Investigation of an Alternatively Certified New High School Chemistry Teacher's Assessment Literacy

Kemal Izci[1], Marcelle A. Siegel[2]
[1]Necmettin Erbakan University
[2]University of Missouri-Columbia

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Article Info	Abstract
	Assessing student learning to adapt instruction to support learning is an important skill all teachers need to develop. However, it is not an easy task for teachers and even more difficult for new teachers. The current study aims to explore an alternatively certified new chemistry teacher's understanding and practices of classroom assessment to help educators and researchers to support teachers' assessment literacies. This study used holistic case study design to explore the teacher's assessment literacy. Pre/reflective interviews, observations, classroom artifacts, including assessment tasks and a survey, were used as data sources. The results suggest that, in theory, the teacher's understanding of assessment aligned with current view of assessment as she mostly valued formative function of assessment while, in practice, the teacher faced difficulties to practice assessment as she preferred and did not select and use appropriate assessment tasks to accomplish her aims, such as supporting conceptual learning.

Introduction

Classroom assessment forms a critical part of instruction. Based on recent changes in our understanding of learning, teaching and assessment, classroom assessment is no longer seen as a one-shot activity that is used at a specific point of instruction to provide grades. Classroom assessment is considered as a process used throughout instruction to elicit students' prior knowledge, gain data on their progress to check and monitor their levels of understanding and reflect on the conducted data to inform and support learning and teaching (Abell & Siegel, 2011; Black & Wiliam, 1998; National Research Council [NRC], 2012; Organization for Economic Co-operation and Development [OECD], 2009). Related literature has demonstrated that effective assessment practices, which are understood and employed by teachers as a way to inform learning and teaching, enhance student learning (Black & Wiliam, 1998, 2006; Stiggins, 2008; Yin et al. 2008; Vogelzanga & Admiraal, 2017). Thus, adopting these assessment practices is critical in order to monitor and support student learning and adapt teaching (Abell & Siegel, 2011; Ateh, 2015; Black & Wiliam, 2006).

Despite the fact that classroom assessment aids student learning, classroom assessment is seen as a complex process that entails teachers to have a detailed understanding of how students learn, principles for designing or choosing effective assessments, successful practicing of assessment to inform learning and teaching (Abell & Siegel, 2011; Bennett, 2011; Black & Wiliam, 2006). Furthermore, having sophisticated understanding and practices of classroom assessment is crucial for making informed instructional decisions to support desired learning (Abell & Siegel, 2011; 2013; NRC, 2014; Mertler & Campbell, 2005). Yet, research efforts have shown that it is difficult to change teachers' traditional understanding of classroom assessment, and changing teachers' classroom assessment practices is much more difficult (Ateh, 2015; Abell & Siegel, 2011; Black & Wiliam, 2006; Herman, Osmundson, Dai, Ringstaff, & Timms, 2015; Ruiz-Primo & Furtak, 2007, Serin, 2015). Thus, it is crucial to prepare assessment literate teachers and support them during their induction years, where most teachers face difficulties to transform their knowledge into classroom practice to both assess scientific knowledge and practices at the same time, as required by the Next Generation Science Standards (NRC, 2012).

In order for assessment to aid learning, the results conducted through many forms of assessments including formal and informal assessment tasks should be used concisely to support learning via providing effective feedback or adapting instruction (Harshman & Yezierski, 2017). Rather than providing feedback and modifying instruction in general ways, using content specific and informative feedback and revisions are more effective in supporting conceptual learning (Coffey, Hammer, Levin, & Grant, 2011; Harshman & Yezierski, 2017).

However, when the assessment literature in science education is reviewed, researchers mostly provide general principles about using assessment to support learning while different disciplines of sciences, because of their nature, require teachers to differently design and use instruction and assessments (Coffey et al., 2011). For experienced teachers, it may be doable, but it is quite difficult for many preservice and novice teachers to adapt the general principles and suggestions into their classroom practices to support student learning of a specific science discipline. Thus, in order to support all teachers' assessment practices, we need to develop and provide them with discipline-specific ways to conduct, interpret and use assessment results to support learning.

One of the necessities to provide subject-specific ways to initiate assessments, evaluate student learning and act on assessment results to aid learning is to have a high level of subject matter knowledge (Nixon, Hill & Luft, 2017). As well, highly qualified teachers who have high levels of subject matter knowledge are known as those who have an undergraduate degree in their field (Lewis & Lu, 2017). However, because of the variety in teacher education programs and paths to earn a teacher certificate to teach high school science in the USA, high school science teachers have a variety of levels of content knowledge, and some teachers teach out of their field. There are two common ways to become a teacher in the USA. The first path is known as traditional teacher preparation program in which teacher candidates earn bachelors or master's degree in education by taking courses related to content, pedagogy and field experiences. On the other hand, the second path is known as alternative certification program and it aims to prepare candidates holding a bachelor`s degree from different fields and wanting to change their career to a teaching career. While the requirement of alternative certification program varies from state to state, the plan for initiating an alternative certification program is to address issues stemming from a shortage of teachers in schools. Limited research has specifically studied chemistry teachers' understanding and practices of classroom assessment (Harshman & Yezierski, 2015; 2016; Izci, 2013; Lyon, 2011; Sandlin, Harshman & Yezierski, 2015). We were able to find just one study (Lyon, 2011) specifically focused on chemistry teachers during their induction years, while there is no study focused on an alternatively certified chemistry teacher's assessment literacy. The early years are critical times for teachers because they may face many trials while adjusting to school culture, students' needs and their own professional development (Nixon, Hill & Luft, 2017). Thus, the early years are important for teacher educators to understand these challenges to develop effective programs to support preservice and novice teachers' professional progressions. Chemistry is a field that strongly combines both qualitative and quantitative concepts that require different levels of understanding and provide teachers a context to use different forms of assessment to assess and support student learning. Therefore, we aim to investigate an alternatively certified high school chemistry teacher's understanding and practices of classroom assessment during her induction year and her struggles to incorporate effective assessment practices in her instruction to aid student learning of chemistry. In this way, we aim to provide instances that the teacher succeeded and struggled for translating the general principles of assessment into her instruction.

The overarching question this study aims to explore is: How does an alternatively certified new high school chemistry teacher understand and incorporate classroom assessment into her instruction to support learning? By selecting specific content units to prevent from any other influence as assessment itself is the main scope, this study in particular focuses on the following questions: 1) How does the teacher understand learning and classroom assessment? 2) How did the teacher practice classroom assessment while teaching atomic structure and electron configuration units in high school classes?

Theoretical Framework

The guiding theoretical framework of this study stems from the reformed view of classroom assessment based on social constructivist view of learning that structures assessment as a way to inform learning and teaching. Unlike a traditional view of learning, social constructivism considers learning as a personally constructed and socially mediated process, which learners engage in co-constructing their own learning through social interaction. Therefore, successful teachers must provide a learning environment in which students are motivated to provide their prior knowledge, think, collaborate and actively engage in the learning process to enhance their current level of competence (Black &Wiliam, 2006). Contrasting traditional role of a teacher, a teacher role within constructivist approach of learning is to provide a learning environment and scaffold student learning in order to support students' knowledge construction process. As a result, a successful assessment practice necessitates teachers to: a) use assessment to elicit students' prior knowledge and misconceptions to aid learning, b) employ various assessments throughout instructions to monitor, engage and facilitate student learning and c) use assessment results to inform learning and teaching to make informed instructional decisions.

