

Visual Thinking Routines: A Mixed Methods Approach Applied to Student Teachers at the American University in Dubai

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Visual thinking routines are principles based on several theories, approaches, and strategies. Such routines promote thinking skills, call for collaboration and sharing of ideas, and above all, make thinking and learning visible. Visual thinking routines were implemented in the teaching methodology graduate course at the American University in Dubai. The following study used mixed methods. It was guided by two research questions: 1) To what extent did visual thinking routines implemented in the Math/Science methodology course offered at the Graduate School of Education at the American University in Dubai inspire learning in the classroom and made time for students' questions, contributions, and thinking? 2) How do visual thinking routines inspire learning in the classroom and make time for students' questions, contributions, and thinking? Eight student teachers enrolled in the teaching methodology course at the American University in Dubai (Spring 2017) participated in the following study. First, they completed a survey that measured to what degree they believed visual thinking routines inspired learning in the classroom and made time for students' questions, contributions, and thinking. In order to build on the results from the quantitative phase, the student teachers were next involved in a qualitative data collection phase, where they had to answer the question: How do visual thinking routines inspire learning in the classroom and make time for students' questions, contributions, and thinking? Results revealed that the implementation of visual thinking routines in the classroom strongly inspired learning in the classroom and made time for students' questions, contributions, and thinking. In addition, student teachers explained how visual thinking routines allowed for visibility and reinforced thinking skills and questioning. As with all new and novel resources, visual thinking routines are not free of challenges. To make the most of this useful resource, visual thinking routines need to be highly valued at all academic levels starting from early stages. It is essential that such routines become embedded in the curriculum to allow for a rich meaningful learning journey that incorporates questioning, thinking, and deep understanding.

Introduction

At every stage of our collective human history, individuals have faced a distinctive set of challenges and encounters that have forced us to change the way we communicate with one another and interact with the world around us. Leaders, entrepreneurs, engineers, medical doctors, educators, and parents have been encountering such changes and difficulties. Even students are among these individuals. Today's students are tomorrow's future leaders. We need to pause for a while, think about them, and consider the following essential questions: What do we expect from them? What do we want them to know? What do we want them to be able to do? What about their future? In order for our students to face the challenges of their day, we as educators, need to equip them with the necessary tools that are at our disposal. So, how do we ensure we prepare our students for the life of tomorrow?

Teachers need to make sure their learning classrooms are highly engaging, mentally stimulating, and inspiring. Creativity, communication, and thinking need to dominate the classroom culture. Thinking plays a vigorous role in preparing our students for the obstacles of the future. Thinking is innate, yet skillful thinking must be cultivated (Costa & Kallick, 2009). Visual thinking routines are used in the classroom to externalize students' thinking, opinions, feelings, and misconceptions. Visual thinking routines are considered effective tools that engage students in the learning process and make students' thinking visible to themselves, peers, and teachers (Dajani, 2016).

The purpose of this study was to explore the extent to which student teachers believed that visual thinking routines implemented in the Math/Science methodology course at the American University in Dubai inspired learning in the classroom and made time for students' questions, contributions, and thinking. It also aimed at studying student teachers' reflections on how visual thinking routines promote thinking time in the classroom and help in designing an inviting physical place that documents and calls out for student learning. Hence, the study focused on the following two research questions:

1. To what extent did visual thinking routines implemented in the Math/Science methodology course offered at the Graduate School of Education at the American University in Dubai inspire learning in the classroom and made time for students' questions, contributions, and thinking?
2. How do visual thinking routines inspire learning in the classroom and make time for students' questions, contributions, and thinking?

Visual Thinking Routines in the Classroom

Teachers expect their students to acquire knowledge, grasp meaning, apply knowledge to novel situations, analyze parts to generate a whole, synthesize information, make judgements, and engage in metacognition. All of these attributes are examples of thinking skills, which are a must in any classroom. However, we need to recall that thinking happens automatically (Moore, 2015) and is invisible to both, teachers and students (Ritchhart & Perkins, 2008). If thinking is internal and invisible, how does it become visible? To answer the question, it is essential to unwrap the phrase, 'visual thinking routine'.

