

EFFECTS OF A TEACHERS' PROFESSIONAL LEARNING COMMUNITY: CASE STUDY OF A MARINE TECHNOLOGY SCHOOL

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ABSTRACT

The purpose of this study was to explore the operational effects of a teachers' professional learning community, using qualitative research methods such as teacher interviews, documentary analysis, and reflection paper analysis. The sample consisted of eight teachers at a marine technology school who were participating in professional learning community for teachers. Results of this study indicated the following: a) The intentions of both voluntary and involuntary members affected community progress, b) Most community members were willing to follow the International Convention on Standards of Training, Certification, and Watch-keeping for Seafarers (STCW), c) Community members were able to complete 16 instructional designs that incorporated new technology into project-based courses, d) When community members utilized inquiry instruction, students provided the most positive feedback, e). Although administrative departments worked hard to promote community operations, these processes were nonetheless negatively affected by inadequate communication. In general, the quality of interactions among community members, particularly with regard to the communication of feedback, could be improved.

Keywords: involuntary community members, marine technology school, professional learning community

INTRODUCTION

This study grew from the need to examine recent trends in the development of marine technology that emphasize energy-saving methods and environmental conservation in terms of their significant influence on curriculum planning and instruction in marine technology schools. Training courses for electricians must abide by the International Convention on Standards of Training, Certification, and Watch-keeping for Seafarers (STCW). In 2017, new courses will be added for seafarers. Thus, marine technology schools in Taiwan need to follow international standards and provide training to new electricians so that they can participate in a skilled workforce that meets the qualifications set by international standards.

This study also addressed the rapid changes in technology and the challenges presented by future workplaces, especially with regard to needed modifications in academic curricula and requirements. As technology advances, schools will be required to incorporate these innovations into the project-based learning environments of vocational and high school courses to increase the international competitiveness of students. This is especially true for marine technology schools. As they face the need to develop new curricula, they will also need to establish professional learning communities for teachers that promote international perspectives and prepare students for certification.

The third goal of this study was to understand the process of community progress, to identify the possible challenges that may arise in this setting, and to seek effective problem-solving strategies and ways for improving community efficacy. This is important because teachers' professional learning communities are dynamic institutions dedicated to continuous progress via collaboration, sharing, discussion, and improvement of instructional methods. Community leaders must be willing to interact, share, and discuss topics with community members and, when necessary, address negative behaviors that may promote conflict, avoidance, and personal attacks.

The fourth goal of this study involved exploring the following questions: How do teachers participate in professional learning communities? How do personal views affect the participation and performance of teachers in communities? How does the instructional self-efficacy of teachers change? How does this affect the courses and instructional strategies related to new technology and what are the learning effects on students? How do involuntary members interact with professional learning communities?

These aims underlie the overall purpose of this study: to understand how teachers at Taiwanese marine technology schools participate in professional learning communities. To this end, we focused on the operational effects of five dimensions: shared leadership, shared values and visions, collective inquiry, shared teaching practices, and a supportive environment.

LITERATURE REVIEW

The Meaning of Professional Learning Community

The Origins and Significance of Teachers' Professional Learning Communities

Teachers' professional learning communities, which are only about 20 years old, are part of an emerging educational trend focused on school reformation. The term "teachers' professional learning community" is derived from the field of anthropology, the context learning theory proposed by Lave and Wenger (1991), and the communities of practice theory developed by Wenger (1998). Sociologists have also proposed similar views, such as the learning community view suggested by Senge (2000). The concept of community was added later and applied to situational and organizational learning. Although academic concepts of "community" are, in general, similar to one another, different terms are used; these include "community of practice" (Wenger, 1998), "professional community" (Louis, Marks & Kruse, 1996), "professional learning community" (Hord, 2004), and "teacher community" (Grossman, Wineburg & Woolworth, 2001). This study emphasizes peer interactions among teachers in the context of a teaching environment. Thus, the term "teachers' professional learning community" is used.

The origin of teachers' professional learning communities can be traced to the 1980s and 1990s. At that time, the United States was promoting school reform but achieved poor results. Professional learning communities advocated for the active participation of its members in decision-making processes to improve their professional skills. Moreover, their belief that the motivation of a professional learning community to learn was important to the success or failure of school reform (Handy, 1995; Louis, Kruse, & Raywid, 1996) also contributed to the development of teachers' professional learning communities.

