

Examining the influence of *Vision and Change* and a mentoring network on teaching philosophies and strategies

Stephanie L. Mathews,¹ Carlos Goller,¹ Michael J. Wolyniak,² Uma Swamy,³ Anjali Misra,⁴ Michael E. Moore,⁵ Jeremy L. Hsu,⁶ Dina L. Newman⁷

AUTHOR AFFILIATIONS See affiliation list on p. 16.

ABSTRACT The 2011 report *Vision and Change: A Call to Action* (V&C) resulted from a national effort to rethink biology curriculum. V&C outlines core concepts and core competencies for biology undergraduates and promotes evidence-based pedagogy, undergraduate research, and inclusive practices. However, it is unclear how much biology educators know about V&C and what motivates educators' development of their teaching philosophy and practices. We leveraged the Promoting Active Learning and Mentoring (PALM) Network, a group that introduced evidence-based instructional practices (EBIPs) to instructors through mentoring, journal clubs, and a community of practice, to investigate how much V&C has influenced educator knowledge and motivation. Through focus groups, 16 mentors and 22 fellows were asked about their motivations to join PALM, familiarity with V&C, how they learned about V&C, and how PALM and/or V&C shaped the development of their teaching philosophies and strategies. We found that the teaching philosophies and practices of these educators align strongly with V&C principles. V&C provided expectancy (established value), while PALM contributed to greater instructor self-efficacy in EBIPs, overall resulting in reformed teaching philosophies and practices. This model highlights the importance of mentorship and community to successfully drive biology education reform.

KEYWORDS *Vision and Change*, active learning, evidence-based instructional practice, mentoring, situated expectancy value theory

Vision and change

About 15 years ago, the National Science Foundation (NSF) and the American Association for the Advancement of Science sponsored a large-scale rethinking of undergraduate biology education, resulting in the 2011 report *Vision and Change: A Call to Action* (V&C) (1). V&C outlines a set of core concepts and core competencies for biology undergraduates and promotes evidence-based instructional practices (EBIPs) and undergraduate research (see box 1 in reference 2). The report sparked systematic efforts to increase the use of evidence-based practices and transform undergraduate biology education, including the open-access journal of peer-reviewed teaching resources for undergraduate biology, *CourseSource* (3–7). In addition, multiple tools for course design aligned with V&C have been published, including the BioCore Guide and the BioSkills Guide (8, 9). Similarly, there have been several implementation frameworks and assessment instruments published that align with V&C (10–13).

While some instructors may employ teaching practices aligned with V&C, there is still a great need for more widespread reform. For example, a recent study documented the limited application of V&C principles in exam questions from lower-division courses—particularly a lack of assessing scientific practices (14). Barriers to implementation include finding resources, especially resources that fit an individual instructor's context, as well as sustaining the recommended practices in part due to a lack of departmental

Editor Sarah Fankhauser, Emory University, Atlanta, Georgia, USA

Address correspondence to Stephanie L. Mathews, stephanie_mathews@ncsu.edu, or Dina L. Newman, dina.newman@rit.edu.

The authors declare no conflict of interest.

Received 4 March 2025

Accepted 6 May 2025

Published 30 May 2025

Copyright © 2025 Mathews et al. This is an open-access article distributed under the terms of the [Creative Commons Attribution-NonCommercial-NoDerivatives 4.0 International license](https://creativecommons.org/licenses/by-nd/4.0/).

collaborators (15–17). Despite the proliferation of pedagogical tools and programs intended to facilitate the implementation of *V&C*, it is still not applied universally to undergraduate biology courses.

Mentoring as a tool for implementing *V&C* reform

Mentoring is one model for instructional reform that provides individual support and a collaborative and supportive environment to promote that instructional reform. This type of professional development has been measured as successful and mutually beneficial (18–20). One mechanism for providing this mentorship is through NSF Research Coordination Networks for Undergraduate Biology Education (RCNs-UBE) that support networks of scientists with common goals. Previous research has demonstrated the success of RCNs in promoting collaboration and knowledge diffusion (21), and networks like the Northwest Bioscience Consortium and the Advancing Competencies in Experimentation in Biology have published EBIPs that have resulted from their work (22, 23).

The Promoting Active Learning and Mentoring Network: an RCN-UBE designed for long-term mentoring in *V&C* EBIPs

In this study, we interviewed members of Promoting Active Learning and Mentoring (PALM), an RCN-UBE that established a mentoring network to help faculty include more active learning in the classroom, as recommended by *V&C*. Faculty paired together (mentors and fellows) to implement changes in the fellows' courses. Many PALM mentors and fellows teach similar courses, which establishes the mentor as an experienced expert in implementing active learning in the fellow's context. Individualized plans were carried out to introduce a variety of EBIPs into a course selected by the fellow. Monthly journal clubs were also hosted virtually for mentors and fellows in which discipline-based educational research (DBER) articles were discussed, and several in-person meetings allowed for network members' interaction. PALM networking was largely effective at reducing barriers, allowing educators to implement EBIP (24). It has resulted in the dissemination of EBIPs in numerous posters, oral presentations, and 21 publications by PALM fellows and mentors. Here, we use PALM as a case study for determining how *V&C* impacts the development of instructor philosophies and practices, drawing upon this network of instructors interested in pedagogical change. PALM exists to promote active learning, which is one of the major recommendations of *V&C*. While *V&C* was foundational to the program's design, it was not explicitly discussed in PALM. There was no requirement for mentors to highlight *V&C* with their fellows, and the PALM network's journal clubs or other meetings never directly discussed *V&C*, the BioCore guide, the BioSkills guide, or the Bio-MAPS assessment. Thus, the PALM network provides an interesting case study to analyze how much *V&C* has permeated the community of biology instructors who are interested in pedagogical reform.

Research questions

The dissemination efforts previously mentioned (RCNs, published resources, communities of practice, and mentoring) are intended to inform instructors in their day-to-day practices. We assume that this will ultimately lead to changed teaching philosophies (beliefs and motivations about teaching); however, the specific ways in which these pedagogical training activities influence teaching philosophies and teaching strategies remain underexplored.

Thus, this study addresses the following research question:

1. How much do instructors in a network looking to implement evidence-based instruction know about *V&C*?

2. To what extent does V&C motivate instructors in this network to engage in pedagogical reform and form the basis of their pedagogical decisions?
3. Have instructors in this network observed a link between V&C principles and education reform?

To answer these questions, we interviewed PALM network mentors and fellows and analyzed their responses. The resulting model provides information for future STEM educational reform on how instructors make choices about their courses in relation to V&C principles in the context of a mentoring network.

Motivation framework

Situated Expectancy Value Theory (SEVT) explains how various factors can affect (influence) an individual's choices and actions (25–27). We used SEVT as a framework to understand instructor motivation for choices about educational practices. SEVT outlines three components of an individual's decision-making process: (i) self-efficacy: perception of current abilities, (ii) expectancy: perception of likeliness to succeed, and (iii) task value: personal beliefs about the value of the task, which include usefulness, importance, and interest (25, 28). SEVT is useful to consider the factors that influence decision-making and is often studied in the context of teaching reform. It was first applied to the educational context by Abrami et al. (29) to identify differences between those who implemented educational innovation and those who did not (29). Since then, other researchers have used this framework to identify the motivation of instructors to better understand what influences reformed instructional practices. Experience and ability beliefs are motivating factors that increase the likelihood of instructors making a decision to implement reform practices (30–34). Thus, we apply the SEVT framework to better situate instructor motivation for pedagogical reform and examine the different components of V&C and PALM on self-efficacy, expectancy, and instructor interest.

