between informal exposure to non-SI units at home and the expectation to use SI units in academic and professional STEM contexts. Consequently, researchers and educators emphasize the need for integrated, culturally responsive instruction that bridges this divide and promotes fluency in SI-based measurement to ensure students' scientific literacy and global career readiness.

Research Design and Methodology

Who

This research method allowed for an exploration of specific and meaningful context: the implementation of a curriculum designed by teacher education students for middle grades learners in Southern Appalachia. As Janesick (2004) notes, the first question a researcher must address is, who? In this study, "who" refers not only to the individuals who designed and implemented the curriculum, but also to the students who engaged with it in the classroom setting.

This study involved six students—two undergraduate and four graduate students—each pursuing degrees in secondary education. Among the participants, four identified as female and two as male. The two undergraduate students were both female, while among the graduate students, two were male and two were female. These students collaboratively developed a curriculum as part of their coursework, with guidance and mentorship from two faculty members in the education department.

The curriculum they created was implemented with middle grade students located in the Southern Appalachian region. The middle grades students are not the primary focus of the study, but they are important to understand the context in which the curriculum was delivered. Their engagement and responses shaped how the curriculum was experienced and refined.

Purposeful sampling was used to select participants for this case study. The teacher education students were chosen based on their enrollment in a course that integrated curriculum development with field-based implementation. Similarly, the middle grades classroom was selected due to its accessibility, the teacher's willingness to collaborate, and its relevance to the regional focus of the study.

Why

It is essential to articulate why any study is undertaken. As Neale, Thapa, and Boyce (2006) explain, studies are often selected because they are exemplary, effective, or of special interest. This project reflects that notion in several meaningful ways.

This study was conducted to demonstrate the power of multidisciplinary curriculum design. In a time when STEM and STEAM education dominate the conversation around curriculum innovation, this project affirms that social studies and English Language Arts belong in that conversation. The integration of content across disciplines shows that students benefit from learning that reflects the complexity of the world around them.

The study is significant because it places Southern Appalachia at the center of the narrative. This region holds a rich cultural, historical, and intellectual tradition but is often overlooked. By situating the curriculum in Southern Appalachia, the study challenges deficit narratives and affirms that this region contributes to the broader educational landscape.

The “why” for this study is simple. This study matters because it helps reimagine what curriculum can look like when disciplines are not siloed, when underrepresented regions are given voice, and when teacher preparation is connected to the real work of schools and communities.

Where

This study was situated in Southern Appalachia, a region often underrepresented in education research. It was conducted at a regional university known for its strong teacher preparation program and commitment to research. The curriculum design process took place within this university setting, while implementation occurred in a local middle grades classroom. These settings grounded the project in both theory and practice.

The participants brought a global perspective to a local context. The two undergraduate students and one of the faculty mentors are from the United States. The four graduate students are from the Republic of Korea and were enrolled in a master’s program housed at the university. The second faculty mentor is from the People’s Republic of China. This diversity of backgrounds enriched the curriculum design process and contributed to a broader, more inclusive perspective on teaching and learning in the Southern Appalachian region.

How

The current project adopts an interdisciplinary framework to design a series of six lesson plans for sixth grade classrooms. Rooted in students’ real-life contexts, the lesson plans integrate content from math, science, language arts, and social studies, aiming to examine how students synthesize knowledge from diverse disciplines to address complex problems. To support effective learning, the lessons incorporate evidence-based strategies, such as graphic organizers, which enhance comprehension while fostering critical thinking and problem-solving skills (İlter, 2016; Cho & Kim, 2023). Additionally, the lessons also embed cross-cultural awareness to prepare students for a globalized world, helping them become more adaptable, inclusive, and engaged, and better equipped to navigate an interconnected and diverse society.

Confliction of Interest Statement

The faculty members involved with this study provided guidance and mentorship to the graduate and undergraduate student participants during the curriculum development process. They did not influence the reporting or interpretation of outcomes, and the authors declare no conflicts of interest.

Data Collection

English Language Arts Standards

The Alabama Course of Study Standards for English Language Arts (2021) were taken from the Alabama State Department of Education and used in the designing of this curriculum. The standards used in the ELA lessons are as follows:

ELA21.6.R1- Utilize active listening skills during discussion and conversation in pairs, small groups, or whole-class settings, following agreed-upon rules for participation.