Teachers' professional learning communities have been defined in different ways. DuFour and Eaker (1998) defined a teachers' professional learning community as a group of educators who establish an environment that promotes mutual cooperation, emotional

support, and personal development; in this environment, teachers can achieve objectives that could not be achieved individually.

Thus, a teachers' professional learning community is a group of professional educators dedicated to promoting pedagogical ideas and techniques by sharing, interacting, studying, and reflecting on the practice of education in a cooperative and emotionally supportive environment. Such communities respect the individuality of teachers by allowing for personal growth through a process of constructive and innovative thinking and practice.

Characteristics (Or Dimensions) Of Teachers' Professional Learning Communities

Scholars generally agree on the characteristics (or dimensions) of a teachers' professional learning community. Hord (1997) believed that teachers' professional learning communities provide a situational context in which the concept of dispersed leadership could be developed and maintained through the following: 1. a shared leadership structure that offers support, 2. a vision and set of values that emphasize sharing, 3. opportunities for collective learning and learning applications, 4. supportive situations; and 5. the sharing of personal instructional practices.

The Southwest Education Development Library (1997) in the United States summarized the relevant literature, noting that successful teachers' professional learning communities have the following five features: 1. a principal who invites teachers to participate in making decisions and shares power and authority with teachers; 2. a common vision developed jointly by the faculty and staff that includes a complete commitment to student learning and is expressed in the pedagogical efforts of these individuals; 3. collective learning by staff and faculty for the purpose of resolving the problems of students; 4. peer support for opportunities to observe and learn about the classroom teaching behaviors of colleagues, constructive feedback, and mutual assistance and support; and 5. cooperation among faculty and staff in the service of improving teaching skills (cited from McCollough, 2007: 47).

DuFour and Eaker (1998) believed that professional learning communities are characterized by the following six features: 1. the ability to share tasks, visions, and values; 2. collective inquiry designed to evaluate and significantly change the practice of instruction; 3. cooperative team-teaching and efforts to continue to improve the learning of students; 4. willingness to experiment and test hypotheses; 5. commitment to continuous improvement; and 6. emphasis on results and the use of data to make decisions about instruction and evaluation.

In summary, teachers' professional learning communities have the following traits: 1. shared leadership (including leaders who are supportive and open); 2. Shared values and visions (including about tasks); 3. Collective inquiry (including collective learning, group learning, and collaboration); 4. Shared teaching practices (e.g., action- and/or experiment-based); and 5. a supportive environment (that encourages continuous improvement).

Effects of a Professional Learning Community

Hunzicker (2011) believed that teachers' personal and professional needs (e.g., concerns and interests) should influence their professional development and that questions of what is being learned and how it is being learned should be emphasized in teacher education. He suggested that teachers use a checklist addressing five dimensions related to professional development and experience in other fields to evaluate themselves:

1. *Supportive*: Are personal needs connected to school objectives?

2. *Job-embedded*: Are teachers' efforts to improve themselves professionally integrated into their daily work? Do teachers continue to improve themselves and integrate such improvements into their teaching?
3. *Instruction-focused*: Is improved student education emphasized?
4. *Collaborative*: Are teachers working toward a common, consensually accepted objective?
5. *Ongoing*: Are opportunities provided for teachers to test their ideas and methods or practice new techniques?

Lee, Zhang, and Yin (2011) studied 660 middle and elementary school teachers in Hong Kong to examine professional learning communities among teachers and associations between trust among faculty members, teachers' collective efficacy, and teachers' commitment to students. The scale assessing professional learning communities included three factors: shared and supportive leadership, collective learning and the application thereof, and supportive conditions–structures.

The study found that 1) the commitment (sense of mission) of teachers at different school levels to students was significantly positively correlated with the degree to which the professional learning community was characterized by collective learning and the application thereof, supportive conditions, trust among colleagues, and collective efficacy. However, shared and supportive leadership in the professional learning community could not predict the commitment (sense of mission) of teachers to students. 2) Support from professional learning communities, shared leadership; collective learning, supportive conditions, and trust among colleagues were associated with significant and positive improvements in the efficacy of the new or alternative instructional strategies emerging from such communities.