Ritchhart, Morrison, and Church (2011) note that routines dominate the classroom and teachers have routines that serve different purposes: organize the work environment, facilitate transitions, and maintain rules for communication and discourse. According to Ritchhart (2002), teachers who are successful at promoting students' thinking tend to make use of specific routines to guide and support students' thinking. Ritchhart et al. (2011) describe the role of thinking routines: "Such routines, which consist of few steps, provide a framework for focusing attention on specific thinking moves that help reach enduring understanding" (p. 45). Salmon (2011) perceives thinking routines as a series of questions that teachers ask their students in order to model and facilitate critical thinking. Tools such as mind maps, charts and lists, diagrams, and worksheets are considered visible thinking if and only if they make students' thinking visible (Tishman & Palmer, 2005).

Researchers Moeller, Cutler, Fiedler, and Weider (2013) strongly believe that visual thinking strategies reinforce critical thinking. Wolberg and Goff (2012) mention that such routines make students' thinking and learning visible to themselves, peers, and teachers: "They contribute to a classroom culture that encourages students to be self-directed learners by giving them the tools to drive their own thinking" (pp. 60-61). The teaching becomes visible and students learn how to engage in meaningful metacognition and therefore become their own teachers (Hattie, 2012). Visual thinking routines develop a thoughtful, curious, open-minded, objective, and skeptical mind (Ritchhart & Perkins, 2008). Wolberg and Goff (2012) argue that "certain thinking skills, such as being able to understand different points of view or providing evidence, do not come naturally to young children and must be taught explicitly and strengthened within a learning environment" (p. 60). As a summary, Ritchhart (2015) provide the following reasons for implementing thinking routines in the classroom: help direct teachers'

attention straight to the issue of thinking, provide specific practices that teachers can employ and see results from almost immediately, encourage discussion and action around thinking, and help build the infrastructure for thinking and learning in the classroom.

How are visual thinking routines implemented in the classroom? Ritchhart (2015) asserts that all types of thinking routines function on three levels: 1) as tools to support specific thinking moves, 2) as structures that scaffold the learning and guide action, and 3) as patterns of behavior. As tools, visual thinking routines are used again and again in the classroom to encourage thinking moves such as: “observing closely and describing what is there, building explanations and interpretations, reasoning with evidence, making connections, considering different viewpoints and perspectives, capturing the heart and forming conclusions, wondering and asking questions, and uncovering complexity and going below the surface of things” (Ritchhart et al. 2011, pp. 45-46). As structures, visual thinking routines are designed to facilitate and scaffold the thinking, for they simply lay out a sequence in which each step builds on the next (Ritchhart, 2015). Salmon (2008) states that thinking routines offer students significant, relevant, and rich experiences in an arranged manner that offers overall structure in which learning takes place. As patterns of behavior, students become familiar with them and their use (Ritchhart, 2015). Brahal (2008) explains how visual thinking routines become patterns of behavior: “when used regularly, thinking routines help students master and internalize new thinking processes until they become second nature” (p. 299). After several uses, teachers can initiate any thinking routine merely by naming it (Ritchhart, Palmer, Church, & Tishman, 2006).

Methodology

In order to uncover the extent to which student teachers believe visual routines inspire learning in the classroom and make time for students’ questions, contributions, and thinking, and their perceptions regarding visual thinking routines, a mixed method design was implemented to gather and analyze data.

Participants

Visual thinking routines were introduced in the Math/Science methodology course offered at the Graduate School of Education at the American University in Dubai. Eight female student teachers enrolled in the methodology course participated in the following study. One

student teacher was teaching at the preschool level, four student teachers were teaching at the elementary level, one student teacher was teaching at the secondary level, and two student teachers were not teaching at the time. A profile of the student teachers is presented in Table 1.