METHODS

Participant selection

Focus group participants were recruited by emailing all 120 PALM members. Those PALM members who expressed interest were solicited to attend a focus group held in proximity to their professional society. In total, 38 PALM members participated in focus groups conducted in conjunction with eight biology-focused or biology education-focused professional society meetings from 2023 to 2024. Their roles in the program included 16 mentors, 20 fellows, and 2 who started as fellows and later became mentors. In our analyses, the individuals with both roles were coded as fellows.

Focus groups

The eight co-authors collaboratively developed the focus group protocol, drawing upon our collective experiences to create focus group questions aligned with the research questions. Questions were designed to prompt participants to consider their teaching philosophies and practices, their sources of inspiration, and how PALM and/or V&C might have motivated these beliefs and/or practices (Supplemental Material). To ensure clarity of the questions and alignment with the research questions, all eight team members reviewed and edited the questions to improve understanding. Focus groups of up to three PALM members were recorded, for a total of 38 participants. PALM members were asked about their motivations to join PALM, their familiarity with V&C, whether they learned about V&C through discussions with their mentor/fellow or other PALM members, and how PALM and/or V&C shaped the development of their teaching philosophies and strategies. The reflections about V&C and PALM are self-reported. Additional evidence of their teaching strategies and teaching practices was not collected.

Analysis

The interviews were transcribed using Otter.ai and manually cleaned to ensure accuracy; the participants were assigned pseudonyms. A codebook was developed for each research question by pairs of researchers (Table S1). The codebook was discussed with all the co-authors, ensuring the codes were clear, connected to each question, and representative of the data set. Each transcript was independently coded by pairs of researchers, and differences were resolved through discussion. A word cloud was developed based on the frequency of individuals who were coded as citing each teaching philosophy theme.

RESULTS

Familiarity with *Vision and Change*

Focus group participants were asked about their familiarity with *V&C*. The majority of both mentors and fellows were aware of the report, and many (especially mentors) considered themselves well-versed in its contents (Fig. 1A). Of the PALM mentors, 56% stated they were “an expert in *V&C*.” Focus group participants were coded as experts if they implemented *V&C* principles due to prior knowledge of *V&C* and/or used it as a framework for their courses. In comparison, 73% of the fellows stated they were aware of *V&C*; these participants could identify *V&C* and some of its content but did not describe how their pedagogical practices were linked to *V&C*. Only one mentor and two fellows were unfamiliar with *V&C*. Participant introductions to *V&C* were varied (Fig. 1B), with about a third citing professional societies (31% of the mentors and 36% of the fellows) and a third mentioning a colleague (31% of the mentors and 32% of the fellows) (some mentioned both). Other common sources included PALM and DBER literature/conference presentations. Many could not recall specifically where they first heard about *V&C*.

When asked what comes to mind when thinking of *V&C*, the most common answers were core concepts (63% of the mentors and 59% of the fellows), core competencies (63% of the mentors and 50% of the fellows), and a framework for biology education (81% of the mentors and 50% of the fellows) (Fig. 2). No one mentioned other important aspects of the report, such as the emphasis on evidence-based instructional practices and undergraduate research. Interestingly, several people mentioned the BioSkills Guide (8), a document aligned with *V&C* that defines specific skills for biology majors. Only two participants specifically mentioned diversity, equity, and inclusion (DEI) in STEM. Some

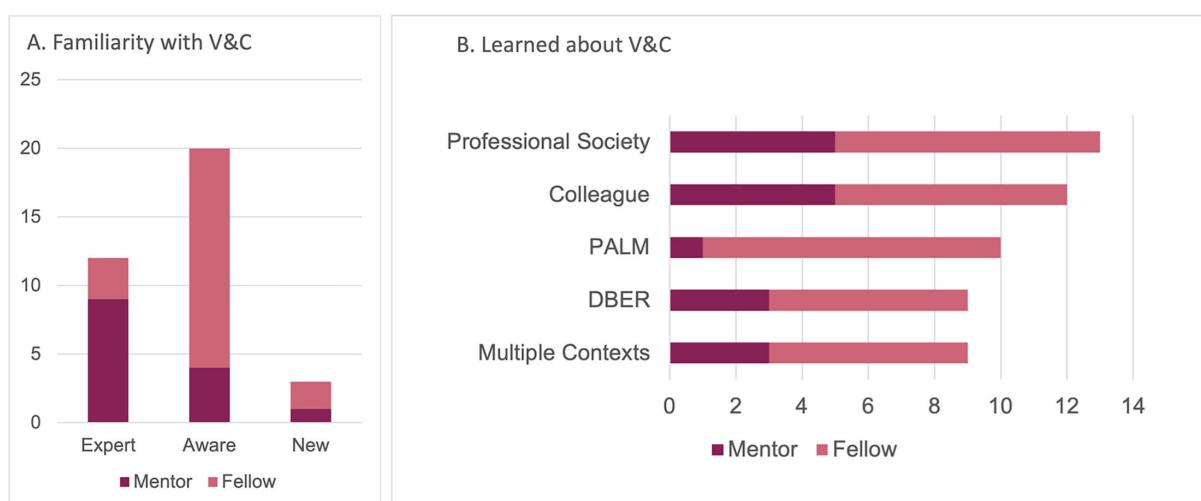


FIG 1 Most focus group participants were familiar with *V&C*. (A) Participants ($n = 16$ mentors and 22 fellows) were asked, “How familiar are you with *Vision & Change*?” (B) Participants (16 mentors and 22 fellows) were asked, “How did you learn about *Vision & Change*?” Several participants cited multiple sources for hearing about *V&C*. The most common co-occurrence was a professional society and an individual.

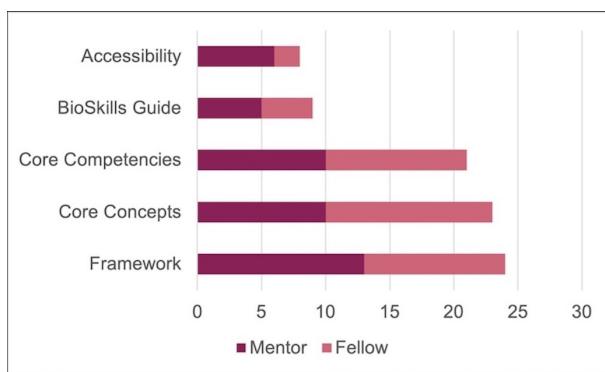


FIG 2 Participants were asked, “What comes to mind when you think of *Vision & Change*?” Answers included an overarching framework, parts of the report itself (core competencies and core concepts), an extension of *V&C* (BioSkills guide), and the accessibility of the document to educators. Many people described multiple themes.

focus group members associated *V&C* with accessibility because *V&C* was approachable by faculty (Fig. 3).

Nearly two-thirds of both mentors and fellows believed that *V&C* is very valuable to education, describing *V&C* as essential to course design (63% of mentors and 64% of the fellows), although a few participants (6) noted its limited scope. The remaining participants did not directly answer this question. Valuable aspects of *V&C* were reported to be the authority (a document that can be used to support reform because it was authored by a nationwide group of expert educators), its application to introductory coursework (building a foundation of knowledge useful for upper-level courses), and its emphasis on training students to think like scientists (observe, ask questions, and find the answer) (Fig. 4). Quotes from participants describing these aspects can be found in Fig. 3.

Motivation for pedagogical reform

Next, focus group participants were asked why they joined PALM. Most participants joined to learn better teaching practices (50% of the mentors and 77% of the fellows), including active learning pedagogy (38% of the mentors and 59% of the fellows), and belong to a community of educators (69% of the mentors and 55% of the fellows) (Fig. 5). Although two fellows and four mentors joined at least in part because of *V&C*, 28 participants (74%) stated that *V&C* did not influence their decision to join PALM, with 12 noting that they failed to see PALM as integrated with *V&C* when they joined. About a third of the fellows were motivated by the stipend and a third by “certification,” which reflects a desire to develop and document their skills in the field of biology education, even though PALM did not provide any official certification.