RESEARCH METHODOLOGY

Research Methodology: Qualitative Research

This study used data from in-depth interviews with members of a professional learning community, student feedback forms, teacher reflection reports, and classroom observations to gain a deeper understanding of the process and effect of implementing a “teachers' professional learning community for new technology” at a marine technology school.

Research Subjects

The sample consisted of eight male teachers at a marine technology school. Seven had master's degrees and abundant experience in instruction and administration; one had a bachelor's degree. The average duration of the teaching experience of community members was 13.6 years. The median age of research subjects was approximately 50 years.

Data Analysis: Qualitative Analysis

Tapes of the qualitative interviews were transcribed for analysis and labeled to maintain the anonymity of respondents (i.e., T1-1-12 refers to the twelfth sentence spoken in the first interview of the first teacher). The interview guidelines served as the main framework for the data analysis, and content that conformed to the framework was identified and subjected to further organization, classification, comparison. Data with similar characteristics were then placed in the same core categories, which were used for the initial coding chart. These core categories evolved into the final framework as data from other subjects were coded.

The feedback forms from the study sessions and student projects were also labeled to protect anonymity (i.e., S1-35-1 refers the first feedback form completed by a student in class 1,

which contained 35 students). Data from student feedback forms were analyzed to answer the research questions.

We used four indicators to evaluate the reliability and validity of the qualitative research: credibility, transferability, dependability, and conformability.

Results

The results of the in-depth interviews and documentary analysis were used to determine how participating in a teachers' professional learning community affected its members. The results are presented below in terms of the characteristics of teachers' professional learning communities specified in Section 2.1 (shared leadership, shared values and vision, collective inquiry, shared teaching practices, and supportive environment).

Shared Leadership

Data from in-depth interviews and documentary analysis revealed the following regarding "shared leadership":

Individuals lacked the willingness to serve as leaders, which reflected the ambiguity of this role and rendered the construction of community norms difficult. This resulted in a lack of member identification with the group:

It's better to have a senior teacher as the leader; the leader should be a volunteer. (T1-1-16), (T2-1-19), (T3-1-28)

People differ with regard to their expectations, motivations, and willingness to participate in various activities at different stages of their career (Vermunt & Endegijk, 2011). Of the eight teachers, T2, T4, T6, and T7 were the most senior, having reached retirement age. They believed that it was best to maintain the status quo. Other teachers were not willing to lead due to health and family issues.

The teachers also had different beliefs about the mission of teaching. Some teachers, such as T1, T2, and T5, thought it was important to do their jobs well. Others, such as T3 and T8, felt a sense of responsibility toward the students. In the process of trying hard, they also actualized themselves.

I think if it is possible, we should provide more educational programs because students cannot wait and will eventually lose their motivation to study. (T3-1-13) (T8-1-57)

Moreover, it was difficult to arrange convenient meeting times due to teaching and administrative workloads, and participants were frequently too busy to attend.

These results show that the motivation and willingness to participate in shared leadership was affected by teachers' 1) lack of personal willingness to be leaders; 2) different career stages, which resulted in different priorities; (3) different philosophies about teaching; and (4) inability to meet due to work and personal obligations. Thus, even though the participants had the professional knowledge and ability necessary to develop new technology courses, they did not have a leader who was passionate enough to assume the responsibilities involved.

Shared Values and Visions

Marine technology teachers generally agreed that it was necessary to incorporate into courses measures of students' ability to serve as electricians and deal with issues related to green energy to satisfy international requirements. Their "reflection and feedback reports" included the following:

I have to change my teaching method. Teachers need to design courses based on student needs so that students can explore and resolve problems in their own ways. (T1)

Because this was a new concept, T7 thought that maintaining the status quo was fine and was only minimally willing to participate. T5 believed that teachers should focus on maintaining their teaching skills and keeping their curricula current on their own before proceeding as a group.

I think it is most important to try to improve our own teaching abilities. (T5-1-72)

Teachers responded differently to the establishment of a teachers' professional learning community for new technology. In theory, all teachers felt that it was necessary and very important. However, when the school administration advised them that a community would be established, T1, T4, and T6 felt that it was too sudden and that there was nothing that they could do about it. T4 clearly felt that the administration had shown a lack of respect for teachers and felt forced to participate under administrative orders.