Assessment Literacy

Different terms in the related literature, such as assessment identity (Looney, Cumming, Kleij & Harris, 2017), assessment expertise (Lyon, 2013) and assessment literacy (Abell & Siegel, 2011; Xu & Brown, 2016) have been used to illustrate teachers' understandings, abilities and practices of classroom assessment. Assessment literacy is defined as the knowledge and skills that a teacher needs to develop and practice in order to investigate what students know and can do, interpret the results of assessments, and use the result to decide how to improve student learning and program effectiveness (Abell & Siegel, 2011; Xu & Brown, 2016). According to Abell and Siegel's (2011) conceptualization of assessment literacy, it includes five components with the teachers' view of learning and values of assessment forming the core (see Figure 1). There are also four outlier knowledge components consisting of knowledge of assessment purposes, assessment strategies, assessment objectives and interpretation and use of assessment results to explore teacher assessment literacy. Particularly, the literature on assessment literacy guides the study. Science teacher assessment literacy (STAL) model developed by the Abell and Siegel (2011) employed both research literature and empirical data collected with science teachers to validate the model. The STAL model was previously utilized by researchers to explore preservice (e.g., Siegel & Wissehr, 2011) and inservice science teachers' assessment literacies (e.g., Gottheiner & Siegel, 2012). Thus, as the study focuses on a chemistry teacher's assessment literacy, the general components of STAL model (see Figure 1) is used not only to represent the teacher's theoretical understanding of assessment but also her practices of assessment by using STAL model as a lens.
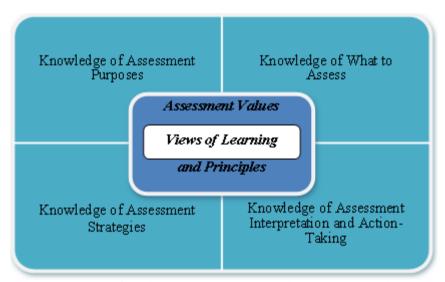

Figure 1. A model for science teacher assessment literacy (Abell & Siegel, 2011, p. 212).

A teacher's view of learning impacts how she understands and employs assessment in her instruction and it constitutes a core part of both assessment literacy models developed by the Abell & Siegel (2011) and Xu and Brown (2016). Pellegrino et al.'s (2001) assessment triangle model, COI, also gives a central role to view of learning as cognition part requires teachers to know how students learn and represent knowledge. For instance, a teacher with knowledge transmission view of learning uses assessment at the end of a unit to assess what her students have learnt to see whether the targeted knowledge has mastered by her students while a teacher with constructivist view of learning employs assessment to elicit, monitor and support student learning by using assessment results to provide learning opportunities for her students. Thus, teachers' beliefs and conceptions of learning and also their experiences with classroom assessment lead teachers to develop certain cognitive and affective values and principles for assessments (Izci, 2018). However, as Shulman (1986) indicated there are three types of knowledge which influence the success in reflecting the espoused beliefs in teaching practices. They are propositional, case or theoretical and strategic knowledge. Propositional knowledge denotes the principles, values and norms of teaching and also known as belief systems about how students learn. It can be developed based on research or observation of teaching and includes the claims of true or false about learning. The theoretical knowledge refers the knowledge about a specific and well known event and requires theoretical understanding of teaching and reflections to be developed. For instance, a teacher's values of assessment that are developed based on observations of exemplary examples and the knowledge gained through professional developments or teacher education programs can be example for the theoretical knowledge (Box et al., 2015). Strategic knowledge goes far from propositional and theoretical knowledge and steps in when a teacher faces with challenging problems where no simple solutions are available. Thus it requires expert knowledge, which is

defined as having organized conceptual structures, or schemas, that guide how problems are represented and understood (Pellegrino et al., 2001), to deeply and comprehensively think about a challenging problem to come up with effective solutions.

According to these models of teacher assessment literacy (Abell & Siegel, 2011; Xu & Brown, 2016), assessment literate teachers should have a detailed understanding of assessment purposes, assessment strategies, what to assess, peer and self-assessment, feedback and interpretation and uses of assessment results. Assessment purpose includes diagnostic, formative, summative and metacognitive purposes. Diagnostic assessment refers to the assessment that occurs at the beginning of instruction to determine students' prior knowledge, conceptions, and beliefs about a specific unit of teaching and it is important to guide future steps of instruction (Abell & Siegel, 2011). Formative assessment, as described by Black and Wiliam (1998), refers to all activities that provide information about students to be used as feedback to enhance learning and teaching. Use of assessment results is an important criterion for formative assessment as it gives the chance to both teachers to adjust instruction and students to regulate their own learning. Summative assessment is defined as an evaluation used at the end of an instructional unit, semester, or academic year to provide documentation of student learning and shows teacher effectiveness (Abell & Siegel, 2011). Metacognitive assessment aims to make students become aware and monitor their own learning to engage in self-regulation process. Metacognitive assessment can be integrated into other assessments. Diagnostic and formative assessments are more useful for teachers and students since they provide opportunities for teachers and students to immediately adjust instruction to enhance teaching and learning, however, it is difficult to support learning via summative assessment as they are undertaken after instructional process is done. Assessment strategies include formal (e.g. exams) and informal (e.g. questioning) assessment tasks that teachers use for different purposes. Research suggests that more open-ended authentic tasks should be used to elicit and assess high level learning, including scientific thinking, reasoning, and practicing skills, because traditional paper-pencil multiple-choice tests are not capable of assessing higher level conceptual learning (Harshman & Yezierski, 2017; Jasien, 2018; Kang & Anderson. 2015; Yin et al. 2008). Thus, more assessment-literate teachers utilize more open-ended authentic assessments rather than traditional multiple-choice tasks to gain evidence of and support student learning. Furthermore, open-ended authentic assessments (e.g., labs, projects, portfolios) constructed on daily life experiences can motivate students to engage in scientific practices, which is the core purpose of the new framework for K-12 science education (NRC, 2012). Assessment content mostly depends on disciplinary objectives and includes the concepts and skills that a teacher wants her students to master. The new US framework of science education (NRC, 2012) requires teachers to help students in mastering the three-dimensional learning including disciplinary core ideas, science and engineering practices and crosscutting concepts for a given topic. As NRC (2014) indicates, it is impossible to use any one assessment to assess all grade level expectations in the three-dimensional learning, thus it is vital to use as much as varying assessment to assess and aid student learning.

Knowledge of interpretation and use of assessment consists of ways to interpret assessment results and use them in a way to aid student learning and improve instruction. Teachers can gain a range of data about their own students via different formal and informal assessments. Through the analysis and interpretation of the gained data, teachers are able to understand their individual students` prior knowledge and understanding of a concept, the success of their instruction and so on. There is no better source of data that teachers accessed about their individual students to make adjustment of instruction to aid learning while impact of use of assessment results on student learning cannot be underscored enough (Harshman & Yezierski, 2017; Herman et al., 2015; Yin et al., 2008). Thus, effective interpretation and use of assessment results are important for a successful teacher to support learning. One effective use of assessment results is known as providing effective feedback to learners. There are different types of feedback as descriptive, evaluative, or formative (Hattie & Timperley, 2007). Researchers indicated that just focusing on right answers to provide evaluative feedback is not effective for learning, thus it is suggested for teachers to provide more descriptive and formative feedback to guide students to engage in learning to understand a phenomena or complete a learning task on their own (Cisterna & Gotwals, 2018; Hattie & Timperley, 2007; Izci, 2013). Having students review assessment results individually or in groups is also a way for use of assessment results. It helps students to engage in peer and self-assessments to see their peers or own weaknesses and strengths to take responsibility of their own learning. Making adjustment of instruction to address classroom or individual learning needs is also an important use of assessment results to support learning. However, as researchers indicate using discipline-specific strategies to adjust instruction is difficult for teachers (Coffey et al., 2011; Harshman & Yezierski, 2015) and most teachers just prefer to use same way to re-teach or revisit related content if the results of assessments did not satisfy them (Haug & Ødegaard, 2015; Harshman & Yezierski, 2017). Thus, teachers need to know how to differentiate instruction to meet the needs of their students by using discipline-specific productive strategies.