ELA21.6.7- Produce clear, coherent narrative, argument, and informative/explanatory writing in which the development, organization, style, and tone are relevant to task, purpose, and audience, using an appropriate command of language.

These standards provided the foundation for the course goal in the ELA lessons, which allowed students to grasp the objectives of the curriculum.

Course Goals

Course goals were created in the curriculum to ensure alignment with the Alabama Course of Study Standards. For the ELA lessons, students reconstructed a Southern Appalachian Thanksgiving recipe and created a recipe for peanut butter and jelly sandwiches in order to produce specific written directions. In addition, students expressed their opinions in whole group discussion to utilize active listening and discussion skills, constructed a peanut butter and jelly sandwich to follow written directions, and provided constructive peer review feedback in order to produce specific informative writing. These course goals laid a framework for the design of the lesson.

Science Standards

In middle school science education (Grades 6–8), the Science and Engineering Practices (SEPs) help students understand how scientific knowledge is developed. Students engage in quantitative investigations, distinguish between correlation and causation, and apply basic statistics and error analysis to interpret data. They also use mathematical and computational thinking to identify patterns and support scientific explanations. Crosscutting Concepts (CCCs) link scientific ideas across disciplines, fostering a deeper understanding of natural phenomena. A key CCC in Grades 6–8 is *Scale, Proportion, and Quantity*, through which students learn unit conversions (e.g., speed, mass, volume), proportional reasoning, and scientific representation using formulas and ratios (Alabama Course of Study: Science, 2023).

These concepts are related with the following standards:

SC23.6.4 – Analyze and use data to determine scale properties and characteristics of objects in the solar system including sizes, distances, orbital periods, basic composition, and ability to support life.

SC23.6.8a – Plan and carry out an investigation to determine the differences in rates of energy transfer from the Sun to air, land, and water via conduction, convection, and radiation.

Course Goals

The goal of the lessons was to emphasize the importance of understanding both imperial and SI (metric) units within the context of science, building on concepts students had learned in other subject areas. By making real-world connections, the lessons aimed to help students see

the relevance of unit conversions in everyday situations. According to Jones and Cook (2017), the "SI-gap" not only hinders teachers' efforts to engage students in science, technology, engineering, and mathematics (STEM), but also limits students' ability to accurately assess the validity of their own results. To actively participate in integrated STEM fields, students must be fluent in using and converting SI units. National standards, including those outlined by the National Council of Teachers of Mathematics (NCTM, 2015), stress the importance of structuring curricula to develop students' proficiency in measurement. Therefore, the objective was to ensure students could understand how units are applied in scientific contexts and become fluent in converting between units related to key concepts such as weight, volume, speed, and distance.

History

Standards

For the social studies section of this project, the 9th grade, seventh standard was used as the students participating in the study proved to be more advanced in their studies after observations of these classes were conducted. The seventh standard for 9th grade in the Alabama Course of Study states that students should be able to "describe the impact of the French Revolution on Europe, including political evolution, social evolution, and diffusion of nationalism and liberalism" (Alabama Course of Study, pg. 68). Within the additional content that was required, the students were taught the causes of the French Revolution. This standard was used throughout the entire lesson to explain to the students the French Revolution. Students were taught the causes of the war while using graphic organizers. The lesson itself was an interactive lecture that allowed the students to be interactive with each other as well as with the teacher. The teacher walked through the effects of the war and explained how the international system of units came to be through the feelings and thoughts after the French Revolution. It was during this section of the lesson that the teacher was able to incorporate the multidisciplinary portions of the next lessons to come from ELA, math, and science. There was an emphasis on the importance of the SI system and the role it continues to play throughout the students' daily lives.

Course Goals

The course goals for this specific lesson were for students to understand the importance of the French Revolution. This was done by conveying causes and effects of the war. One of the outcomes of the war that was emphasized was the ideas that emerged post-war. This was done in order to highlight the cross-curricular aspect of the lesson and incorporate themes from science, math, and ELA lessons that would follow the social studies section. It allowed for a perfect set-up for the multiple lessons to follow in which the students would be engaging with the SI system through various subjects.