With regard to the advantages of a professional community, teachers believed that it could increase the self-confidence of both teachers and students, achieve the required objectives, and foster self-actualization. However, the teachers were involuntary participants and strongly emphasized personal privacy and autonomy in their approach to teaching. Moreover, because the community had not developed clear "norms" to be followed by members, difficulties arose with regard to starting the community.

The teachers' common visions should be shared along with personal expertise; it's not that easy to do research. (T2-1-9)

Even though all the teachers had expectations with regard to the quality of instruction, different educational philosophies produced different degrees of enthusiasm. For instance, subjects T1 and T2 had passive teaching styles and viewed instruction as work. T3 worked hard to teach students and emphasized the need for the further education of teachers. T4 believed that a teacher's role was to follow the curriculum of the course. T5 believed himself to be enthusiastic about his job. T8 had high demands for himself and hoped to provide students with exceptional instruction.

Students have infinite possibilities, and I think there are some things that I can help them with. (T8-1-7)

Most members were willing to incorporate new technology and standards for electricians into the curricula as one objective of the community and understood the need for change. However, there was clearly room for improvement in the processes by which common values and visions were developed and members communicated and engaged in discussion. Most approved of establishing a teachers' professional learning community, and most thought that it would provide a personal sense of accomplishment and enhance the education of students. However, time and an insufficient understanding of community operations were major challenges that were reflected in the difficulty of starting the new group. Behind these challenges was insufficient motivation, compounded by a refusal to face change or do something new and unfamiliar. Bowing to the expectations and pressures associated with the role of teachers, members resigned themselves to accepting this responsibility even as they resisted it and exhibited passive resentment.

Collective Inquiry

The in-depth interviews revealed the following:

Few teachers had an understanding of the process of collective inquiry. Of the eight members, T8 best understood the concept; this was followed by T1 and T5. The interpretations of these members reflected a sense of urgency about changing the current curricular content.

Community might mean discussion and sharing, making greater changes to instruction, or departing from existing formulaic instructional methods. (T1-1-10), (T5-1-30)

The teacher participants were very concerned about “instructional autonomy” and did not want others to interfere with their methods of instruction; that is, such interference was perceived as an invasion of their privacy. Additionally, the time and format of the meetings led teachers to believe that they would be required to spend a great deal of time thinking about new instructional models. A leader was needed to create the necessary interactive atmosphere. Moreover, the concept of teacher autonomy was so deeply rooted that it was difficult for members to share and collaborate with one another.

Discussing and creating an instructional framework in the community may require time. (T3-1-53), (T7-1-35)

Lack of knowledge about the standards used by the STCW to assess the ability of electricians and their expertise with regard to green energy communities led to a lack of motivation to actively participate in the process of collective inquiry.

Vessel electrical engineering and electrician courses are very complex, and it’s not easy to do a good job. (T1-1-1), (T2-1-15), (T2-1-9)

The above belief suggests that teachers may have become accustomed to using the instructional materials provided by publishers. Additionally, their jobs were secure because of minimal competition for students in marine schools. The creation of new instructional materials via productive exchanges of ideas would have required more interaction and cooperation among participants.

Sharing Instructional Practices

The in-depth interviews showed that teachers emphasized instructional methods that catered to the individual differences among students. T5 was astonished by the infinite creativity of students, and T8 spoke about methods for guiding students as they learned about new technology.

The creativity of students is difficult to imagine; they make really special things. (T5-1-25)

In their feedback forms, students S1-35, S1-04, and S1-06 showed that they searched for the root of a problem and then reviewed and tried different possible solutions in their individual learning processes. They were very motivated and produced significant accomplishments. For example, student S1-23 discovered the advantages of using solar-powered boats and improved a design to resolve a persistent problem. Students S1-22 and S-1-3 were motivated to learn after observational learning. Student S1-12-1 had a greater understanding of international trends. Teachers generally used guidance and encouragement to inspire students in their studies.

I was very proud to receive the professor’s approval at the results presentation today, and I hope next time I will do better than I have done in the past.(S1-35-2)

I found that everyone had the same problem with the crooked keel, because...