Method

This study focuses on a specific case involving a new alternatively certified high school chemistry teacher teaching atomic structure and electron configuration units in high school chemistry classrooms at a small rural school district located in the Midwest part of United States. Thus, this study was designed as a holistic single case study consisting of in-depth analysis to investigate the teacher's assessment literacy. The study used holistic design since the unit of analysis was a teacher`s assessment literacy and single unit analysis was used (Yin, 2009). According to Yin (2009), case study is "an empirical inquiry [that] investigates a contemporary phenomenon within its real-life context, especially when the boundaries between phenomenon and context are not clearly evident" (p.18). The case study approach has a clear advantage over other research designs, because "the strategy employed is to investigate 'how' or 'why' questions asked about a contemporary set of events over which the researcher has no control" (Yin, 2009, p. 9). Furthermore, the study contains multiple data sources, which researchers have identified as the unique power of the case study research design (Yin, 2009). Case study design is also used by many researchers to investigate teachers' assessment literacies (e.g., Barendsen & Henze, 2017; Lyon, 2011; Serin, 2015).

Participant

The alternatively certified novice teacher, hereafter "Sophia", is a 44-year old white woman, holds an undergraduate degree in nutrition and two years ago was certified by an alternative certification program to teach general science including physical science, health, chemistry, and physics through 9th to 12th grade. The alternative certification program she attended did not require her to go back to college to take educational courses since the program required her to take practice exams related to each discipline she certified to teach. Thus, it was easy for Sophia to take teaching certification as she explained;

> I just knew that there was a need for science teachers and I enjoyed the subject and it was fairly simple for me to get the certifications because of the need. I did not have to go back to college and I just needed practices exams to take for chemistry and physics.

In other words, Sophia did not have educational courses related to teaching when she started to teach high school science. Sophia worked for the health department for seven years and then she worked for the department of environmental science for four years before starting teaching at Stylist High School. This was her second year of teaching and first year of teaching chemistry. Her chemistry content knowledge comes from the courses including Kitchen Chemistry, Food Chemistry and Analysis, Food Chemistry II and Food Chemistry and Analysis Laboratory she took during her undergraduate education. However, she missed to take essential courses such as Analytical Chemistry, Electrochemistry, Physical Chemistry, Organic Chemistry, Biochemistry and Inorganic Chemistry that a traditional chemistry teacher takes before teaching high school chemistry. Furthermore, she did not take any pedagogical and teaching practices courses that a teacher in traditional teaching training program takes to teach high school chemistry. Thus, she had distinct differences with a traditional novice teacher as a traditional teacher should take diverse courses related to content, pedagogy and teaching practices. Stylist High School, Sophia works in, is the only high school located in a small, Midwest community and includes 132 students with an average of 16 students in per classroom. There was not much diversity within the school as 98.5 % of students were white and 1.5 % of them were black.

Procedure

Sophia was one of the four teachers included in a larger study of chemistry teachers` assessment literacy. The data collection process initiated in Spring semester by implementing a five point-Likert-scale survey in which 1 indicates often use and 5 never use for the given assessment practice to determine the participants. We used the survey developed by Box (2015) that focuses on teachers' understanding and self-reported frequency of using classroom assessment. We used the survey since we wanted to observe teachers who practice assessment at different levels to investigate what factors support or limit their successes in assessment practices. The survey includes four subsections as a) Instructional response, b) Dialogue and questioning strategies, c) Feedback and d) Student involvement and uses such items as, "I guide students to brainstorm and list student ideas on the board", "I use peer assessment", "I provide written feedback with advise on improvement" and "I provide opportunities for students to reflect on their work". As a result, a lower score from this survey means that the teachers perceived themselves to be more likely to use assessment formatively in their classrooms, as opposed to the high scoring teachers who perceived themselves less likely to use assessment formatively in their

teaching. Based on the scores shown in Table 1, Sophia was one of the teachers who self-reported high frequency users of classroom assessment (4 out of 24 participants) and she was the only teacher in her induction years to teach chemistry. Table 1 shows her and the other three teachers` survey results. Sophia indicated she often uses classroom dialogue and questioning to elicit and monitor student learning (2.11) and provide feedback to students (2.0). Sophia generally uses assessment results to adapt her instruction (2.50) and sometimes involve her students in assessment process (3.27) as she indicated in her survey. Thus, she was purposefully selected for the current study to gain more insight about an alternatively certified new teacher's assessment literacy.

Table 1. Survey results of participants

Pseudonym	Level of Education	Teaching Experience	Survey Results ($\bar{x}$/order)
John	M.Ed.	11	2.3 (1/24)
Sophia	B.S.	1	2.6 (4/24)
Kate	M.Ed.	9	3.3 (22/24)
Gary	B.S.	24	3.5 (24/24)

We employed purposeful sampling to identify the participant to gain more insights about new and alternatively certified teacher`s assessment literacy. Purposeful sampling is a method usually used in qualitative studies for determination and selection of information-rich cases for the most effective use of limited resources (Patton 2002). According to Merriam (1998), purposeful sampling is "based on the assumption that the investigator wants to discover, understand, and gain insight and therefore must select a sample from which can learn the most" (p. 48). Sampling in qualitative research consists of setting the boundaries of the identified case and creating a frame to verify, reveal, or qualify the basic processes that support the determined study. Critical case, one of the purposeful sampling strategies, was used to determine the participant of the study. We used critical case strategy since the specific case we focused represents an alternatively certificated new chemistry teacher, which does not fall into a traditional teacher category. The goal of critical case strategy is to richly describe and provide information about a specific case rather than provide some generalization (Patton 2002). Thus we employed critical case strategy to describe and provide rich information about Sophia`s assessment literacy.

After selecting Sophia as the participant of the study, a preliminary interview was conducted with her to identify her understanding of learning, teaching and classroom assessment. The details of the interview are provided under data sources section. Later, a specific content unit was identified to observe her real assessment practices. We chose to observe Sophia's teaching during both content units because both atomic structure and electron configuration units were included in state content standards, and we wanted to choose a specific content unit to only observe her assessment practices by preventing any other influential factors since assessment itself was the main scope of the study. After that, during Fall semester, her instruction of atomic structure and electron configuration to 10th grade students were observed to explore her assessment practices. Sophia's class periods were 45 minutes long, and she spent 14 days to complete both units. 12 of the 14 class period were observed by the first researcher and because of time scheduling issue two of her class period could not be observed. During the observations, field notes and teacher and student artifacts were also collected.