Table 1. Student Teacher Profiles

CHARACTERISTICS	EDEL606/EDSE608
Course Size	8
Gender	
Male	0
Female	8
Teaching Level	
Preschool	1
Elementary	5
Middle	0
High/Secondary	1
Not Teaching	2

Design and Procedure

The first method focused on surveys. Surveys in quantitative research are used to obtain data that will depict the numerical distribution of variables in a given sample population. Check and Schutt (2012) define survey research as: “the collection of information from a sample of individuals through their responses to questions” (p. 160).

Visual thinking routines were administered in the teaching methodology course at the American University in Dubai for two main purposes. First, to ensure a student centered learning culture that embraced the following essential factors: collaboration, reflection, and higher order thinking. Second, to make sure student teachers receive hands-on experience related to visual thinking routines and implement them meaningfully in their own classroom. In every learning session, student rolled in the methodology course were asked to make their thinking visible through a variety of visual thinking routines. The different routines were used as tools to promote engagement, thinking, deep understanding, and make the thinking visible.

The student teachers completed an online survey titled, “The Development of A Culture in My Classroom: Self -Assessment” developed by S. Brooks and Ron Ritchhart. The survey considered eight forces that promote cultures of thinking in the classroom. For the purposes of the following study, two forces were considered: ‘Time’ and ‘Physical Environment’. Each of the two forces included five self-assessment statements. The ‘Time’ force included statements

that reflected classroom engaging time where students were actively involved in thinking, questioning, elaborating, and developing the ideas of others. The 'Physical Environment' force included statements that reflected the positive effects of documenting and displaying students' thinking inside the classroom. Student teachers were asked to think of each self-assessment statement and rate the extent to which they agree that it reflected the behavior of their professor. Each student teacher received an electronic copy of the forces and indicators and a brief short introductory paragraph which included an overview of the study and an assurance of confidentiality. The participants were asked to use a Likert scale from 1 to 5 to respond to each force and indicator. A score of '1' indicated 'strongly disagree', '2' indicated 'disagree', '3' indicated neutral, '4' indicated 'agree', and '5' indicated 'strongly agree'.

In order to build on the results from the quantitative phase and provide space for freedom and spontaneity, the student teachers were next involved in a qualitative data collection phase. Student teachers had to answer the open-ended question: How do visual thinking routines inspire learning in the classroom and make time for students' questions, contributions, and thinking?

Findings

In order to evaluate the extent to which student teachers believed that visual thinking routines promoted thinking time and inspired learning in the Math/Science methodology course offered at the American University in Dubai, they were probed to rate two forces, 'Time' and 'Physical Environment'. Each of the two forces included five indicators.

The first 'Time' indicator evaluated by the student teachers was, 'I make some time for students' questions and contributions.' The mean score was 5 on a 5 point scale, indicating that the student teachers strongly agreed. The second 'Time' indicator evaluated by the student teachers was, 'I provide the space for students to extend, elaborate, or develop the ideas of others.' The mean score was 4.87 on a 5 point scale, indicating that the student teachers almost strongly agreed. The third 'Time' indicator evaluated by the student teachers was, 'I avoid disseminating an abundance of ideas without the time to process them.' The mean score was 4.87 on a 5 point scale, indicating that the student teachers almost strongly agreed. The fourth 'Time' indicator evaluated by the student teachers was, 'I give students time to think and develop ideas before asking for contributions.' The mean score was 5 on a 5 point scale, indicating that the student teachers strongly agreed. The fifth 'Time' indicator evaluated by the student teachers

was, ‘I monitor the amount of time I talk so as not to dominate the classroom conversation.’ The mean score was 5 on a 5 point scale, indicating that the student teachers strongly agreed. The mean score for the overall force, ‘Time’ was 4.94 indicating that student teachers almost strongly agreed that visual thinking routines promote thinking time in the classroom. Table 2 presents the mean scores of the first force, ‘Time’.