Math

Standards

The lesson aligned with the 2019 Alabama Course of Study standard MA19.6.15, which emphasizes writing, reading, and evaluating algebraic expressions in which letters represent numbers in real-world contexts (Alabama State Department of Education, 2019). This standard is particularly relevant to the topic of unit conversion, as such conversions are commonly represented using variables in algebraic expressions. For instance, the conversion formula

between Fahrenheit and Celcius, $C=(F-32)59$ and $F=(C95)+32$, are expressed using variables C and F. By engaging with these types of formulas, students not only practice algebraic reasoning but also gain an understanding of how variables and expressions are used to solve practical problems, thereby reinforcing the importance and applicability of algebra in everyday life.

Course Goals

The course goal for the math class was as follows. Students will focus on weight and volume, emphasizing unit conversion and solving related problems through practical applications. Students can understand and use the expression of the conversion between Fahrenheit and Celsius in order to convert between Fahrenheit and Celsius as used in recipes and weather in real-world scenarios.

IRB Protocols

Institutional Review Board (IRB) approval is not required for this curriculum design project because it does not involve human subjects research. According to federal regulations (45 CFR 46.102), research requiring IRB oversight includes studies involving "a living individual about whom an investigator... obtains information or biospecimens through intervention or interaction,

and uses, studies, or analyzes the information or biospecimens." This project does not meet these

criteria for the following reasons:

1. No Human Subjects Involvement
2. No Collection of Identifiable Data
3. Focus on Materials, Not Individuals.

Analysis

English Language Arts

Lesson Design

Students interacted with the parts of a recipe by reconstructing a Southern Appalachian Thanksgiving recipe and creating a recipe for peanut butter and jelly sandwiches. Students also expressed opinions on the importance of recipes to various cultures in whole group discussion and then constructed a peanut butter and jelly sandwich. The lesson design of the ELA curriculum was created using a teaching model that focuses on four learning styles to increase engagement in the classroom. According to a study conducted at the collegiate level, researchers found that the application of this method "increased learner motivation and engagement, and provided students with greater opportunities for practice and application of their learning in settings outside of the classroom" (Nicoll-Senft & Seider, 2010). The ELA lessons use this model to help students engage with and appreciate the writing process. Each activity within the curriculum was designed to appeal to one of the four types of learners: imaginative, analytic, common sense, and dynamic. At the conclusion of the final lesson, students engaged in peer review. At the conclusion of the lesson, students were given a peer review worksheet to provide feedback on their partner's recipe. Completing a peer review allows students to reflect on their own writing abilities, as well as their partner's. Students provided two "glows" and one "grow," giving their partner positive, yet constructive feedback.

Reflection

After designing and teaching the curriculum came the opportunity for reflection. The nature of this study was such that the lessons were taught to two separate sixth grade classes. In each classroom, management strategies differed based on student needs. Strategies such as giving specific verbal praise, calling all students by name, and having students verbally repeat directions were all implemented into the ELA lessons. These management strategies allowed the activities to run more smoothly, further encouraging student engagement. The levels of comprehension also varied from student to student, which made the use of the implemented teaching model extremely relevant. The comprehension levels also changed the pacing of the lessons in each class, requiring adaptation to the activities in order to keep students engaged throughout the lesson. Students effectively incorporated prior knowledge from the first ELA lesson to complete activities in the second lesson. The incorporation of the Thanksgiving holiday also engaged students, since the holiday is a familiar one. The inclusion of peer review at the conclusion of the lesson also provided students with the opportunity to reflect on their own work, further emphasizing the real-world connections made within the lesson.

Science

Lesson Design

To introduce the lesson, the students were presented with two chocolate chip cookie recipes—one using the imperial system and the other using the metric system. The students were asked which recipe felt more familiar to them; most identified the imperial system, citing units such as cups, teaspoons, and pounds. This provided a natural transition to introducing the metric system, particularly the use of grams. The importance of understanding both systems was emphasized, noting that in science—especially in chemistry—grams are used to measure the mass of atoms and molecules. Since the students were in sixth grade, the explanations were simplified to ensure accessibility and engagement.