After the collection of data, data analysis process was started. During the data analysis process, in order to ensure trustworthiness of the presented data, we use a set of efforts. Prolonged engagement by having more than ten interviews with the participant, data triangulation by conducting various types of data as stated in the data sources section, peer review by asking researchers outside of the study to review and provide their feedback, member checking by sending our findings to the participant and asking to inform us if the findings did not provide her experience with classroom assessment, and rich-thick description before, during, and after collecting this data were utilized to ensure trustworthiness of the findings of this study.

Data Sources

The main data sources of this study were interviews, classroom observations, field notes and artifacts. All data sources were conducted by the first author as a part of his doctoral dissertation. After analyzing the survey results, an hour long pre-interview conducted with Sophia to understand her understanding of assessment, including her perception, beliefs, and knowledge of learning and classroom assessment. After each of the observations of her instruction, a reflective interview (in total nine reflective interviews) that mainly focuses on her assessment practices was conducted in order to investigate the reasons of her assessment related decisions and the factors influencing her assessment decisions and practices. The reflective interviews include questions, such as: 1) What were you trying to achieve with this specific assessment? 2) Do you remember what prompted

you to use this strategy? 3) How did you use the results of the specific assessment? 4) What were the challenges and limitations you encountered during to implementation of this assessment? These reflective conversations aimed to gain information about (1) Sophia's practices of assessment, (2) the way she provided feedback and interpreted and used assessment results, (3) her perceptions on changing and using the assessment tasks in the future, and (4) how the contextual elements constrain or facilitate her use of assessment. The conversations were audio recorded and transcribed for analysis.

Teacher's and students' artifacts included the collection of documents that were produced by Sophia before, during, and after instruction. These materials were unit plans, lesson plans, syllabi, documents about learning, and informal assessment activities, including worksheets, student assignments, materials created to communicate program goals and grading and performance standards, and formal assessment materials that included rubrics and feedback provided to students. Students' artifacts consisted of copies of collected student assignments, quizzes, formal and informal assessment materials, and teachers' written feedback.

Data Analysis

Different researchers may draw different conclusions from the same set of qualitative data because of differences in their reality, knowledge, and values (Shank, 2006). Therefore, a general approach is needed for the analysis of qualitative data. This study used the four levels developed by Babtiste (2001) as a general approach to analyze the collected qualitative data: (1) define the type of analysis to use, (2) categorize the data, (3) connect the different data set, and (4) present the results of the analysis.

Data analysis began with the transcription of pre-interviews immediately following the pre-interview of the participant. Then, data analysis continued after observation cycle for the teacher, in which observations, artifacts and reflective interviews were conducted. In this study, the collected qualitative data was both inductively and deductively coded. By using analytical induction, any statement about assessment was openly coded (Patton, 2002). With deductive coding, predefined categories from assessment literacy literature and the models of teacher assessment literacy (Abell & Siegel, 2011; Xu & Brown, 2016) were used to analyze the data. In addition, additional themes were formed to categorize the data when the predetermined categories were not appropriate. An instance of inductive coding would be codes for factors such as lack of instructional materials and high-stakes testing pressure that constrain the participant's assessment practices. The teacher's view of learning constitutes the core of her assessment literacy, which comprises assessment values and principles. We drew upon the work of Brown (2008) and developed codes within the following four dimensions of teacher's view of learning including: 1) goals for teaching learners, 2) perception of teacher role, 3) perception of student role, and 4) sequence of teaching to explain Sophia's view of learning.

Results and Discussion

The study investigated Sophia's assessment literacy through her understanding of learning and assessment and her assessment practices. The first part of the results presents Sophia's assessment literacy at theoretical level including her view of learning and understanding of classroom assessment. The second part of the results focus on her practical assessment literacy by presenting her teaching and assessment practices.

Understanding of Learning

Sophia, as new teacher, identified her main goal for teaching as assisting students to develop and gain important skills and knowledge to be able to figure things out in the natural world. She explained, "The purpose of education in general, I think most importantly, is to develop critical thinking skills, and secondarily get some basic knowledge to figure things out." Furthermore, specific to chemistry, she stated the goals as, "With chemistry since it is a science I think the big thing is some scientific method which goes into critical thinking and problem solving." Sophia believed that learning best occurs when new knowledge is built upon previous knowledge, as she stated "I think in general most people learn by tying new information to previous information so that is just a building block. If you do not have the previous knowledge to attach it, then it is not going to stay very long so the association." Therefore, as a teacher she recognized her role as to provide information in meaningful ways to motivate students to engage in learning to construct their own learning. Conceptual learning rather than memorization was also identified by Sophia as crucial in learning process. She provided periodic table as an example construct and explained, "I do not think it is important to memorize periodic table just so

long if you have understanding what the periodic table is, why it is the way it is, and then you can go to use it as a tool." Sophia perceived the students' role as being intrinsically motivated, responsible, and active participants of learning process to construct their own knowledge. She explained, "If students more engaging and doing more thinking, I think they are seeking to learn more." Thus, in theory, Sophia's view of learning aligned with constructivist view of learning and explains the importance of conceptual learning, teacher's guidance role and benefits of students' active participation in learning process.

Understanding of Classroom Assessment

In theoretical realm, Sophia understood that when assessment is formatively used, it supports conceptual learning by: a) eliciting prior knowledge and misconceptions to plan instruction, b) checking and gauging students' progress to assist learning, c) providing opportunities for students to apply and enhance their knowledge, d) providing feedback to aid their learning, and e) evaluating and adjusting instruction to support learning. Figure 2 shows the details of what Sophia identified as purposes, strategies, knowledge construct and interpreting and acting on assessment results to formatively use classroom assessment to support students' conceptual learning.

Sophia believes that both formative and summative assessments are useful for instruction because they provide precious data for teachers to evaluate and enhance learning and teaching. She believed assessment purposes is important because "…you can use a lot of assessments either formative or summative way. But the formative questions tend to be more open ended. And then, the summative tend to be a big picture and focus on big ideas". For example, she conceived the benefits of formatively using the results of summative assessment to adjust or change instruction as she stated, "Summative assessments are useful because I can look at those and go okay and next year I am going to do this different because I did not get this across, which we can do better". Then again, Sophia felt that formative assessment is certainly practical for teachers to support students learning and teaching. Sophia also believed that "formative assessments are definitely useful for adjusting your instruction as you go". Therefore, Sophia favored formative role of assessment because as she stated, "It helps me with the instruction. I mean if the students did not learn, then I need to change my instruction to help them learn it better. So, that is main role of assessment for me individually".

In particular, Sophia highlighted formative function of classroom assessment and felt that assessment should be used to support students' conceptual learning, motivation and metacognition via using the purposes, strategies, construct and results of assessment as shown at Figure 2. For instance, she explained the role of assessment in checking student learning and providing feedback to students and teachers in order to aid student conceptual learning as she stated, "The role of formative assessment is to see how well the students are and to see how well I am teaching [because] it is just to give the students feedback on what they know and what they do not know and give me feedback on what they comprehend and what they did not comprehend." Furthermore, Sophia identified the role of assessment in adjusting instruction to support conceptual learning and stated, "It [assessment] helps me with the instruction. I mean if the students did not learn, then I need to change my instruction to help them learn it better." Sophia also perceived that assessment should be used to improve students' motivation since she thought assessment motivates students to engage in applying and enhancing their learning. For example, one of the ways to motivate students via assessment for Sophia is to provide grades for assessments as motives to motivate students to engage in learning. She explained, "I use grades because that is what motivates students. Grades motivate them to learn and take notes but I also say it is not worth a huge percentage of their grade because I do not want to stress them all". Additionally, Sophia conceived that assessment should be used to foster students' metacognition as assessment: a) informs students' about their strength and weaknesses, b) encourages them to use provided feedback, and c) provides opportunities to engage students in self-assessment to let students regulate their own learning. For instance, one of the ways Sophia identified in order to foster students' metacognition is to provide feedback on assessments to let students see their own strength and weaknesses and use the feedback to improve their own learning. Sophia considered that "formative assessments give the students feedback on what they know and what they do not know" to improve their own learning. She provided an example of assessment-open book quizzes- as a way to use assessment to improve students' metacognition and explained, "I actually give them open book quizzes but they are timed… In that way, they can see what they know and do not know to evaluate their own learning. So, the open book quizzes I found that are pretty helpful."