To gain insight into the impact of *V&C* and PALM on instructor philosophies and practices, focus group participants were asked first to describe their teaching philosophy and then how they developed their ideas about teaching. Their responses indicated that they were motivated by a desire to improve their teaching, which typically involves the implementation of EBIPs, inclusive practices, and other student-centered practices described in *V&C*. Figure 6 shows the prevalence of major themes included in the teaching philosophies of focus group participants. Not surprisingly, considering the focus of PALM, most participants discussed the importance of evidence-based strategies, often simply characterized as “active learning,” which focuses on student engagement (Fig. 7).

Other common themes related to the course content (Fig. 7). Participants also highlighted the importance of critical thinking, often phrased as trying to teach their students to “think like scientists.” Concepts and skills were valued by many educators who described how using core concepts and skills in course design benefits student

What is the value of Vision & Change?

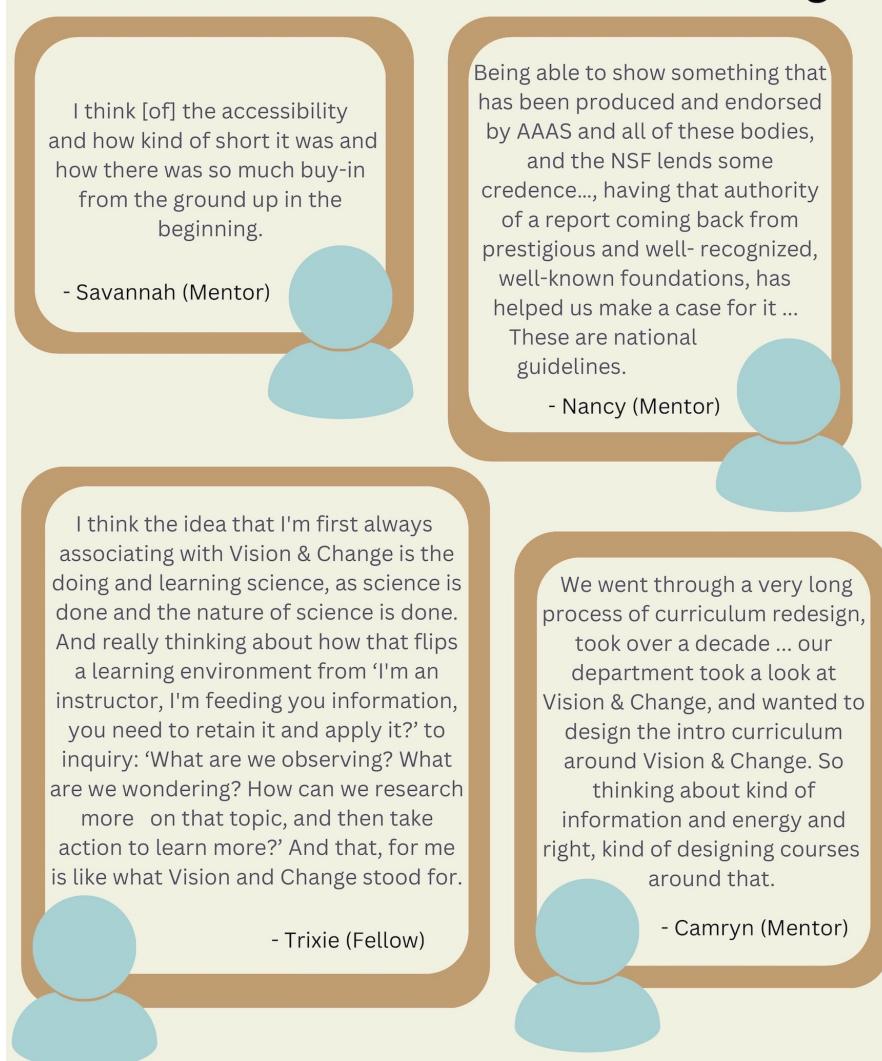


FIG 3 Selected quotes from participants when asked "Is *Vision & Change* valuable or important to biology education?"

learning. A few participants also mentioned the importance of connecting the material to "real-world" applications such as the COVID-19 pandemic.

Many instructors described aspects of the classroom related to the classroom environment, student identity, or socioemotional aspects of the learning process (Fig. 7). A common theme was DEI, which included valuing diversity in the classroom, striving for equitable outcomes, and building inclusive spaces. Many participants discussed the concept of a student-centered classroom, which is built on empathy for students and their struggles. Others focused more on engaging students in the learning process or "making it fun."

After describing their teaching philosophies, participants were asked how they developed those philosophies. We coded for three sources that contributed or did not contribute to their teaching philosophy: (i) *V&C*, (ii) PALM mentorship (including mentor-to-fellow and fellow-to-mentor influence), and (iii) PALM network (including journal clubs, in-person meetings, and informal discussions with members outside of mentor-fellow pairs) (Fig. 8). The majority of participants cited *V&C* as a contributing source in developing their teaching philosophy: 94% of the mentors (15 people) and 77% of the fellows (17 people). Only three fellows stated that *V&C* did not contribute

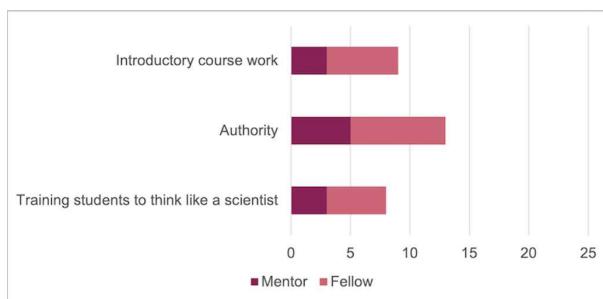


FIG 4 Participants were asked, “Is *Vision & Change* valuable or important to biology education?” All participants agreed that it is important, with most describing the value in three major categories.

to their teaching philosophy. Most participants also cited both the PALM mentorship and the PALM network as contributing to their teaching philosophy, with only three mentors stating that PALM did not contribute to their teaching philosophy. They were not specifically asked to discuss other sources of motivation, but 5 mentors and 11 fellows did mention non-V&C and non-PALM sources, such as professional societies and research mentors.

To better understand how V&C and PALM experiences influenced teaching, their responses to the questions “how did participation in PALM alter your own pedagogical practices and strategies in the classroom?” and “did *Vision & Change* inspire reflection on your own pedagogical practices and strategies in the classroom?” were analyzed, resulting in seven major themes (Fig. 9). Focus group participants described V&C as a document that they could cite to validate their teaching practices. V&C also provided resources for the course curriculum and course design for both mentors and fellows. Focus group participants cited core concepts and core competencies as helpful for department curriculum design, such as creating course objectives, as well as content selection in their own courses (Fig. 9). V&C was also cited as an inspiration to use EBIPs. Focus group participants made choices about what activities to include in their teaching based on the principles outlined in V&C (Fig. 9). For example, participants cited V&C as the reason to implement inquiry-based labs and metacognition activities.

Two elements of PALM, the mentorship and the network itself, contributed to many of the choices instructors made in their courses. Those cited most often were awareness of EBIPs, inspiration to use EBIPs, resources for EBIPs, and (for fellows) having a role model for teaching. The PALM network provided the most support for awareness of EBIPs and inspiration to use EBIPs, such as awareness of backward design. Not only were focus group participants aware of EBIPs due to the PALM mentorship network, but they were also inspired to use them. This included mentors who reformed their teaching practices and fellows who described the importance of mentorship and the

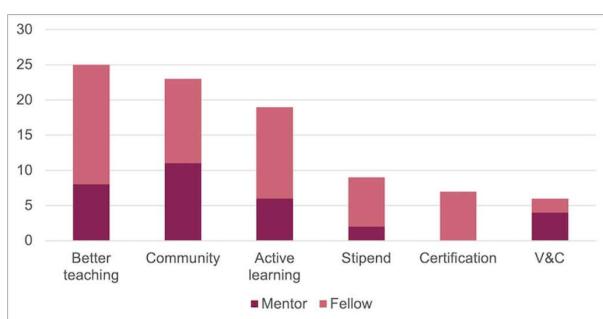


FIG 5 Participants’ motivations to join PALM centered around EBIPs and membership in a community of educators. Focus group participants were asked, “Why did you join PALM?” Many individuals mentioned more than one reason.