To introduce the concept of moles in chemistry, the students were given an analogy they could relate to: atoms were compared to Lego pieces, and moles to dozens of eggs. This helped them grasp the idea that a mole is simply a standardized quantity of particles, similar to how a dozen refers to twelve items. To reinforce the concept, they practiced converting the mass of one mole of various elements, such as carbon, copper, and zinc, between pounds and grams.

The focus was then shifted to volume measurements by revisiting the conversion between fluid ounces and liters. To create a culturally relevant and engaging context, the students from the United States were introduced Galbi, a traditional Korean dish often served during Korean Thanksgiving. It was recommended that the students try it if they had the opportunity and used its recipe as a real-life example of why accurate unit conversions matter—particularly when interpreting international or scientific recipes. This linked it to the scientific importance of liters, which are used to measure the volume of liquids and gases in chemistry.

Building on this, the topic of phase changes was introduced—a concept students had previously encountered—and connected it to the role of volume in different states of matter. Students demonstrated a strong understanding of the relationship between intermolecular forces and volume in solids, liquids, and gases. The exception of water expanding when it freezes was addressed, briefly explaining the role of hydrogen bonding. To reinforce learning, students practiced converting between volume units (e.g., fluid ounces to liters and vice versa), using familiar visual aids such as images of water bottles to support comprehension.

Reflection

While preparing these lessons, one of the graduate students was reminded of their first visit to the United States. During a grocery shopping trip, the graduate student found it challenging to decide how much of a vegetable to buy because the items were measured in pounds, instead of the more familiar grams. This experience highlighted the importance of understanding measurement systems—especially as a science teacher. Many countries, including South Korea, use the metric system, which is also the standard in scientific disciplines. As a student, the graduate student had little difficulty learning scientific measurements because it was already the familiar units of measurement. However, since the United States primarily uses the imperial system, the graduate student realized that helping students become comfortable with both systems could support their learning and make science more accessible.

The goal was for students to explore how metric units are used in scientific measurements and understand how these units connect to real-world situations. The graduate student explained the concepts, provided practical examples, and guided students through hands-on unit conversion exercises. Although some students initially struggled with complex calculations and working with decimals, they gradually developed confidence as their understanding deepened. By the end of the lesson, most students demonstrated a clear grasp of the importance and application of unit conversions. This lesson was personally meaningful, as it allowed one of the graduate students to connect their own experience with their teaching practice. It also influenced the way that the graduate student will approach future lessons—reinforcing the importance of unit conversions when teaching scientific measurement to help bridge students' understanding between academic content and everyday life.

Math #1

Lesson Design

Building on the preceding history lesson, in which students explored the origins of the International System of Units (SI), the first mathematics class was intentionally designed to deepen conceptual understanding of SI units through authentic, cross-curricular instruction. The lesson situates algebraic reasoning and unit conversion within the culturally relevant context of Thanksgiving-themed recipes, making mathematical concepts accessible and meaningful for middle-grade students in Southern Appalachia. This design not only supports disciplinary learning but also fosters interdisciplinary connections and cultural awareness (Goos, Carreira, & Namukasa, 2023).

Central to the lesson's instructional approach was the application of the Universal Design for Learning (UDL) framework, which informed both the structure and delivery of activities. UDL was operationalized by providing multiple means of representation (e.g., visual graphic organizers and unit conversion tables), multiple means of engagement (e.g., culturally relevant recipes and collaborative problem-solving), and multiple means of expression (e.g., group discussions, written reflections, and verbal explanations). Incorporating UDL principles into STEM/STEAM instruction has been shown to enhance accessibility and engagement for students with diverse needs, including those with disabilities (Taylor & Hwang, 2021; Thoma et al., 2023). By intentionally embedding UDL, the lesson accommodated varied learning preferences and promoted equitable participation, ensuring all students could access rigorous mathematical content (Cho & Kim, 2023). The instructional sequence commenced with an

activating task in which students examined various weights presented in both customary U.S. and SI units, prompting reflection on the real-life significance and utility of standard measurement systems. This introduction was intended to stimulate curiosity and establish a foundation for inquiry-based learning centered on the relevance of SI units in everyday contexts.