Sophia valued use of different activities and methods to teach same concepts. She indicated that "I use the standards and objectives I am addressing and then the activity, the assessment. I guess within the activity, it various and it seems like when I am doing the same subject, several days overall, I have different activities for

the same subject. So, students are given the information with different methods." Thus, she identified different formal and informal assessment strategies that she uses during her teaching. The 14 assessment strategies shown in Figure 2 she specified during her pre-interview to assess her students' learning includes some traditional assessments such as quizzes, lab reports and questioning while some innovative assessments such as debate, group assessments, posters, and research papers also remarked. Sophia also recognized advantages and disadvantages of some strategies. She felt that "The labs are pretty good ways of promoting critical thinking". She also believed that group assessments and debates are useful for engaging students in critical thinking as providing grades to these kinds of performance assessments is difficult. She noted, "I think critical thinking may be a good thing for group quiz or group questions. I did a debate with a renewable energy, coal and oil energy and they (students) had to go back and forth. But, it was hard for me to grade."

Based on her understanding of curriculum and her values, Sophia identified factual and content knowledge, conceptual understanding and scientific thinking and science process skills as important values that should be assessed in high school chemistry as shown in Figure 2. Sophia believed that students should have some basic factual and content knowledge to engage in conceptual learning, thus she assesses basic factual knowledge including vocabulary and terminologies "…because students may not know very basics simple things." Sophia also emphasized the importance of conceptual learning for her students. Therefore, she stated she assesses students' conceptual learning by doing "… more explain this, apply this, and predict this" types of assessments. She explained, "I try to do more test questions where they actually have to apply their knowledge, not just definitions or not just what the equation is. I give more attention to their processing and applying the knowledge."

Figure 2. Assessment literacy of Sophia at theory

Assessment Purposes	What to Assess
Summative: Showing understanding of main objectives; Providing data/grades for graduation *Formative:* Eliciting and checking understanding Providing feedback to students Helping teacher to evaluate/guide instruction Promoting self-assessment	Factual knowledge Content knowledge Conceptual understanding Scientific thinking skills Science process skills

Valued formative assessment.

View of learning
Constructivist, student-centered

Assessment supports both teachers and students

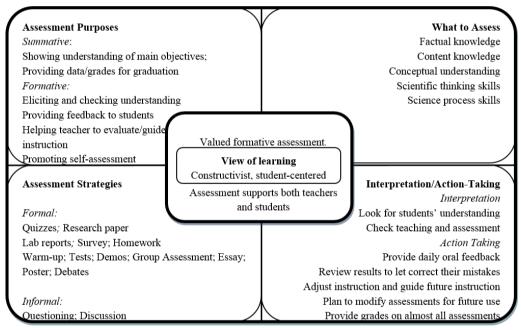| Assessment Strategies	Interpretation/Action-Taking
Formal: Quizzes; Research paper Lab reports; Survey; Homework Warm-up; Tests; Demos; Group Assessment; Essay; Poster; Debates *Informal:* Questioning; Discussion	*Interpretation* Look for students' understanding Check teaching and assessment *Action Taking* Provide daily oral feedback Review results to let correct their mistakes Adjust instruction and guide future instruction Plan to modify assessments for future use Provide grades on almost all assessments

Figure 2. Assessment literacy of Sophia at theory

Sophia believed that assessment results can be used to "see where (students) are at and what happened" after instruction. She thinks that assessment results show students' achievement level, which can be used to evaluate instruction. She explained, "I look at the average because it is helpful and I also look at how many students get over 90 % , how many get over 80, how many get over 70, how many of them are really low, how many of them are almost perfect. I mean all that information gives me a good idea of how did things went."

Sophia also feels that assessment results can be used to evaluate and modify assessment tasks for future usage. She explained how she used summative assessment results:

> I always look at the outlier like how many people got over 90 to see if it is too easy. If the students did not do very well at all, I will be like the assessment was so difficult. So, may be the next assessment I will be asking easy questions. Generally, that information I do not use a lot for that class, it is kind of for the next year.

Sophia identified several summative and formative actions that can be taken by teachers based on assessment results (see Figure 2). Besides using summative tasks to assign grades, she specified formative use of assessment results to support learning. Sophia thinks that assessment results should be used to provide feedback to assist student learning. She explained, "My feedback is more verbal in daily basis and more written on like weekly basis. So, when they have quizzes that little bit bigger then, I make notes and comments on that". Sophia also thinks that assessment results should be reviewed by teachers to allow students to see and correct their mistakes. She explained how she motivated her students to correct their mistakes: "I have given an assignment and let them correct all of the questions they missed [in their assessments] and I will give them extra points".

Real Teaching and Assessment Practices

Our observation of Sophia's teaching of atomic structure and electron configuration units showed that while she valued constructivist learning, her instructional practices mostly aligned with traditional teacher-centered, knowledge transmission approach in which she directed teaching, students were listened her lecture and use different ways to let students apply what they were instructed. We summarized her regular teaching sequence as; a) elicit prior knowledge and prepare students for learning through propping (e.g. warm-up) questions, b) use PowerPoint slides and textbook to lecture, c) use quizzes and warm-ups to check students' learning, and d) provide ways (e.g. homework, practice problems) to let students practice and enhance what they have instructed. The following vignette represents an example of Sophia`s instruction that we developed based on our observations and records of her instruction.

Vignette-Exploring the Quantum Numbers

Sophia says, "Hi guys, today we are going to use four quantum numbers, yesterday we talked about writing electron configurations of different elements". Students place their chemistry textbooks on their desks and open the first page they studied yesterday as their homework. There are different textbooks are placed on a desk that is located at the right back corner of the classroom for students. By using the Smart Board at the front of students and a PowerPoint slide with five fill-in-the-blank type questions is projected on a screen by Sophia to assess students' understanding of the concepts they covered yesterday.

Sophia asks students to look at the questions and prepare their responses while she takes attendance for today. After taking the attendance, she reads the first question: "The probability map for an electron is called….." and waits for students' responses. Students are quickly scanning their textbooks to find the answer for this question. Then, one of the students responds, "It is called orbital". Sophia says "Yes, we use orbital for the probable place of electron around an atomic nucleus". Afterward, she reads the second question on the screen: "The shape of……orbital is a spherical" and waits for students' response to fill in the blank. Students are looking their textbooks to give their answers. After waiting for 30 seconds, Sophia thinks that they cannot remember the shapes of orbitals and she starts to draw shapes of each of the s, p, d, and f orbitals on the Smart Board to show them. While she is drawing the shape of d orbital, to encourage students to engage in thinking and discussion, she asks: "How many orientations does d orbital have?" By directing the shape of the d orbital shown on the Smart Board, one of students responds, "I think there are five different orientations". Sophia then asks, "How many electrons can be placed within each orientation?" The same student responds, "Two electrons can be placed". "Thus, how many electrons can be placed into d sublevel?" Sophia asks. "10 electrons" the student responds. Then, Sophia asks, "Did you understand guys?" and "Do you have any questions about the shapes of orbitals?" to check students' understanding. Students nod to show that they understand. Next, she reads other questions in the same way to check students' understanding of names, means, and functions of four quantum numbers.