Table 2. ‘Force 1: Time’ Mean Mean Scores

Standard	Mean Score
Standard 1	5.00
Standard 2	4.87
Standard 3	4.87
Standard 4	5.00
Standard 5	5.00
Total	4.94

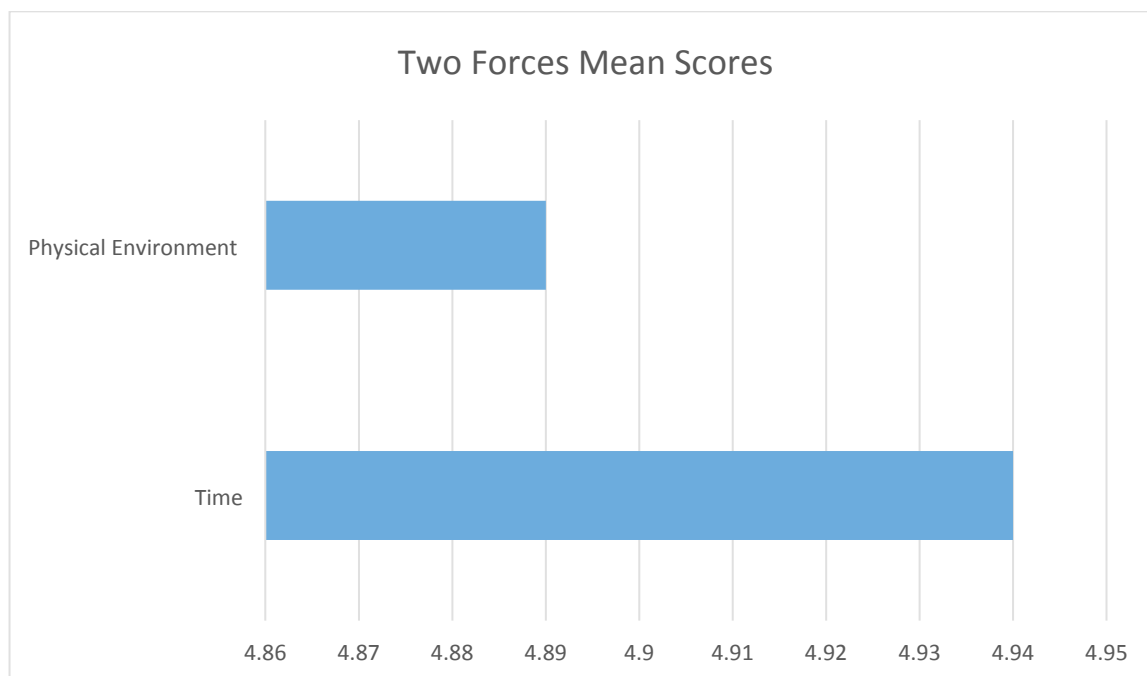
The first ‘Physical Environment’ indicator evaluated by the student teachers was, ‘Displays in the room inspire learning in the subject area and connect students to the larger world of ideas by displaying positive message about learning and thinking.’ The mean score was 5 on a 5 point scale, indicating that the student teachers strongly agreed. The second ‘Physical Environment’ indicator evaluated by the student teachers was, ‘I arrange the space of my classroom to facilitate thoughtful interactions, collaborations, and discussion.’ The mean score was 5 on a 5 point scale, indicating that the student teachers strongly agreed. The third ‘Physical Environment’ indicator evaluated by the student teachers was, ‘My wall displays have ongoing, inchoate, and/or dialogic nature to them versus only static displays of finished work.’ The mean score was 4.75 on a 5 point scale, indicating that the student teachers almost strongly agreed. The fourth ‘Physical Environment’ indicator evaluated by the student teachers was, ‘I use a variety of ways to document and capture thinking, including technology.’ The mean score was 4.87 on a 5 point scale, indicating that the student teachers almost strongly agreed. The fifth ‘Physical Environment’ indicator evaluated by the student teachers was, ‘A visitor would be able to discern what I care about and value when it comes to learning.’ The mean score was 4.87 on a 5 point scale, indicating that the student teachers almost strongly agreed. The mean score for the overall force, ‘Physical Environment’, was 4.89 indicating that student teachers almost strongly agreed that visual thinking routines inspire learning in the classroom. Table 3 presents the mean scores of the first force, ‘Physical Environment’.