The core instructional activities began with the whole class working collaboratively to construct and interpret equations for converting between customary and SI units, such as converting fluid ounces to milliliters and ounces to grams. Through this process, students focused on understanding the algebraic structure of conversion formulas and how these equations are applied in real-world scenarios (Taylor & Hwang, 2021). Building on this foundation, students then worked in teams to apply the conversion equations to a practical context by converting ingredient amounts in the “Grammy’s Creamed Potatoes” recipe. This group activity reinforced both procedural fluency and conceptual understanding through cooperative problem-solving (Cho & Kim, 2023). Finally, each student individually practiced additional unit conversions using a peanut butter and jelly sandwich recipe, allowing for further differentiation and adaptation to class pacing and individual needs. Throughout the lesson, the instructor consistently modeled mathematical reasoning, provided explicit explanations for each procedural step, and fostered peer teaching by encouraging students to articulate their problem-solving strategies. This approach, combined with UDL strategies, not only minimized misconceptions but also supported metacognitive development and ensured all students had access to the learning objectives (Thoma et al., 2023).

Importantly, this mathematics lesson was deliberately sequenced to serve as a foundation for subsequent science instruction. By providing students with opportunities to learn and practice key mathematical concepts—specifically, unit conversions and algebraic reasoning—this lesson equipped students with the skills necessary to meaningfully engage in later science activities involving measurements and physical changes. In practice, students were able to apply the mathematical concepts acquired in this class directly to the science lesson that followed, demonstrating effective transfer and functional integration across subject areas (Taylor & Hwang, 2021). The lesson concluded with a reflective summary, wherein students articulated what they had learned and considered the practical implications of mathematical concepts in real-life contexts. Formative assessment was embedded throughout, with student understanding evaluated via activity outcomes and peer explanations, allowing for targeted feedback and support.

Reflection

In the first mathematics class, instruction centered on constructing equations to convert recipe ingredient units into SI units, followed by substituting given x-values to solve for corresponding y-values. Each procedural step was explicitly explained with underlying reasoning, and similar problems were solved collaboratively to reinforce students’ understanding and enable them to articulate the logic behind each step. Although calculator use was permitted, some students encountered difficulties performing fractional calculations. To address this, one member from each group was asked to present their solution strategy to their peers. This practice facilitated metacognitive reflection, enabling students to identify both correct conceptual understanding and potential misconceptions, thereby reducing computational errors.

In a subsequent class with a different group, the lesson was adapted to employ alternative instructional strategies aimed at fostering greater student interaction. This adjustment was informed by the varying levels of rapport between instructors and students, as well as prior consultation with the homeroom teacher regarding differences in mathematical ability. Across all classes, students generally reported that the allotted time for responding to questions was sufficient; however, many found SI units to be an unfamiliar concept, presenting initial challenges. By approaching the topic from multiple perspectives throughout the day, students became increasingly comfortable with SI units, ultimately meeting the instructional objectives.

Moreover, this mathematics lesson was integrated into a broader, Thanksgiving-themed cross-curricular project spanning mathematics, science, English language arts, and history. Students participated in a full day of interconnected lessons, each reinforcing the role and relevance of SI units across disciplines. This integrated, culturally responsive approach enabled students to recognize the interconnectedness of academic content, promoting both deeper understanding and greater engagement with abstract mathematical concepts (Thoma et al., 2023). By anchoring algebraic reasoning and unit conversion in authentic, culturally significant contexts and by employing the UDL framework to address diverse learner needs, this lesson design advances the research aim of making mathematics both accessible and meaningful for middle-grade learners in Southern Appalachia, while also serving as a replicable model for multidisciplinary STEM/STEAM education.

History

Lesson Design

Throughout the history lesson design, students were instructed to login into NearPod, an interactive lecture site. It was here that the teacher instructed students to pass around a graphic organizer where they could complete the sections that would be covered through the lesson. Throughout the lecture, students were able to discuss the causes of the French Revolution. This section had a corresponding part on their graphic organizer where they were able to fill this part in. Next, the teacher and students walked through the effects of the French revolution which was included on the graphic organizer. The last section of the lesson gave students an insight of what was to come throughout the remaining lesson of the day through Math, Science, and ELA. Students discussed the importance of the ideas that emerged from the French Revolution, which allowed for the creation of the International Systems of Units. After the closure of the lesson, students were instructed to look over their graphic organizer one last time before a short review game began. This game allowed the students to test their knowledge and the teacher to see the progress that was made. It also allowed the teacher to gauge each students' comprehension of the material that they were presented with during the lesson through this game. The site that was used for the lesson allowed the teacher to have a log of the students and their score by the end of the game.