By using PowerPoint slides she prepared from the textbook, Sophia starts to lecture about Bohr's atom model and the place of electrons around atomic nucleus. Her PowerPoint slides include explanations supported with diagrams and pictures about four quantum numbers, including principle, orbital, magnetic, and spin quantum numbers. At the end of her lecture, she explains how to use the four quantum numbers to write electron configuration of elements by writing sodium, chlorine, and neon's electron configurations as examples. After her lecture, Sophia requests her students to form groups of three or four and asks them to answer the practice problems in their textbook on pages 304-307 on a piece of paper and then turn their answers in to her. During the group work session, she is circulating around the students and helps them by providing verbal feedback. Then, she asks students to take the rest of questions and return their answers as their homework for tomorrow.

As the above vignette of Sophia`s instruction shows, briefly, we can say that Sophia relied on the textbook she used to prepare her students for the concepts related to atomic structure and electron configuration units, used PPTs developed based on the textbook to lecture about the related concepts and employed practice problems from the textbook to checked her students' understanding. During the instruction of both units, Sophia did not employ any lab investigations that can motivate students to engage in exploration. However, she once employed a scientific article to let her students to see the application of knowledge they have learned about electrons and how electrons spin around a nucleus to create a magnetic field. The article was in the textbook and Sophia gave the article as homework to her students to read before coming to next class period. The article explains a frog placed in a powerful magnetic field, generated by a current flowing through a water-cooled coil of wire, appears to float in midair in defiance of gravity. Furthermore, the article also concludes that a person can be levitated by the magnetic field. Sophia explained her aim to use the article as, ``….just to get them (students) to take it one step further and think about how it (magnetic properties of atoms) could benefit things in the real world, life in the real world.`` In the next class, Sophia asked some open-ended questions related to the article `` because they (students) usually skip those (scientific readings) and then respond to it (questions related to readings). So, the questions, I will be able to tell if they read that article and actually understood it by how they answered the questions.`` The questions she asked from the textbook included;

> Is it possible for human to levitate in a magnetic field? If not, why is this not possible? If so, why is it possible? Why do you think the electron is close to the nucleus? Write one example that you can think of that would be a useful application of diamagnetism for technology in our daily life.``

Sophia used the questions from the textbook rather than developing her own questions. She explained how she planned to use the results of that assignment as, "I am planning to just see what is there. Making some comments just based on their answers and I'll probably just put positive feedback on their insights and then, I may do a small class discussion over the article". However, after students returned their individual written answers to these questions, she asked students to form groups to discuss their answers in groups and did not check individual students` answers to see their understanding. Because of lack of content knowledge, she had difficulties to explain why electrons more become close to nucleus within the same quantum numbers if number of electrons increase and did not mention about the increasing power of magnetic field to explain as the reason of the situation.

We describe Sophia as demonstrating a traditional knowledge-transmission view of learning in practice because that shapes her teaching decisions from developing materials to designing and teaching lessons. Thus, we concluded that while Sophia's view of learning aligned with constructivist view of learning, in practice, her teaching showed there was a conflict between what she believed and what she practiced.

Assessment Practices

Sophia, in theory, mostly valued formative function of assessment and aimed to support students' conceptual learning and higher order thinking skills. However, in practice, her assessments were mostly multiple choice or close ended short questions that focused on low level learning as opposed to higher-level conceptual learning. Thus, even if she set formative purposes for her assessments to aid conceptual learning (see Figure 3), her assessment practices did not support it. For instance, she regularly employed warm-up questions at the beginning of her instruction to elicit students' ideas about a concept/topic students are going to learn for that day to decide where to and how to start her instruction. However, as seen from the example questions she used as warm-up for some core concepts in atomic structure unit (see Figure 4), the questions were mostly focused on low level understanding including memorization and recalling specific definitions rather than asking open ended why and how type questions to make students explain relations of focused concepts or their scientific reasoning and conceptual understanding.

Furthermore, even if Sophia believed that performance assessment such as labs are useful assessments to involve students in using their basic lab and thinking skills to engage in conceptual learning, she did not employ any lab or performance activities during her instruction, and she did not assess students' science process skills, which she identified as important for her students to gain and develop. When asked about why she did not use any lab activity or projects to assess her students' conceptual learning rather than using multiple choice test questions, she showed her struggles and dissatisfaction with the assessments and indicated lack of resource as a reason for not using labs or performance assessments. She explained, "I do not like my assessment too much because I do not feel I can come up with on my own or can find very good questions on a certain thing." Furthermore, she elucidated "Not much labs because I have already said I have limited resources and I only

have one hook. I did water placement reaction but I did just demo you know because for each pair of students to do it will be difficult. So, for assessing skills of students in the performance assessments, equipment will be a limitation."
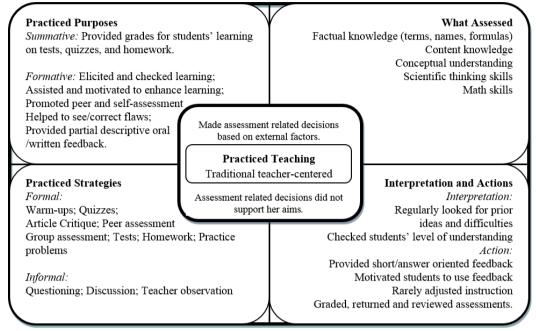

Practiced Purposes
Summative: Provided grades for students' learning on tests, quizzes, and homework.

Formative: Elicited and checked learning; Assisted and motivated to enhance learning; Promoted peer and self-assessment Helped to see/correct flaws; Provided partial descriptive oral /written feedback.

What Assessed
Factual knowledge (terms, names, formulas)
Content knowledge
Conceptual understanding
Scientific thinking skills
Math skills

Made assessment related decisions based on external factors.
Practiced Teaching
Traditional teacher-centered
Assessment related decisions did not support her aims.

Practiced Strategies
Formal:
Warm-ups; Quizzes;
Article Critique; Peer assessment
Group assessment; Tests; Homework; Practice problems

Informal:
Questioning; Discussion; Teacher observation

Interpretation and Actions
Interpretation:
Regularly looked for prior ideas and difficulties
Checked students' level of understanding
Action:
Provided short/answer oriented feedback
Motivated students to use feedback
Rarely adjusted instruction
Graded, returned and reviewed assessments.

Figure 3. Assessment literacy of Sophia at practice.

Warm Up
John Dalton's atomic theory stated that atoms of the same _____ are exactly alike.
The nucleus of an atom has a (n) _____ electric charge.
Neutrons and protons are found in the _____ of an atom.
Atoms have equal numbers of _____ and _____.
According to modern atomic theory, the exact location of a(n) _____ is uncertain.