I saw that all of the students were mobilized and seemed to have an objective, not because the teacher forced them but due to the power of the group. (S1-04-2)

The above statements show that the sharing of teaching practices was rewarding for students. The feedback forms and the projects undertaken by the students indicated that they were very proactive about learning more about their subjects. Indeed, the students' enthusiasm promoted a very positive learning environment, and everyone was inspired.

Additionally, encouragement yielded great improvement in the study habits of students. More importantly, encouragement and accomplishments inspired students to explore new technology. This showed that all these paths can effectively enhance the motivation and interest of students.

Supportive Environment

The school offered rewards for teacher participation and supported students in their learning of new technology by providing instruction and project materials. However, the teachers did not experience a strong sense of support.

I suggest that it would be better to have an administrator with exclusive responsibility for preparing instructional and experimental materials. (T7-1-30), (T1-1-9)

This shows that although the administration had worked hard to create a supportive environment, communication with teachers seemed to be inadequate. Indeed, it is not enough to provide funding for materials or creating instructional frameworks. Teachers were also stressed and distracted by excessive teaching loads. Thus, decreasing the number of teaching hours and enhancing the social incentives, such by giving awards or certificates of merit, may create the kind of supportive environment that teachers appreciate.

Development of a Professional Learning Community

When most community participation is not voluntary, leaders need to provide clear explanations regarding the rights of and norms to be followed by members. These include basic rights, which should be explained before participants even enter the group, and rights enjoyed in the community, such the right to freely leave and reject unilateral and inappropriate decisions.

Data used in qualitative analyses and collected via a checklist developed by the researchers show that a professional learning community develops in the following stages. In the preparation stage, members are selected and informed of the rights and obligations associated with participation in the community and the purpose and proposed trajectory of the group.

During the first stage, trust is established among members to create a safe atmosphere. The second stage, conflict and resistance, involves consolidating the group's motivation, resulting in the active implementation of community tasks. Thus, in the work stage, the third, members are able to focus on course development; in this case, the focus was on an electrician course that conformed to STCW standards. Finally, in the conclusion stage, the fourth, the resulting course, based on "scientific inquiry instruction," would rely on lectures, educational activities, instructional demonstrations, sharing, and feedback. Use of a process such as this enables both students and teachers to feel encouraged to improve their skills and abilities and to experience a sense of accomplishment. However, care must be taken to ensure that the teachers (members) have time for professional self-development and development of future goals.

SUMMARY, CONCLUSIONS, AND SUGGESTIONS

Summary

This study examined a teachers' professional learning community in terms of five dimensions: shared leadership, shared values and visions, collective inquiry, shared teaching practice, and supportive environment. This approach differs slightly from the Professional Learning Communities Assessment (PLCA) developed by Lee, Zhang, and Yin (2011), which includes three factors: shared and supportive leadership, collective learning and application, and supportive conditions–structures. The five dimension of the teachers' professional learning community is similar with Hipp and Huffman's (2004) suggestion. However this study focused on vocational school teachers at a marine technology school. In this case, the professional learning community, consisting of eight teachers at the school, was established to meet the urgent need to teach the new technology required for certification. The analytic process adopted in this study was unique and instructive in that it relied on a checklist of tasks that needed to be completed to achieve community objectives.

Voluntary And Involuntary Members

Many studies agree that teachers' professional learning communities can enhance individual and collective instructional efficacy. The most important benefit is that leaders can create a supportive, sharing, and collaborative team environment (Lee, Zhang & Yin, 2011). In this study, most members just get the job done of insufficient motivation and discussion. These reactions significantly limit the ability of teachers to benefit professionally from collaborative teamwork. Because as Dooner, Mandzud and Clifton (2008) suggested a means-convergence model, tension and conflict is inherently embedded in the collaborative process. However, most of the participants in this study were involuntary community members who were either not interested in or not able to fill the leadership role but hoped, instead, for an administrative director to assume that position. This study also found that many community members were unwilling to participate in either the creation or the operation of the community. Indeed, attendance rates were low. Despite the establishment of common times for meetings, teachers would often have to leave due to other responsibilities, including teaching. Some members were unwilling to learn new technology. Thus, an important contributor to the success of a community is the ability to recruit willing participants.