Table 3. 'Force 2: Physical Environment Mean Scores

Standard	Mean Score
Standard 1	5.00
Standard 2	5.00
Standard 3	4.75
Standard 4	4.87
Standard 5	4.87
Total	4.89

Figure 1 compares the mean scores of the two forces, 'Time' and 'Physical Environment'.

Figure 1. Comparing the Two Forces Mean Scores



Data collected from the open-ended question, 'How do visual thinking routines inspire learning in the classroom and make time for students' questions, contributions, and thinking?' were categorized into two themes: visual thinking routines ensure visibility in the classroom and visual thinking routines reinforce thinking skills and questioning.

Theme1: Visual thinking routines ensure visibility in the classroom.

Displaying visual thinking routines shows/depicts what is happening in the classroom. First, visuals designed by the students add a colorful and decorative touch to the classroom. When a classroom is full of visual thinking routines, students sense their work is highly valued, respected, and appreciated. They also feel proud of their work. Second, exhibiting visual thinking routines in the classroom documents students' thinking. The notion of documenting thinking itself serves a stimulus to more learning, as it provides both teachers and students scaffolding and metacognition opportunities. As a result, the classroom turns into a lively and dynamic learning environment that celebrates, sustains, and nurtures thinking. When displaying visual thinking routines in the classroom, every student occupies the same space of display area no matter what his or her academic attainment is. Students can easily access their prior understanding, reflect on it, and add new acquired thoughts and ideas as their knowledge deepens and extends. Therefore, the classroom walls come alive with learning, and students become surrounded by their views, opinions, ideas, concerns, and questions. Student teachers reported:

"...In our Math and Science Methods classes, evidence was always there for our learning. Our thinking was always displayed on the classroom wall."

"... When I was asked to revisit my visual thinking routine, I felt proud of it, as I was able to realize my thinking."

"... I owned that VTR. I truly felt it belonged to me."

"...Our professor did not hang exemplary work but rather made it a point to show well-documented displays of students' progress."

"...The VTRs hanging on the walls did not result in creating a traditional competitive class rather a more coveted self-directed differentiated one."

"...It is the perfect environment to spark new, creative ideas."

"... VTRs can be expounded upon... You can always add to the learning."

Documenting the thinking in the classroom establishes student ownership of their learning and allows for student reflection and collaboration. Students can build on their understanding as well as those of their peers. They can engage in meaningful gallery walks around the classroom, observe and study the different visual thinking routines displayed on the

wall, and recognize their classmates' thoughts, ideas, perceptions, and questions. They can make connections and comparisons among the visual thinking routines. Student teachers reported:

"... Personally, displaying VTRS in our class helped me to see my progress and to reflect on my ideas and thoughts."

"... For instance, when had the chance to re-visit our IBL mind map, not only I was able to think of new themes and new ideas to add, but also I could easily see things that I could have done differently. I was able to reflect."

"... Since most of us come from different backgrounds and experiences, learning from our visual thinking routines added a lot to my knowledge."

"... For example, when we were discussing the topic about the current state of education, it was beneficial to read other students' comments and learn their concerns, questions, and thoughts."

"... Also, the diamond ranking routine was an interesting activity to use as it showed me how each one of us gave different priorities to important characteristics that should be present in teachers."

When thinking is visible in the classroom, teachers, students, parents, and classroom visitors are very well informed of the learning. Teachers are informed of their students' thinking. They can track their students' learning journey and look for understandings or misconceptions. Students can visualize their thoughts, questions, or concerns, notice their weaknesses and strengths, and realize how their thinking has extended or changed as new information has been acquired. Parents get to monitor their children's progress, realize what they still need to improve, and identify how the learning has matured. When classroom visitors enter the classroom, they are able to tell what is happening in the classroom and spot students' questions, concerns, thinking, and learning. Student teachers reported the following:

"... VTRs stand as symbols of the learning that has taken place."