Figure 4. Warm-up questions

Sophia mostly employed certain type of assessments that mostly were constructed on traditional multiple choice and fill-in-the-blank type questions as opposed to open-ended and performance-based questions that challenge students' thinking to involve them in learning. We were also concerned about why even if she knew about various types of assessment strategies, she employed certain strategies within her instruction to assess and support her student learning. One of her reason for using multiple choice and short answer questions was easy to grade since she provided grades for almost all her assessments for motivating students to complete assessments and also for graduation. She explained, "Because of grading, I do a lot of easy to grade assessments for summative like multiple choice, fill in the blank, and matching. It is just because the summative tests are bigger and longer to grade and they are more like about graduation". One of the other reasons to use certain types of assessment for Sophia was state testing, which includes certain type questions that lead her to use those type questions. She explained, "I actually have a lot more short answer questions but my principal did ask me to do my finals with multiple choice because that is how EOC (End of Course test) is given and they just want that format." Lack of time and chemistry colleagues was also found by Sophia as reasons for not using different assessments. She stated:

> I do not have much time because I teach four different classes. And then I do not have any other chemistry person to talk with. This is all me. I do not have any peer. I have another science teacher I talked to; we can talk strategies for teaching and assessing basic science concepts like the scientific method. But when it comes to specific teaching chemistry concepts, I do not have anybody to go to.

During our observations of Sophia's instruction, it was obvious that she had difficulties to ask probing questions to elicit students' ideas and misconceptions and also use results of her assessment to make instructional decisions. In fact, Sophia regularly employed warm-ups at the beginning of almost all her lessons to elicit students' prior ideas, check their understanding of covered concepts, inform them about her expectations, and initiate classroom discussions to engage students in learning because of the nature of her warm-up assessments,

it was difficult for her assessment practice to meet her aims for use. For instance, she used a warm-up at the beginning of her instruction of atomic structure and explained her aims for using this as:

> By using warm-ups, I just wanted to forward to my plan, which was review of what they learned in nine grade or what they should have learned in ninth grade, which was that part of subatomic particles, where they located, what their charges are, the relative sizes and masses all that. That was the review that I had hope to see what they would remember about sub-atomic particles.

However, the warm-up questions she used (see Figure 4) were mostly close-ended including multiple choice and fill in the blank type questions that were far from asking students to explain their thinking and rather just providing their answers as wrong or right. Moreover, another example that provided students' understanding as right and wrong can be the multiple-choice practice problems from the textbook Sophia employed during her instruction of atomic structure to check her students' learning of sub-atomic particles and their properties. After she completed the practice problem session we asked her what the results of the assessment showed her about student learning. She explained:

> I went through some of the problems, which were the review problems from our book, and just kind of asked questions to see if there was understanding. The people that understood it answered the questions and the people that did not understand I could see from their face because their faces showed they did not understand it.

Similarly, Sophia's interpretations of written formal assessment practices also focused on right or wrong answers and she paid attention to numerical grades students received in order to make conclusions about student learning rather than looking at the difficulties and progresses students illustrated on their assessment tasks. For example, we asked about how she was going to look at the end of unit test students were taken at the end of her teaching, she stated:

> I look at the average because it is helpful and I also look at how many students get over 90 % , how many get over 80, how many get over 70, how many of them are really low, how many of them are almost perfect. I mean all that information gives me a good idea of how did things went.

Furthermore, Sophia faced difficulties to decide how to use assessment results to support her students learning. Especially, when the results of her assessment showed that her students did not understand the concepts as she aimed, she had frustrations for how she can adjust her instruction to help her students. When we asked Sophia about what she was going to do after seeing her students did not comprehend related concepts besides of reviewing or re-teaching the concepts with the same way she used, she conceived she needed to change her instruction but as an alternatively certified novice teacher did not know how. She explained, "I mean its differentiated teaching which is very difficult for me because my knowledge is not great yet. I still have to remind myself of everything because I don't remember from college. So, it's very difficult to do the differentiated teaching". As seen from her statement, she thought that as an alternatively certificated teacher, who changed her career more than ten years after her graduation from college, it was difficult for her to remember the details of the content knowledge she was teaching. Thus, during the reflective interview after our observation of her instruction Sophia explained, even if not faced with difficulties in grading and producing assessments, she struggled with adjusting her instruction to support her students' learning of chemistry. She stated:

> I struggled a lot with assessments but that's not terribly burdensome for me to grade and produce. I feel more challenged with the instruction, like especially, if I do an assessment and I get the results back and I'm like they didn't learn this. Then, now I got to go re-teach it but I don't want to do the exact same thing over because that doesn't do anything good to do the same thing over. So, it is difficult for me to differentiate teaching to help my students.

In summary, Figure 3 illustrated the purposes, strategies, constructs and interpretations and uses of assessment results she practiced during her instruction of both content units. However, the listed practices in Figure 3 did not fully support and reflect her theoretical understanding of assessment because: a) her assessments focused on low level learning as opposed to higher level conceptual learning, b) her lack of teaching experience limited her to elicit and address common misconceptions and use assessment results to provide descriptive formative feedback and adjust/change instruction to scaffold students' learning, and c) her reliance on the textbook guided her to use certain types of assessments.

Discussion and Conclusion

The study aimed to investigate an alternatively certified new high school chemistry teacher's assessment literacy in theoretical and practical realms. The results showed that in theory Sophia, as a new teacher, holds a constructivist view of learning while her teaching practices mostly aligned with traditional knowledge-transmission view of learning. The results also showed that, in theory, Sophia valued assessment as a way to assess and aid student conceptual learning, motivation, and metacognition and illustrated a broader knowledge of assessment including knowledge of assessment purposes, strategies, objectives and ways to use assessment results to support and grade student learning (see Figure 2). Yet, in the practical realm, because of some limiting factors, Sophia demonstrated varying degrees of sophistication of assessment literacy during her teaching of the atomic structure and electron configuration (see Figure 3) and she did not successfully transfer her understanding of assessment into classroom practices as she preferred.

While the study just focuses on one alternatively certified high school teacher during her first year of teaching chemistry, we believe that the richness of data sources we collected and used for triangulation allowed us to draw conclusions that may have implications for a range of teachers including traditional and alternatively certified preservice, novice and practicing teachers. However, our purpose is not to generalize our conclusions to other teachers in different disciplines, countries and stages of their careers. We hope to inform teacher educators to understand the difficulties an alternatively certified novice teacher faces and find ways to support preservice and novice teachers in transferring their theoretical assessment literacy into classroom practices. In this way, we think the study provides insights to researchers about the complexity of how alternatively certified new teachers make assessment related decisions and understand the difficulties of implementing formative assessment.

Effective assessment practices in science require teachers to provide a constructivist, student-centered learning environment and for specific to assessment, know how to elicit student' ideas, use content knowledge to interpret elicited ideas and provide content specific and informative feedback and revisions to meet students' needs (Gottheiner & Siegel, 2012; Gotwals & Birmingham, 2016; Harshman & Yezierski, 2017; Kang, Thompson & Windschitl, 2014; Vogelzang & Admiral, 2017). A teacher's constructivist view of learning and her knowledge and motivation to put this view into practice are important for the achievement of providing a learner-centered instruction and formative assessment (Box et al., 2015; Chen & Wei, 2015; Fletcher & Shaw, 2012). However, as Box et al. (2015) stated, a constructivist view of learning does not assure providing a learner-centered learning environment because a teacher's lack of appropriate theoretical or strategic knowledge and other constrains may retain her putting this view into practice. Supporting this, the results of the study showed that because of some limitations including lack of teaching experience in chemistry, discipline specific teaching strategies, and reliance on the textbook to guide instructional and assessment decisions, the teacher's beliefs about constructivist view of learning were not reflected in her classroom practices and failure of this shaped and influenced her assessment practices. These findings are consistent with what Box et al. (2015) and Lyon (2011) found as the novice teachers in their studies also failed to transfer their beliefs of constructivist learning into classroom practices because of lack of theoretical and strategic knowledge and other constraints such as time and teaching experience.