FIG 6 Word cloud of codes based on PALM members' descriptions of their teaching philosophies. The size of the text indicates how many individuals mentioned each theme.

PALM network because they learned many strategies from a community of instructors (Fig. 10).

When considering a change to teaching practices and incorporating EBIPs, one of the obstacles is finding resources appropriate for the instructor's context. Fellows reported that PALM mentorship and the PALM network helped find appropriate resources to implement and ensured the approach was sustainable as it fit their specific courses (Fig. 10). Mentors pointed them to specific practices in alignment with the principles of V&C that fit their classroom contexts, such as Process Oriented Guided Inquiry Learning. However, the PALM mentorship also established a teaching role model for PALM fellows. Because of the reciprocal observations between fellows and mentors, fellows like Glenn were able to see the mentors using EBIPs, which served to create a role model for implementation and increased belief in the ability of the EBIPs to bring about change in the classroom.

The last of the seven themes centered on resources for teaching is the inspiration for discipline-based education research. All three sources of change were cited: the PALM Network (six participants), the PALM mentorship (five participants), and V&C (four participants). The experience in PALM reshaped the professional focus of both fellows and mentors. Not only were they applying active learning and EBIPs aligned with V&C principles, but focus group participants were also measuring the effectiveness of these practices when implemented in the classroom and publishing papers to disseminate information to STEM faculty outside of the PALM network (Fig. 11).

The SEVT model was also applied to understand participant motivation to include V&C in their teaching practices and philosophies. Table 1 demonstrates how the themes described above are connected to the components of SEVT: expectancy, task value, and self-efficacy.

Explicit links between V&C and education reform efforts

We next investigated if participants linked PALM to V&C. PALM was inspired by V&C and an effort to increase active learning and EBIPs in STEM classrooms. Although mentors were not explicitly instructed to highlight V&C and the journal clubs did not explicitly discuss V&C, over half of the focus group participants (58%) identified V&C and PALM as being linked. Some participants described the role of PALM connecting like-minded instructors who shared similar beliefs about V&C. For some focus group participants, PALM promoted their research related to V&C. For others, it led to scholarship and professional development around V&C.

DISCUSSION

A model to promote educational reform

This study aimed to understand the motivation of instructors in a network dedicated to active learning to determine if and how biology instructors used V&C in developing their teaching philosophies and making pedagogical choices. We chose to study instructors from the PALM network because their involvement in PALM indicates that they are educators actively engaged in pedagogical innovation and reform. The recruitment strategy for PALM and this focus group may have selected for instructors who wanted

Teaching Philosophies and Practices

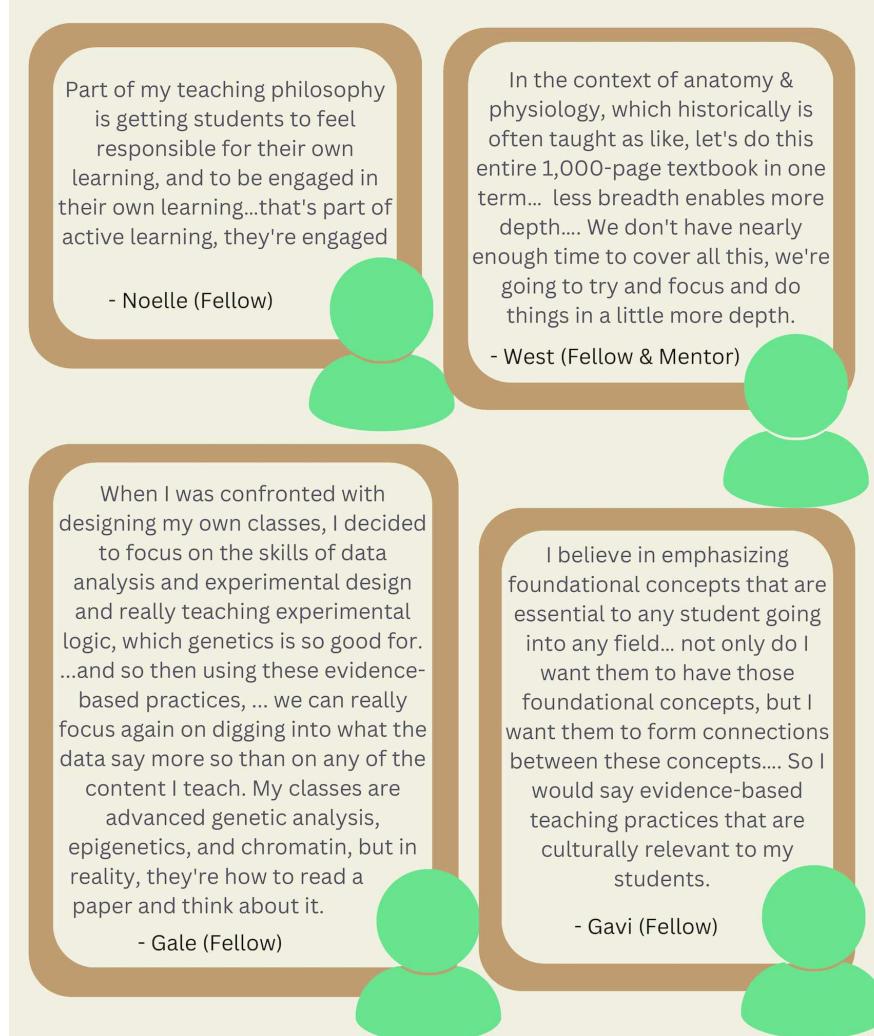


FIG 7 Selected quotes from participants when describing their teaching philosophy and practices.

to learn more about *V&C* or who already had a positive view of *V&C*. While the focus group questions did not explicitly ask instructors to describe their motivation for making pedagogical choices, viewing their answers through the lens of the SEVT framework allows us to better understand their development as reform-minded educators. Figure 12 displays our model of motivation, where *V&C* and PALM together promoted philosophies and practices aligned with the principles of *V&C*.

Expectancy

The *expectancy* to succeed in a particular task is the first component of the SEVT framework. Focus group participants brought many expectations about what *V&C* could do and how it could support their teaching. Our data show that the expectation for success (i.e., implementation of an evidence-based instructional practice to promote student success) was attributed to *V&C* by 25 (66%) participants. Almost all (15 of 16) mentors felt that their own teaching philosophy was influenced by *V&C*. The original *V&C* report (1) was intended to motivate discussion on teaching practices across multiple venues. In this study, the participants typically interpreted *V&C* as a mandate for teaching reform and not a starting point for discussion. In the context of higher education, many

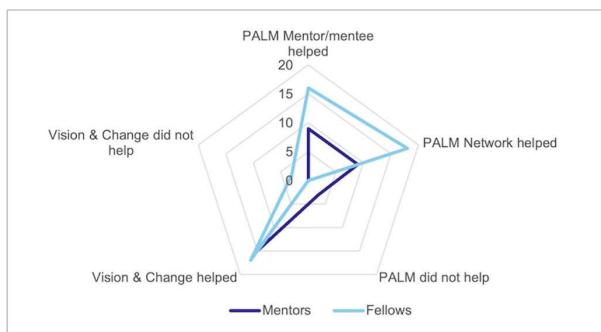


FIG 8 The teaching philosophies and strategies of participants were influenced by *V&C*, PALM mentorship, and the PALM network. Focus group participants were asked whether *V&C* and/or PALM helped develop their teaching philosophies and strategies. Mentors ($n = 16$) and fellows ($n = 22$).

instructors do not receive formal educational training. *V&C* serves as a mandate and framework for their own teaching practices and to support their careers. This demonstrates how *V&C* is uniquely positioned for leveraging education reform and providing expectancy for success. *V&C* was reported to be cited when talking with colleagues, departmental or institutional leadership, or during the promotion and tenure process to validate their instructional philosophies and practices. In other studies, instructors' expectancy about education reform included beliefs about their ability to find a guiding document (33), whereas in our study, *V&C* was reported by instructors to be the guiding document. Participants described *V&C* as a tool to support teaching, and while this may have been influenced by the recruitment strategy, it does reflect several aspects of expectancy for instructors with different *V&C* knowledge levels. These participants described that *V&C* can be used by biology instructors as (i) a primer to learn about effective practices, (ii) a framework to model their instructional practices and courses, (iii) a rubric for which peers and administration can evaluate their instructional practices, and (iv) for instructors who are aware of *V&C*, a tool to increase instructor motivation to change their teaching.