I think that if there were more communication or negotiation rather than mandates or assignments it would be better; or maybe there is no need to communicate. (T4-1-12)

I am very stressed, but what can I do?! (Said in a somewhat helpless tone.) (T1-1-7), (T4-1-44), (T-6-17)

Because most of the teachers have not guided students in practical projects, we have different ideas about the

skills necessary for electrician courses. (T5-1-92)

Teachers' Sense of Mission With Regard To Instruction and Their Beliefs about Personal Career Planning

The eight teachers in this study were at two ends of the age spectrum. One group was about to retire or was approaching retirement; the latter were gradually reducing their administrative duties. This group preferred to maintain the status quo due to the time and effort they had already given to the educational system as well as their desire to preserve their classroom time.

The other group consisted of new teachers, who had a sense of mission with regard to the students. They were more willing to try and accept challenges or become leaders in efforts to realize students' potential. These characteristics influenced how proactive they were in the community.

The Process of Community-Building Begins Before the Preparation Stage

Research shows that closed groups are best and that allowing members to freely join and leave interferes with group cohesion (Corey, 2001). Studies have found that community development requires establishing and developing community norms (Van Es, 2012). Because teachers' feelings and beliefs about establishing a teachers' professional learning community vary, some teachers may be more concerned than others about not being chosen or not being respected. Because these communities emphasize non-administrative leadership, information about community objectives should be provided and direct communication should be established before the community begins its work.

However, the community examined in this study lacked sufficient communication and preparation to fulfill its duties. This was due to insufficient motivation, compounded by a refusal to change and do something new and unfamiliar. Although they attempted to appear to participate in the community, many members remained resistant to participation and exhibited passive resentment. This behavior was attributed to the pressures and expectations of the teacher role.

Shared Values and Visions

In-depth interviews indicated that some members felt that it was necessary to incorporate measures of electrician ability and expertise in green energy into coursework, but most were interested in developing international connections. No consensus was reached with regard to other areas. However, the interview process revealed that it was difficult to achieve common values and visions in a short period of time in the absence of an effective community leader.

The Norm of Teacher Autonomy

Community members were generally able to design instructional material incorporating measures of electrician ability and expertise in green technology. However, this process revealed the longstanding image that teachers have of themselves as autonomous and independent individuals. Indeed, teachers preferred designing instructional activities alone in the absence of input from others to ensure their individual freedom. This norm is similar to the phenomenon frequently seen in foreign studies about teacher communities that report that concerns about autonomy and privacy frequently interfere with collaboration among community members and cause conflict when a community moves toward the same objective (Levine, 2010).

Similar to the results of the study conducted by Grossman, Wineburg, and Woolworth (2001), we observed a clear change in attitude when community members (teachers) shared ideas regarding instruction in new technologies, helped students with their projects, and focused on leading the exploratory learning of students. Sharing and reflecting with one another can be quite effective in promulgating new methods of instruction related to new technology. Moreover, members can learn from one another about creating a friendly learning atmosphere and can share techniques for guiding students as they learn about new technology. Most teachers emphasized individual differences among students and provided them with guidance and encouragement. From this study, students learn and reflect more effectively when taught by teachers with this philosophy. Most importantly, students need to be encouraged and feel a

sense of accomplishment in the educational process to be strongly motivated to explore new technology.

T3's comments about S1-23: "You have good ideas, and you should try to realize them."

T5's comments about S-2-15-3: "After a few tries, I think you will have an excellent understanding of ship models. Keep up the good work!"

Supportive Environment

Are the teachers' personal needs connected to the school's objectives? Is communication between teachers and administrators clear? Can teachers choose the type of support they want? How can teachers and students be motivated to actively participate? These are all important questions that deserve consideration. Additionally, administrators should emphasize communication and coordination with teachers. Since there are only eight people in the community, using administrative-level conveyance methods may result in poor communication and misunderstanding or unnecessary delays. Direct communication should be considered in the future. Similar to the findings reported by Lee, Zhang, and Yin (2011), our results show that shared and supportive leadership, collective learning and application, supportive conditions, and trust within a teachers' professional learning community can significantly and positively affect the collective efficacy of teachers' instructional strategies.