"... VTRs that are in the classroom along the walls tell a learning story."

"... It tells where the students' learning started and when their learning has stopped for that topic."

“... VTRs can be indicative of what the students have learned, the progress that they have made and can show the teacher where the student still needs to learn.”

“... Students can monitor their own learning and see their thinking displayed in the classroom walls.”

“... Parents are well informed of their child’s work.”

“... Class visitors learn from the ideas that students are exploring and expanding. They can tell what is happening in the classroom and what students are learning about Evidence is there.”

Theme 2: Visual thinking routines reinforce student thinking and questioning.

Thinking time is one of the main prerequisites for the meaningful and effective implementation of visual thinking routines. Such thinking routines are inclusive and open-ended in nature, which allow for students’ questions, contributions, and thinking. Students engaged in visual thinking routines are at all times involved in the following thinking attributes: building up from prior knowledge, observing, making meaning and interpreting, reasoning, seeing relationships, making judgements, considering different perspectives and points of view, making connections, and reflecting on one’s thoughts and others. When students think out-loud, they talk out their mental states: what they are thinking, wondering, challenging, and feeling. Student teachers stated:

“... We were involved in observation...asked to observe different images and think about them.”

“... A connection with what we already thought about a certain topic was established.”

“... VTR’s encourage students to collaborate, share their thoughts, and reflect on their learning, thus providing time for thinking and questioning.”

“... Connect, Extend, and Challenge pushes and extends our thinking. We are asked to think about the content being presented and discuss new acquired ideas that push our thinking further.”

They are also involved in formulating meaningful and interesting questions. Unlike a systematic question and answer session between teachers and students, the routines are structured so that everyone can work on to them instantaneously. All questions are followed by ‘what makes you say that?’ and are given thinking time to allow profound responses and deep

understanding. Hence, students are strongly encouraged to elaborate on their responses and think beyond a basic answer, which often leads to rich deep classroom discussions and interactions. With the use of visual thinking routines, all students, even the shy or quiet ones, acquire the opportunity to respond and ask questions that pique their interests and welfares. Students learn to listen respectfully and attentively to one another. In addition, when students realize that they are being listened to with a non-judgemental attitude, they contribute fully to classroom discussions and inquiries. As such, students learn that they are never critiqued or challenged. They realize that mistakes are acceptable and encouraged. Student teachers reported:

“... We were always involved in questioning. Visual thinking routines helped us wonder about the topics being explored.”

“... A good example is the Chalk Talk routine, where students are presented with a picture, and must write their ideas and comment to others’ ideas and their question.”

“... Students are always thinking and conversing using the routine, hence everyone’s thinking voice is heard.”

“... There is no judgement. Everyone is interested in listening. We all listen to one another. This motivates us to participate more.”

“... I was never afraid to share my ideas, concerns, or questions because I knew there was no correct or wrong answer. I wasn’t going to be criticized.”

“... A routine like Red Light, Yellow Light helps the learners differentiate between facts and opinions and definitely needs enough time to grasp.”

“... Color, Symbol, Image routine is a very effective tool for engaging with any material, as it requires students to think of the main ideas presented in a text or video and think of one color, one symbol, and one image that can represent this concept.”

“... In I observe, I think, I wonder routine, we were asked to observe different images, interpret meaning, reason, and raise questions. We were constantly thinking.”

Visual thinking routines also provide students with the time needed to compare how their ideas, thoughts, understandings, and questions changed after exploration, explanation, and class activities. Students become engaged in metacognition, which is ongoing. When students are challenged to think about their thinking, they review and evaluate their mental processes until

they reach the final product. A student teacher reported the following: “... *A routine like the 3-2-1 Bridge is very useful in guiding students in seeing the shift in their thinking and how we build knowledge as we learn more about a topic.*” Another student teacher reported the following: “... *At times I had to stop and make a connection between what I was reading and what I already knew in order to reach understandings and conclusions. Some reflective questions I used included: What do I already know? How is this going to help me extend my thinking? What are my strengths? What difficulties do I still encounter? What are the implications? What is next?*”