Task value

Our data suggest that both knowledge of *V&C* and participation in the PALM community increase instructors' beliefs about the *task value*, specifically in the area of usefulness and importance of EBIPs. *V&C* was described to have intrinsic value by many participants, being described as "essential for introductory courses," a "handbook for new faculty," and information "from expert educators" (Table S1). These beliefs contribute to the value of practices described in *V&C* and their motivation to use EBIPs. Previous research also showed that motivation to use EBIPs is increased when instructors perceive that these practices are "better for students" (35) or help students think like scientists (36). Additionally, participants reported that PALM provided inspiration for their own discipline-based educational research. PALM provides the tools to implement the EBIPs in the classroom that are called for in *V&C*. Although PALM did not explicitly train fellows on *V&C*, 22 participants (58%) saw them as linked, and in many cases (43% of fellows), participants recalled learning about *V&C* through PALM. This suggests that the dissemination of *V&C* does not have to explicitly mention the document.

Self-efficacy

PALM was described as promoting *self-efficacy* in that PALM fellows gained awareness of active learning strategies and confidence in their ability to implement these strategies. Many participants also identified the importance of active learning and their use of evidence-based strategies as part of their teaching philosophies (Table S1). While participants, particularly fellows, did not often explicitly say that they gained confidence in using EBIPs, they described the influence of their PALM experience on their teaching

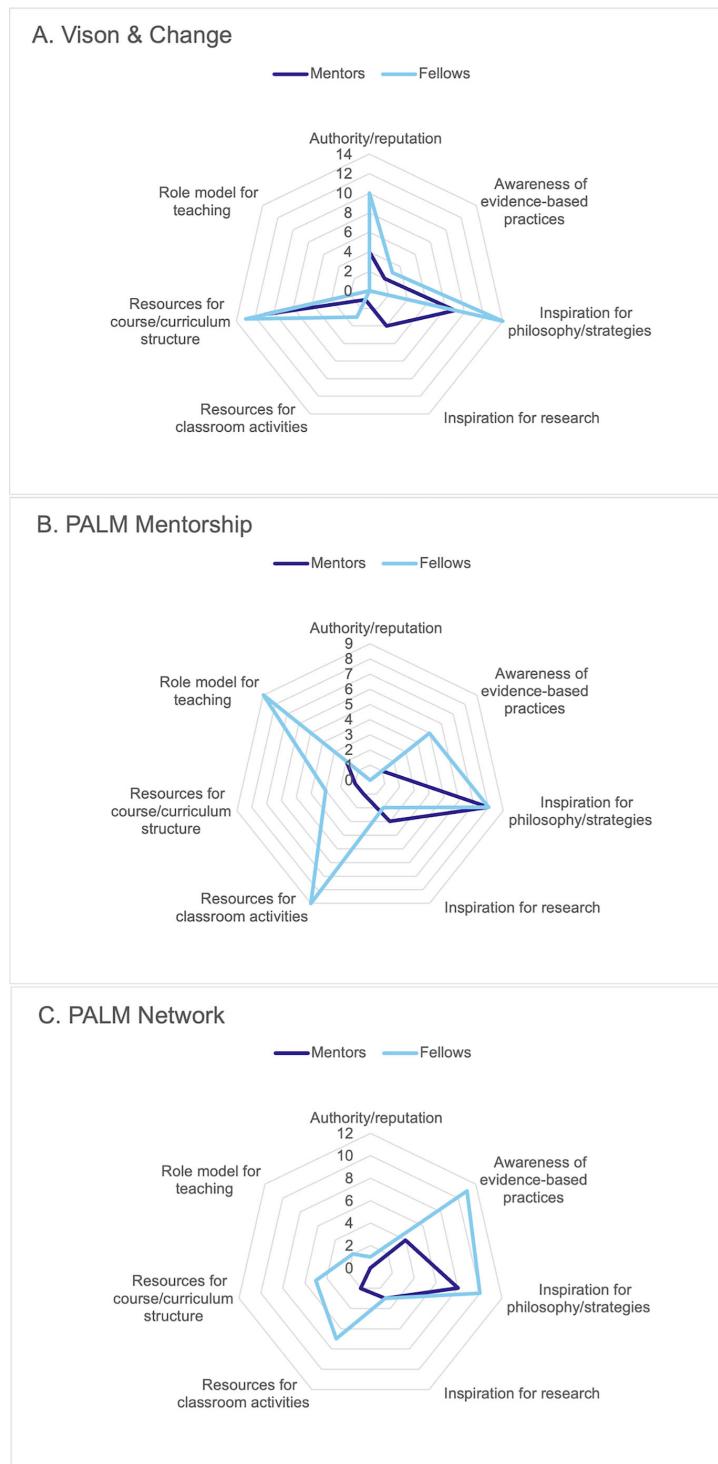


FIG 9 What did you find helpful about *Vision & Change* and/or PALM for your teaching? (A) “How did V&C help?” (B) “How did PALM help?”—coded for mentions of mentor/fellow. (C) “How did PALM help?”—coded for mentions of PALM events and discussions outside of the mentor-fellow relationship. Mentors ($n = 16$) and fellows ($n = 22$).

and their subsequent use of EBIPs. It is likely that participants increased their self-efficacy for using EBIPs due to the feedback and support PALM provided (Table 1). Joo et al. (37) also found that knowledge acquisition also led to improved instructor *self-efficacy* as it relates to changes in instructor practices (37). PALM provided a teaching role model



FIG 10 Selected quotes from participants when asked to describe the influence of V&C on their teaching philosophies and practices.

to help faculty implement instructional changes that matched their course context. Participants described their experience in PALM as providing a tangible pathway to convert motivation into action. They also described changes in their philosophies and practices that have been maintained and often even expanded beyond their involvement in PALM.

Outcomes

These results suggest that V&C was important for instructor motivation, but that a community, such as the PALM network, also contributes positively. After participating in PALM, instructors indicated that they reformed their teaching philosophies and/or practices such that both are now in alignment with the principles outlined in V&C, as evidenced by their teaching philosophies. Both the mentoring relationship and the wider network were important for supporting fellows to embrace the principles of V&C, and even experienced mentors found themselves making positive changes due to their participation in PALM. Other research on STEM education reform supports this finding that communities of practice support the implementation of new teaching practices, mentorship, and promote scholarly research (38, 39).