Reflection

The goal for the students was to be able to build foundational knowledge prior to the lessons from Math, Science, and ELA. The students were able to learn and understand the history of the International System of Units. The graphic organizer allowed for the students to reflect back on the material throughout the lessons that were to come in order to fully understand.

Science

Lesson Design

From the beginning of the lesson, the intention was for students to reflect on the units they use in their daily lives or have learned in science class, such as oz, fl oz, kg, mL, L, km, mile, °F, and °C. In particular, the goal was for them to deepen their understanding of units of length, especially the meter. The daily objective for this lesson was to help students understand the relationship between kilometers and miles. It began by asking the students if they were familiar with the units of length commonly used in the United States, such as inches, feet, yards, and miles—and most students were. Then were then asked if they knew what a kilometer was. Although they had learned about kilometers in class and were somewhat familiar with the concept, it seemed less intuitive to them. To illustrate the difference, they were shown an image of a sign in the desert: it indicated that there was water 1 mile to the left and 1 kilometer to the right. The students were asked, "Which way should we go?" About half of the students chose the left, while the rest chose the right. A caption was added explaining that 1 kilometer is approximately 0.62 miles, and students quickly realized which distance was shorter. The teacher reminded the students once again that 1 mile is approximately 1.6 kilometers, and 1 kilometer is about 0.62 miles. To make this concept more relatable, the class imagined walking to the nearby football stadium and practiced converting that distance from kilometers to miles.

Next, they worked through another real-world example, calculating the distance to the airport for a Thanksgiving trip to visit relatives. We also converted the speed limit from miles per hour (mph) to kilometers per hour (km/h). After this activity, I wanted to give students a chance to engage in critical thinking. I shared that only about 5% of the world's population, including people in the United States, Myanmar, and Liberia - they still primarily use the imperial system. However, I also explained that some industries, such as aviation and display manufacturing, still use units like feet or inches regardless of the country's measurement system. Then, I posed a question: What if we converted all length measurements in our daily lives to the metric system? Students shared their thoughts, and we discussed the pros and cons of such a change.

Reflection

Part of the inspiration for this project began with a conversation between one of the graduate students and one of the faculty mentors. Coming quite literally from a different system of measurement, the graduate student initially found it difficult to intuitively grasp U.S. customary units such as Fahrenheit and the yard-pound system. The graduate student realized that if students in the United States were to visit or live in another country, they might experience the same confusion and challenges. The graduate student made it a goal to help students develop literacy in units and approached the lesson in a way that would make these concepts more accessible and meaningful to them. Throughout the process, the graduate student also identified areas for improvement—for example, having students convert their own height into meters, incorporating more scientific principles, or strengthening cross-curricular connections with other subjects. These reflections led the graduate student to consider how similar lessons could be adapted and applied more broadly across different grade levels in the future.

Math

Lesson Design

In the second math class, the lesson was introduced by recalling the recipe used in the ELA lesson. For this class, the ELA teacher introduced the recipe that included Celsius units. Pointing out the Celsius in the recipe, students were asked a question such as “how can we make the food on the recipe using the oven in Fahrenheit?” or “how can we make the food with the recipe in Fahrenheit in the other country where they use Celsius?” These questions helped students connect between different subjects and understand the needs for the unit conversion.

After introducing the lesson, students explored the conversion between units through connections to science and the real world. For the definition of Celsius and Fahrenheit for the conversion, the phase of the water is used which was covered at the previous science class. As Celsius and Fahrenheit are defined by phase change of water, students could use the definition of Celsius and Fahrenheit to derive out the degrees of Celsius and Fahrenheit when water is solid, liquid, and gas. Then the formula of the conversion is introduced using the definition. For the application of the conversion formula, real world context was used, which is comparing the temperature of Florence, AL and Seoul, South Korea on Thanksgiving Day and Chuseok. Students were asked to compare the temperature of Florence in Fahrenheit and Seoul in Celsius. To compare the temperature, students must convert the units. This activity allows students to try the formula in real-world contexts and get used to algebraic expressions.