Discussion

The findings reported by the student teachers supported previous research investigations concerning the benefits of making student thinking visible. Students’ learning should be on display for three main reasons: “inspire students to reach higher and achieve more as they look at quality work that others have produced, invite reflection and revisiting of one’s learning so as to deepen it, modify it, or take it in new directions, inform the larger community of colleagues, administration, and parents about what learning looks like in this classroom and what learners are producing by way of questions and insights” (Ritchhart, 2015, p. 236). It is also important to document thinking and make it visible for collaborative learning purposes: to be understood by others and be able to build and extend on others’ contributions (OWP/P Architects et al., 2010). The purposes of documenting student learning were explained thoroughly in student teachers’ responses.

The data described by student teachers also supported previous research that emphasized the role of visual thinking routines in reinforcing thinking skills and questioning. A significant goal of thinking routines is to expose students to the language of thinking (Wolberg & Goff, 2012). Student teachers affirmed that visual thinking routines serve this purpose. Ritchhart and Perkins (2008) claimed that when learners speak, write, or draw their ideas down, they deepen their cognition and understanding. This was evident in student teachers’ responses when they agreed that the implementation of visual thinking routines resulted in deeper learning and exploration of concepts as they were given the choice to freely express their ideas. Student teachers strongly believed that the constructive questions implemented in the visual thinking routines often called for higher-order thinking and helped reach deep and enduring understanding. These findings are similar to those of Salmon (2011) and McTighe & Wiggins

(2013) who found that constructive questioning called for interpretations, elaborations, and explorations of ideas. The effective use of open-ended questions had been the contention of Johnston, Ivey, and Faulkner (2011) who affirmed that such questions convey that you are expecting your students to engage in thinking and you are interested in their response. This was also evident in student teachers' responses when they explained that visual thinking routines ensure all students respect each other's thinking and contributions in the classroom.

Student teachers recognized how visual thinking routines allow students to be meaningfully engaged in thinking moves and call up for inquiry-based learning. Many of their mentioned thinking moves were already suggested by Ritchhart et al. (2011): observing, reasoning, making connections, considering different viewpoints, building from the known, and questioning. Studying the impact of visual thinking routines on thinking skills had been the subject of much research (Harvard Project Zero, 2010; Costa 2009). They also shared the way visual thinking routines maintain attentive and respectful listening. The role of listening was supported in previous research: "Deep listening is miraculous for both listener and speaker. When someone receives us with open-ended hearted, non-judging, intensely interested listening, our spirits expand" (quoted in Rao, 2010, p.24).

Conclusion

Our students need to be engaged in significant collaborative tasks. They need to reflect, imagine, discuss ideas, and ask questions. Students need to be able to make use of previously acquired knowledge in new ways. They need to reach decisions based on coherent and rational criteria. They also need to analyze their own and other's thought processes. Students need to express their ideas clearly and creatively, listen respectfully to others, and take into account different perspectives. Visual thinking routines enhance such essential skills that are needed in any 21st century classroom.

Visual thinking routines affect the classroom culture. When a teacher makes use of visual thinking routines, the classroom becomes appreciable and discernible. Thinking becomes visible, students are intentionally aware of their thinking, and teachers chart progress by recalling evidence of students' thinking, and therefore, thinking becomes highly valued in such classrooms. Students become well equipped with sufficient opportunities to express, explain, extend, and challenge their ideas. In return, students become active, curious, engaged,

enthusiastic, and responsible learners. When students are actively involved in the learning process, they become meaningfully engaged and highly motivated and reach enduring understanding that is transferable across real life situations. With visual thinking routines, a teacher never receives an: “I can’t do it” response.

Considering the importance of making student thinking visible through the use of visual thinking routines, teachers, administrators, and parents must ensure rich and unique learning environments that bring out the best in every student, take learning to a new level, and drive all students on a lifelong learning full of explorations, investigations, and inquiries.

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