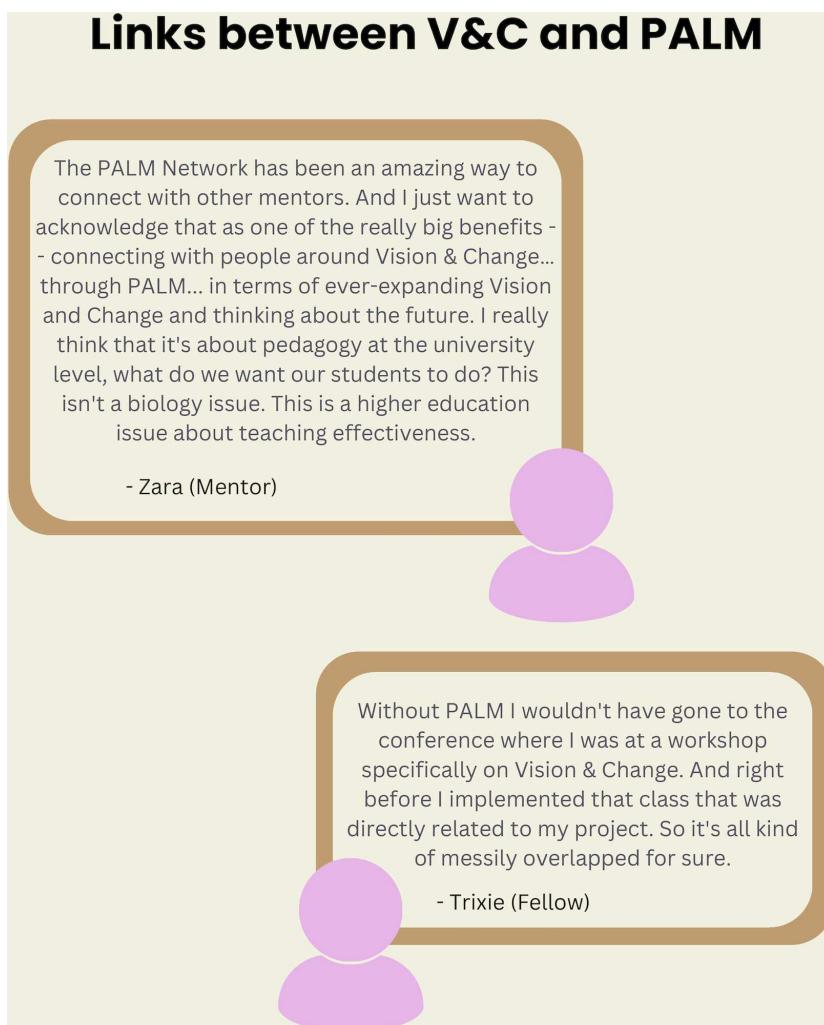


FIG 11 Selected quotes from participants who described the link between V&C and PALM.

Recent work has analyzed the implementation of V&C principles in introductory biology course syllabi and suggests there is a continued need for reform (40). Future pedagogical reform efforts should combine evidence-based practices with a network of support that serves to motivate instructors to implement evidence-based practices that align with V&C. Our model suggests that this approach leads to increased awareness, generates interest, and increases self-efficacy. The PALM network included mentoring, pedagogy journal clubs, and informal gatherings. Most participants joined PALM to "become a better teacher," and future networks will engage instructors who also want to grow in their teaching practice. Participants of this study recognized the value of the PALM network and indicated their desire to continue to participate. This suggests that the expansion of a mentoring network is possible; however, the support for these programs is limited in length based on science-funding agencies. Many of the PALM members have continued to collaborate after funding for PALM ended (e.g., all the authors on this paper met through PALM) and are interested in continuing to promote active learning through mentoring networks. It is important to consider models for increased longevity and sustainability, which could be linked to institutions or societies that could provide resources after a grant has ended. Dissemination efforts by these future networks may serve to not only promote EBIPs but also recruit new participants and should be designed to reach a broad audience of biology instructors.

TABLE 1 Motivation of instructor use of V&C based on SEVT Framework

Component of theoretical framework	Research question	Codes	Summary of SEVT connection	Main findings/quote
Expectancy	RQ2: To what extent does V&C motivate instructors in this network to engage in pedagogical reform and form the basis of their pedagogical decisions?	Expert educators	V&C was written by expert educators and therefore outlines best practices.	<i>"[Vision & Change] provides backup for things that I want to try that maybe colleagues might view as a little bit different than what we typically do. It just provides me with something to say, while actually trying these practices is also backed up by this document that's supported by these agencies."</i> Zoe (Mentor)
		Valuable to education	Core concepts and core competencies establish standards in course design.	<i>"I love that [Vision and Change] continues to inspire my strategies in the classroom... it's become an anchor for me."</i> Zara (Mentor)
		VC handbook	V&C provides a "how to" guide for successful teaching practices.	<i>"With this Vision and Change, I feel like it's extremely important to be able to learn how to teach and get the most amount of information across the students that could actually be useful for the students instead of just hurling facts at them constantly."</i> Sage (Fellow)
Task value	RQ2: To what extent does V&C motivate instructors in this network to engage in pedagogical reform and form the basis of their pedagogical decisions?	VC handbook	V&C identifies the important components of teaching practice in biology.	<i>"So now, when somebody questions my teaching, well, this is really rooted in the teaching and the learning [literature]. Here's the paper [Vision & Change], go read it."</i> Winter (Fellow)
		Introductory course	V&C outlines essential concepts and skills for student success in future courses after introductory biology.	<i>"Our transfer students have come from community colleges where they have built a foundation of Vision and Change. It sets them up more for success in upper level classes"</i> Blair (Fellow)
Task value	RQ3: Have instructors in this network observed a link between V&C principles and education reform?	Inspiration for philosophy/strategies	Implementation of EBIPs promotes student success.	<i>"I'm back to teaching freshman biology, I really want to re-examine everything again and make sure that I'm touching all the core concepts in that class, because it's a foundation for their degrees."</i> Sebastian (Mentor)
		Awareness of evidence-based practices	Learning about instructional practices that are evidence-based is valuable in developing my teaching philosophy.	<i>"My teaching philosophy is to have students imagine themselves as scientists, whether they're practicing scientists professionally, or that's their goal, or whether they are nonscientists in this society. They have to make scientific decisions. And so having helping them think like scientists, teaching them that they have the ability to make decisions based on evidence that they have the ability to find and evaluate the quality of evidence. Those are just the things that make the core competencies... especially valuable in my teaching philosophy."</i> Zara (Mentor)
		Role model for teaching	Observing someone use EBIP helps instructors feel confident implementing it in their own course(s).	<i>"What PALM has added to mine [teaching philosophy] is the evidence... the active learning strategies that are evidence based."</i> Stella (Fellow)
Self-efficacy				<i>"PALM was transformational... And so having a PALM mentor for every version, and then being able to walk through one-on-one with them, how to change certain things that I implemented, based on student feedback was, again, just not something I could have experienced without PALM... I was able to flip my classes to add in active learning, was able to then vary my active learning, refine the active learning, add in unique assessment strategies with kind of instant feedback in the classroom, and then aligning all of that with summative assessments.... I was able to go out and watch</i>

(Continued on next page)

TABLE 1 Motivation of instructor use of V&C based on SEVT Framework (Continued)

Component of theoretical framework	Research question	Codes	Summary of SEVT connection	Main findings/quote
		Inspiration to use EBIPs	V&C provides justification for using EBIPs.	<p><i>a mentored instructor teach in their classroom using active learning strategies. To me that was just like, oh, it's that simple ... and then having them come out and actually watch your implementation of the same thing and how it was able to evolve and grow and, again, would not have been possible without PALM, it would have been like a little tiny bit here and there on my own without having the one-on-one mentoring."</i> <i>Stella (Fellow)</i></p> <p><i>"Vision and Change gave me the courage to prioritize skills over content."</i> Gale (Fellow)</p>

Limitations of this study

This study is focused on a subset of instructors who became members of the PALM network to serve as mentors, network with other instructors, gain pedagogical skills, and/or make changes in their teaching. PALM members represent many disciplines within biology and teach a variety of courses ranging from introductory biology to upper-level electives. However, PALM members are self-selected, and the subset who participated in the focus group represents an additional level of self-selection. As such, our recruitment strategy may reflect a subset of the distribution of V&C knowledge, instructor identities, and subdisciplines of biology. Participants were recruited for focus groups based on attending a workshop about V&C; therefore, this recruitment strategy likely results in participants who want to learn more about V&C or may already have a positive view of V&C. Focus group questions were focused on PALM and V&C, but other influences that contributed to participants' teaching philosophies and practices may not have been described. Evidence of their knowledge and implementation of V&C is self-reported; additional evidence was not collected. Future work by these authors will involve a more representative sample of biology instructors and will collect evidence of teaching practices and philosophies.