At the end of the lesson, students wrote down what they learned about this lesson and project. By writing down what they learned on the project worksheet which is asked to write down at other classes in the project, students can reflect and metacognize the lesson and connect the lesson with other subjects in the project.

Reflection

The conversion between Celsius and Fahrenheit is covered in the second math class because its formula is more complex than those in the first math class. By placing the contents in order of complexity, students could approach algebraic expressions step by step. This strategy fits quite well and students seem to follow the lesson to achieve the goal.

Connectedness with other classes was the most considered component when designing this lesson and it was implemented successfully. Conversion between units connects to other classes as a main topic. The mashed potato recipe which was used to introduce the lesson connects to the ELA class. Students learned the formula for the conversion through phase change of water which was covered by the previous science class. The main theme, Thanksgiving Day, was also used by comparing temperatures of the U.S. in Thanksgiving Day and South Korea in Chuseok. These approaches enabled the mathematics lesson to connect to other subjects and made it a successful multidisciplinary lesson project.

Limitations and Implications

While this study contributes a culturally grounded, cross-curricular model for teaching unit conversion, several limitations should be noted. First, the research focused on two sixth-grade classes in Southern Appalachia, and the sample size was small. Although the purpose of this study was lesson design rather than measuring student outcomes, the specific age group and regional context may limit generalizability to other grade levels or geographic locations. Second, the study’s methodology relied on the collaborative design and reflection of the research team rather than systematic student data. The team itself included eight

members - three from Southern Appalachia and five representing areas from around the globe - which may have introduced assumptions and perspectives that shaped the lesson design. Finally, while the lesson was grounded in specific holiday and food traditions, adapting it to other cultural contexts may require careful modification to ensure relevance and respect.

Despite these limitations, the study provides a replicable framework for integrating culturally responsive content into multidisciplinary STEM/STEAM lessons. Future research could explore adaptations for different age groups, regions, and cultural traditions, as well as the impact of such lessons on student learning outcomes and engagement. Additionally, the collaborative and cross-cultural nature of the research team highlights the value of diverse perspectives in designing interdisciplinary curriculum, offering a model for similar educational research efforts.

Conclusion

Throughout this multidisciplinary lesson, students became more aware of not just the International System of Units (SI), but also the importance of SI in a global world. This began as a conversation between a graduate student from the Republic of Korea and a professor from the United States and evolved into a lesson linking Korean and Southern Appalachian culture in a way that was relevant to sixth grade students. On a practical level, this research demonstrated the connections between English Language Arts, Social Studies, Math, and Science as a comprehensive STEAM lesson that is replicable in other classrooms. This integration illustrates how a multidisciplinary approach can deepen conceptual understanding by showing measurement and conversion not as isolated skills, but as ideas woven into culture, history, and global systems. While this research utilized the Thanksgiving holiday to emphasize the importance of SI, other holidays and other cultures can be used.

For example, this approach could be adapted to a range of holidays in which food plays a central role. Within a Southern Appalachian and United States context, recipes from Christmas, Easter, or Fall festivals provide opportunities to explore measurement through baking, canning, or cooking. Globally, traditions such as Korean Lunar New Year rice cakes, Indian Diwali sweets, Mexican Day of the Dead bread, or Jewish Hanukkah latkes also involve precise measurements that highlight cultural identity while reinforcing unit conversion skills. By situating lessons in these familiar and meaningful contexts, educators can connect abstract mathematical and scientific concepts to lived experiences across diverse cultures.

This demonstrates the instructional opportunities of grounding unit conversion in meaningful, culturally responsive contexts, while also raising challenges such as selecting contexts that are both respectful and accessible across diverse classrooms. Taken together, these outcomes directly address the guiding research questions by demonstrating how a multidisciplinary, culturally grounded approach to unit conversion reveals deeper conceptual understanding, creates rich instructional opportunities, and highlights both the possibilities and challenges of designing interdisciplinary curriculum.

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