CONCLUSION

1. Shared leadership: Community members can provide supportive and shared professional leadership, but involuntary members need more information, respect, and understanding about their individual value systems.
2. Shared values and visions: A vision should be established for the new technology and its connection to international indicators. Community norms should be formed via collaborative discussions and then followed by the community. The resulting increase in dialogue among members should be encouraged.
3. Collective inquiry: The concept of "instructional autonomy" means that community members incorporate measures of electrician ability and expertise in green technology into the design of the instructional material used in their respective courses. However, this process can be marred by insufficient interaction and too few exchanges of ideas. The process by which instructional material is created should involve intra-group cooperation, discussion, and sharing.
4. Shared teaching practices: The quality of interactions among community members and of participation in the sharing of ideas is related to how lessons are taught and reviewed as well as to the feedback provided by students. Teachers who receive approval for the application of new techniques learned from other members will be motivated to enhance their participation in those processes in which instructional practices are shared.
5. Supportive environment: We found sufficient administrative support, instructional material, and funding, but insufficient communication between the two groups. In the future, the administration should consider measures that satisfy teacher needs.
6. The process by which a professional learning community is created can be described in terms of preparation followed by four stages: relationship establishment, conflict and resistance, work, and conclusion.

SUGGESTIONS

Based On These Conclusions, We Offer the Following Suggestions

Motivate Teachers to Participate In Teachers' Professional Learning Communities

Methods may include the following:

- i. Select members who are willing to voluntarily participate in communities. The motivation and level of participation of voluntary and involuntary members differ.
- ii. Before organizing the community, establish adequate communication between the administration and the teachers. Direct communication is recommended for explaining the rights, obligations, and norms that should be followed by community participants.
- iii. Teachers should have a given time allotted for community meetings so that they do not have to leave early to teach a class or fulfill another school-related responsibility. The school can arrange this in advance to facilitate community activities.
- iv. Organize lectures on themes related to teachers' professional communities to enhance teachers' understanding of communities.
- v. Provide incentives for participation, such as increased scores or points on teacher evaluations, reduced teaching hours, and/or bonuses.

Provide Leadership Training For the Leaders of Teachers' Professional Learning Communities

Training sessions should accomplish the following:

- a. Provide more opportunities for teachers willing to be leaders to engage in study and training related to leading communities,
- b. Organize sharing sessions in which leaders share professional knowledge.
- c. Reward and assist teachers who serve as leaders with regard to scheduling classes.

Enhance the Process by Which the Professional Learning Community Operates

This can be accomplished in the following ways:

- i. Consolidate the visions and enhance the consensus of the community through brainstorming and discussion.
- ii. Discuss the expectations of the community and establish the norms that need to be followed by community members (e.g., participation, punctuality, timely completion of work, and sharing).
- iii. Inquiry instruction: Hold symposia on writing instructional materials to improve members' abilities in this domain.
- iv. Provide training to teachers on the new STCW indicators of electrician ability and expertise in green energy communities so that they can improve their ability to create instructional materials and provide instruction in these areas.
- v. Observational learning: Provide opportunities to observe how other schools have incorporated new technologies into specialized instructional modules.
- vi. Provide a warm, accepting, and safe atmosphere for sharing.

Improve Education Techniques

Relevant methods may include the following:

- i. Provide and increase the interscholastic opportunities for project observation and self-motivation.
- ii. Arrange symposia that promote a cooperative atmosphere and draw on the latest scientific learning methods.
- iii. Increase the number of opportunities for reviewing high-quality instructional materials and methods and informative case studies.
- iv. Establish personalized pedagogical approaches to the presentation of case reports and relevant material and encourage engagement in scientific inquiry.

Suggestions for the Administration

- a. Increase intrinsic and extrinsic motivation to learn (e.g., establish an awards system based on evaluations of community activities).
- b. Offer administrative assistance by providing an administrator whose sole responsibility is meeting preparation and procurement of instructional and experimental materials.
- c. Reward outstanding projects, student work, and/or teacher reflection reports.
- d. Encourage participation in international competitions. Increase the self-confidence and professional expertise of teachers and students so that they can interact as equals with their colleagues throughout the world.

Suggestions for Future Research

Future research should further explore the pedagogical and interpersonal processes that contribute to the teaching of new technology skills. Analysis of videos of community processes and completion of checklists to identify the most important features of interactions among members may be helpful approaches to assessing and improving the quality of community dynamics.

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