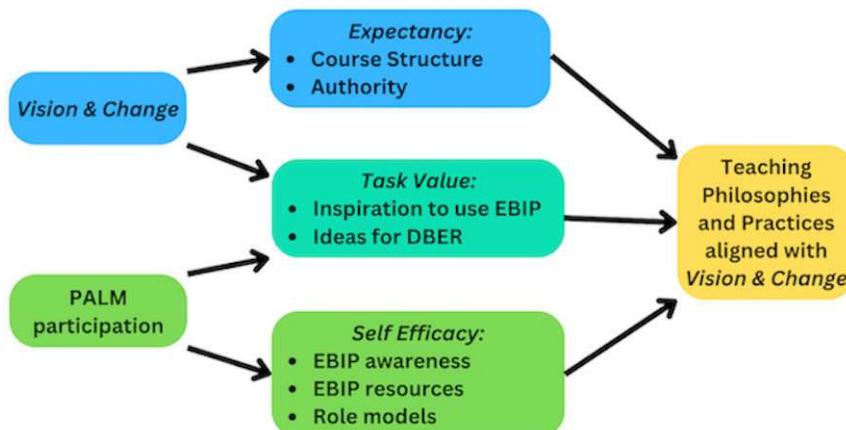


FIG 12 Model of the effect of *Vision and Change* and PALM on reformed teaching philosophy and practices modeled using the SEVT framework (25, 26, 28). The arrows in the model show how the authors conceptualize that V&C and PALM each provide aspects of SEVT to result in reformed teaching.

ACKNOWLEDGMENTS

We are grateful to the members of the PALM Network who participated in rich discussions to inform this study and continue to support educator development.

This work was funded by NSF DUE #2223276.

AUTHOR AFFILIATIONS

¹Department of Biological Sciences, North Carolina State University, Raleigh, North Carolina, USA

²Department of Biology, Hampden-Sydney College, Hampden-Sydney, Virginia, USA

³Department of Chemistry and Biochemistry, Florida International University, Miami, Florida, USA

⁴Department of Molecular, Cell & Developmental Biology, University of California, Santa Cruz, Santa Cruz, California, USA

⁵STEM Education Center, University of Arkansas at Little Rock, Little Rock, Arkansas, USA

⁶Schmid College of Science and Technology, Chapman University, Orange, California, USA

⁷Thomas H. Gosnell School of Life Sciences, Rochester Institute of Technology, Rochester, New York, USA

AUTHOR ORCIDs

Stephanie L. Mathews  <http://orcid.org/0000-0001-5909-2024>

Carlos Goller  <http://orcid.org/0000-0002-2013-0334>

Michael J. Wolyniak  <http://orcid.org/0000-0003-0076-6682>

Michael E. Moore  <http://orcid.org/0000-0002-5493-2802>

Jeremy L. Hsu  <http://orcid.org/0000-0001-5600-2345>

Dina L. Newman  <http://orcid.org/0000-0002-2983-1102>

AUTHOR CONTRIBUTIONS

Stephanie L. Mathews, Conceptualization, Data curation, Formal analysis, Funding acquisition, Investigation, Methodology, Writing – original draft, Writing – review and editing | Carlos Goller, Conceptualization, Data curation, Formal analysis, Funding acquisition, Investigation, Methodology, Writing – review and editing | Michael J. Wolyniak, Conceptualization, Data curation, Formal analysis, Funding acquisition, Investigation, Methodology, Writing – review and editing | Uma Swamy, Conceptualization, Data curation, Formal analysis, Funding acquisition, Investigation, Methodology, Writing – review and editing | Anjali Misra, Conceptualization, Data curation, Formal analysis, Funding acquisition, Investigation, Methodology, Writing – review and editing | Michael E. Moore, Conceptualization, Data curation, Formal analysis, Funding acquisition, Investigation, Methodology, Writing – review and editing | Jeremy L. Hsu, Conceptualization, Data curation, Formal analysis, Funding acquisition, Investigation, Methodology, Project administration, Validation, Writing – review and editing | Dina L. Newman, Conceptualization, Data curation, Formal analysis, Funding acquisition, Investigation, Methodology, Project administration, Visualization, Writing – original draft, Writing – review and editing

ETHICS APPROVAL

This study was approved by the Rochester Institute of Technology's Human Subjects Research Office #10042222.

ADDITIONAL FILES

The following material is available [online](#).

Supplemental Material

Supplemental Material (jmbe00074-25-s0001.docx). Focus group protocol and codebook.

REFERENCES

1. American Association for the Advancement of Science (AAAS. 2011. Vision and change in undergraduate biology education: a call to action. Available from <https://visionandchange.org>
2. Hsu JL, Misra A, Wolyniak MJ, Goller CC, Mathews S, Swamy U, Newman DL, Moore ME. 2025. Charting a new vision: lessons on *Vision & Change* from a network of biology educators. *J Microbiol Biol Educ* 26:e0017224. <https://doi.org/10.1128/jmbe.00172-24>
3. Dolan EL. 2012. Next steps for Vision and Change: moving from setting the vision to change. *CBE Life Sci Educ* 11:201–202. <https://doi.org/10.1187/cbe.12-06-0082>
4. Fink ADD, Allen T, Arriola PE, Barea-Rodriguez EJ, Jacob NP, Kelrick MI, Otto J, Reiness CG, Washington J. 2024. PULSE Ambassadors program: empowering departments to transform STEM education for inclusion and student success. *J Microbiol Biol Educ* 25:e0005224. <https://doi.org/10.1128/jmbe.00052-24>
5. Musante S. 2013. PULSE: implementing change within and among life science departments. *Bioscience* 63:254–254. <https://doi.org/10.1525/bi.o.2013.63.4.4>
6. Schlegel WM, McFarland JL, Marley KE. 2013. PULSE partnerships for change: moving from “Vision” to “Change” in undergraduate life science education. *FASEB J* 27:27. https://doi.org/10.1096/fasebj.27.1_supplement.739.6
7. Vasaly HL, Feser J, Lettrich MD, Correa K, Denniston KJ. 2014. Vision and change in the biology community: snapshots of change. *CBE Life Sci Educ* 13:16–20. <https://doi.org/10.1187/cbe.13-12-0234>
8. Brownell SE, Freeman S, Wenderoth MP, Crowe AJ. 2014. BioCore guide: a tool for interpreting the core concepts of vision and change for biology majors. *CBE Life Sci Educ* 13:200–211. <https://doi.org/10.1187/cbe.13-12-0233>
9. Clemons AW, Timbrook J, Herron JC, Crowe AJ. 2020. Bioskills guide: development and national validation of a tool for interpreting the vision and change core competencies. *CBE Life Sci Educ* 19:ar53. <https://doi.org/10.1187/cbe.19-11-0259>
10. Branchaw JL, Pape-Lindstrom PA, Tanner KD, Bissonnette SA, Cary TL, Couch BA, Crowe AJ, Knight JK, Semsar K, Smith JL, Smith MK, Summers MM, Wienhold CJ, Wright CD, Brownell SE. 2020. Resources for teaching and assessing the vision and change biology core concepts. *CBE Life Sci Educ* 19:es1. <https://doi.org/10.1187/cbe.19-11-0243>
11. Brownell SE, Hekmat-Scafe DS, Singla V, Chandler Seawell P, Conklin Imam JF, Eddy SL, Stearns T, Cyert MS. 2015. A high-enrollment course-based undergraduate research experience improves student conceptions of scientific thinking and ability to interpret data. *CBE Life Sci Educ* 14:14: <https://doi.org/10.1187/cbe.14-05-0092>
12. Couch BA, Wright CD, Freeman S, Knight JK, Semsar K, Smith MK, Summers MM, Zheng Y, Crowe AJ, Brownell SE. 2019. GenBio-MAPS: a programmatic assessment to measure student understanding of vision and change core concepts across general biology programs. *CBE Life Sci Educ* 18:ar1. <https://doi.org/10.1187/cbe.18-07-0117>
13. Durham MF, Knight JK, Couch BA. 2017. Measurement instrument for scientific teaching (mist): a tool to measure the frequencies of research-based teaching practices in undergraduate science courses. *CBE Life Sci Educ* 16:ar67. <https://doi.org/10.1187/cbe.17-02-0033>
14. Umiński C, Couch BA. 2024. Identifying factors associated with instructor implementation of three-dimensional assessment in undergraduate biology courses. *PLoS One* 19:e0312252. <https://doi.org/10.1371/journal.pone.0312252>
15. Sansom RL, Winters DM, St Clair BE, West RE, Jensen JL. 2023. Factors that influence STEM faculty use of evidence-based instructional practices: an ecological model. *PLoS One* 18:e0281290. <https://doi.org/10.1371/journal.pone.0281290>
16. Orr RB, Gormally C, Brickman P. 2024. A road map for planning course transformation using learning objectives. *CBE Life Sci Educ* 23:es4. <https://doi.org/10.1187/cbe.23-06-0114>
17. Clark N, Hsu JL. 2023. Insight from biology program learning outcomes: implications for teaching, learning, and assessment. *CBE Life Sci Educ* 22:ar5. <https://doi.org/10.1187/cbe.22-09-0177>
18. Bryant S. 2022. The role of teacher motivation in the implementation of the professional development. (Doctoral Dissertation, Southern Nazarene University)
19. Guskey TR. 2000. Evaluating professional development. Corwin Press.
20. Stock MJ, Duncan HE. 2010. Mentoring as a professional development strategy for instructional coaches: who mentors the mentors?, p 57–69. In *Planning changing*. Vol. 41.
21. Garner JG, Porter AL, Newman NC, Crowl TA. 2012. Assessing research network and disciplinary engagement changes induced by an NSF program. *Res Eval* 21:89–104. <https://doi.org/10.1093/reseval/rvs004>
22. Kruchten A, Baumgartner E, Beadles - Bohling A, Whitman J, Duncan J, Kayes L, Kiser S, Shriner W, Stavrianeas S. 2016. Transformation of the introductory biology experience for biology majors: progress of the northwest bioscience consortium RCN - UBE. *FASEB J* 30. https://doi.org/10.1096/fasebj.30.1_supplement.553.12
23. Pelaez N, Anderson TR, Gardner SM, Yin Y, Abraham JK, Bartlett EL, Gormally C, Hurney CA, Long TM, Newman DL, Sirum K, Stevens MT. 2018. A community-building framework for collaborative research coordination across the education and biology research disciplines. *CBE Life Sci Educ* 17:es2. <https://doi.org/10.1187/cbe.17-04-0060>
24. Moore ME, Naganathan A, Blumer SL, Goller CC, Misra A, Raut SA, Swamy U, Wick S, Wolyniak MJ. 2020. Facilitating long-term mentoring to effectively implement active learning instruction: formation of the promoting active learning and mentoring (PALM) network. *J Microbiol Biol Educ* 21:21.3.71. <https://doi.org/10.1128/jmbe.v21i3.2203>
25. Wigfield A, Eccles JS. 2000. Expectancy-value theory of achievement motivation. *Contemp Educ Psychol* 25:68–81. <https://doi.org/10.1006/ceps.1999.1015>
26. Eccles JS, Wigfield A. 2020. From expectancy-value theory to situated expectancy-value theory: a developmental, social cognitive, and sociocultural perspective on motivation. *Contemp Educ Psychol* 61:101859. <https://doi.org/10.1016/j.cedpsych.2020.101859>
27. Reinholz DL, White I, Andrews T. 2021. Change theory in STEM higher education: a systematic review. *IJ STEM Ed* 8:37. <https://doi.org/10.1186/s40594-021-00291-2>
28. Garn AC, Simonton Jr KL, Mercier K. 2024. Development and validation of the teacher motivation in physical education questionnaire. *J Teach Phys Educ* 44:201–211. <https://doi.org/10.1123/jtpe.2023-0335>
29. Abrami PC, Poulsen C, Chambers B. 2004. Teacher motivation to implement an educational innovation: factors differentiating users and non-users of cooperative learning. *Educ Psychol (Lond)* 24:201–216. <https://doi.org/10.1080/0144341032000160146>
30. Palermo C, Thomson MM. 2019. Large-scale assessment as professional development: teachers' motivations, ability beliefs, and values. *Teacher Development* 23:192–212. <https://doi.org/10.1080/13664530.2018.1536612>
31. Thatcher Day C. 2021. Expectancy value theory as a tool to explore teacher beliefs and motivations in elementary mathematics instruction. *Intl J Elem Educ* 13:169–182. <https://doi.org/10.26822/iejee.2021.182>
32. Russo J, Powers T, Hubbard J, Buckley S, Livy S. 2023. How often and when teachers should teach with challenging tasks: the role of motivational beliefs. *J Math Teacher Educ Math Teach Educ*. <https://doi.org/10.1007/s10857-023-09612-4>
33. Brice LD, Tetteh L. 2024. Examining teachers' conceptualizations and motivation for providing in-class independent reading opportunities. *Read Psychol* 45:459–484. <https://doi.org/10.1080/02702711.2024.2319577>
34. Chew KJ, Matusovich HM. 2024. Exploring fundamental engineering course instructors' test usage beliefs and behaviors: a multicase study. *J Eng Educ* 113:1146–1176. <https://doi.org/10.1002/jee.20614>
35. Riihimaki CA, Viskupic K. 2020. Motivators and inhibitors to change: why and how geoscience faculty modify their course content and teaching methods. *J Geosci Educ* 68:115–132. <https://doi.org/10.1080/10899995.2019.1628590>
36. Nelson PC, Matz RL, Bain K, Fata-Hartley CL, Cooper MM. 2023. Characterizing faculty motivation to implement three-dimensional

learning. *Discip Interdiscip Sci Educ Res* 5:11. <https://doi.org/10.1186/s43031-023-00079-0>

37. Joo YJ, Park S, Lim E. 2018. Factors influencing preservice teachers' intention to use technology. *Educ Technol Soc* 21:48–59.

38. Kleinschmit AJ, Rosenwald A, Ryder EF, Donovan S, Murdoch B, Grandgenett NF, Pauley M, Triplett E, Tapprich W, Morgan W. 2023. Accelerating STEM education reform: linked communities of practice promote creation of open educational resources and sustainable professional development. *IJ STEM Ed* 10:16. <https://doi.org/10.1186/s40594-023-00405-y>

39. Mixter PF, Kleinschmit AJ, Lal A, Vanniasinkam T, Condry DLJ, Taylor RT, Justement LB, Pandey S. 2023. Immune literacy: a call to action for a system-level change. *J Microbiol Biol Educ* 24:e00203-22. <https://doi.org/10.1128/jmbe.00203-22>

40. Heil A, Olaniran J, Gormally C, Brickman MP. 2024. It's in the syllabus: what syllabi tell us about introductory biology courses. *CBE Life Sci Educ* 23:ar37. <https://doi.org/10.1187/cbe.23-05-0081>