Eliciting a range of students' ideas creates a rich evidence base for teachers to shape their instruction and is a crucial component of formative assessment. More open-ended, authentic and productive tasks can elicit and assess high level learning, including scientific thinking, reasoning, and practices, while traditional paper-pencil tests are not capable of assessing higher level conceptual learning (Kang & Anderson, 2015; Sach, 2015; Xu & Brown, 2016). Type of questions used in assessment also influence the richness of elicited evidence on student learning and asking open-ended including "why, how or what do you think?" type questions can provoke students to share their diverse ideas (Kang & Anderson, 2015). However, besides how to elicit students ideas, what is elicited is also crucial since it is used as base for instruction. Thus, researchers highlight just using general strategies to elicit student ideas will be useless unless providing higher cognitive demanding questions that require students to make connections between different concepts and representations to reflect disciplinary core practices, conceptual understanding and reasoning (Coffey et al. 2011). The results of the study showed that the alternatively certified novice teacher's elicitation of her student learning was limited as she mostly used close-ended assessment from her textbook including multiple choice, fill-in-the-blank and short answer questions that limited her to see a rich set of students' ideas to base her instruction. Besides, her assessment items mostly focused on low level learning including recall of information and factual knowledge rather than making students to compare different concepts, reasoning about them and provide their explanations. Similar to other studies (Box et al., 2015; Lyon, 2011) we also found that teaching experience is important for using

productive assessments and even if the alternatively certified novice teacher in the study knew different productive assessment strategies, she preferred to rely on textbook and used unproductive assessments in her classroom. Similarly, other researchers also indicated that less field teaching experience and lack of educational background of alternatively certified teachers cause issues in instructional practices including assessment practices and impact their students' learning outcomes (Shuls & Trivitt, 2015; Whitford, Zhang & Katsiyannis, 2018). Furthermore, high stake testing, time requirement and lack of colleagues' support also were reported by Sophia as influencing her assessment decisions.

Another important responsibility of teachers is to interpret assessment results in a way to make informed instructional decisions. To support conceptual learning, teachers need to analyze students' responses in a way to see how the responses align with learning goals and where students are at their learning progress (Gottheiner & Siegel, 2012; Harshman & Yezierski, 2017; Pellegrino, 2014). Interpreting students' responses as right or wrong rather than focusing on where the students are at their learning process, where they are struggling and what are the details of their thinking with respect to a particular content is not practical for letting teachers to provide effective feedback and revisions to meet students' needs (Barnhart & Es, 2015; Gotwals & Birmingham, 2015; Harshman & Yezierski, 2017). Thus, focusing on the details and nature of students' thinking regarding to particular concepts such subatomic particles is cornerstone of more sophisticated interpretation of assessment results. The results of the study displayed that the most challenging point Sophia faced was acting on assessment results. She routinely had students work in groups to see and correct their mistakes. Her struggle of using assessment results to modify her instruction was obvious because of her lack of teaching and assessment experience that may result from the alternative teaching program she attended. For instance, after an assessment she carried out to see her students' understanding of electromagnets, she explained, "Those written questions showed that they did not quite have it yet and I have to review and give some examples…So, I am going to try other ways for them to learn the information." However, she did not elaborate what other ways she was going to support her student learning because she mostly expressed her struggle to differentiate instruction for her students' learning of chemistry. As researches indicate, it is more difficult for alternatively certified teachers since they rarely take courses related to pedagogy that can help them to decide how to differentiate teaching to address students' needs (Redding & Smith, 2016). However, based on the results of the study, it is difficult to claim that the reason for the struggles Sophia faced were due to being a new teacher or an alternatively certified teacher. Thus, this is a limitation of the study and further studies can use different research designs to elicit whether the reasons for the difficulty in transforming assessment literacy into practice are due to being new teachers or alternatively certified teachers or both.

Recommendations

Science educators have made great progress to support teachers' theoretical assessment literacy including their understanding and knowledge of assessment to make teachers aware of the role of assessment in supporting learning. However, supporting teachers' practical assessment literacies is a complex but important task because improvement in science learning depends on how teachers use assessment to assess and aid their student learning. Because of internally constructed and externally imposed factors, it is difficult for many teachers to formatively practice assessment to support learning and can be even more challenging for preservice and novice teachers. The current study is unique to investigate in depth a new alternatively certified chemistry teacher's assessment literacy by focusing on both her understanding and practices of assessment. The study has implications for both teachers and teacher educators who prepare teachers through different programs including such program that the new teacher in this study certified to teach or other similar programs that just require teacher candidates to take some tests rather than taking courses related to pedagogy.

Providing learner-centered quality instruction requires teachers to use a range of pedagogical strategies to make their students to construct their own learning (Lewis & Lu, 2017; Nixon et al., 2017). However, many alternatively certified teachers come from a different disciplinary background or they changed their career after working in a different field for a long time. This presents both advantages and disadvantages for alternatively certified teachers. Because of their lack of teaching experience and content, they rely more on textbooks and stick with textbook-driven instruction as the results of the study showed. Therefore, it is important for teacher preparation programs to require teacher candidates to take courses in order to have sufficient content knowledge, teaching experience and discipline-specific pedagogical strategies in the discipline they will be teaching. Or the teacher preparation programs that just certify teachers through tests should provide different opportunities such as professional development programs for novice and inservice teachers to close the gap.

Science teachers need to know how to elicit students' ideas including conceptual learning and scientific reasoning by using different common and discipline-specific assessment tasks since basing instruction on students' ideas is a critical component of quality instruction. However, the results of the study illustrated that it was difficult for the alternatively certified novice teacher to use appropriate open-ended and discipline-specific assessment tasks to elicit her students' deep learning rather than using traditional close-ended assessments. Thus teacher education programs need to provide opportunities for preservice teachers in both alternative certification and traditional education programs to learn a range of general and discipline-specific assessments and how to use them to elicit and assess their students' learning of science. It requires providing discipline-specific science method courses rather than providing general science method courses for all teachers teaching high school sciences. Plus, discipline-specific professional development programs need be available for novice and inservice teachers to provide knowledge and practices of discipline-specific assessment tasks and practices.

Interpretation of students' responses as right or wrong and relying on the scores they received rather than focusing on details and nature of students' thinking related to a particular learning goal limit teachers' use of assessment results but it is common among teachers (Harshman & Yezierski, 2015; Otero, 2006). Thus, preservice and inservice teachers should be informed about the potential of students' responses in supporting learning and instruction and also need to know how to and what to focus on students' responses which require sufficient teaching experience, which some alternative certification programs not require, to see the nature, potentials and struggles of students' thinking that their responses showed.

Use of assessment results to provide informative feedback and revisions to meet students' needs is another important component of formative assessment and determines the impact of assessment on student learning However, as the results of the study showed, it is not an easy task for teachers and teachers mostly faced difficulties in this component of formative assessment. Teachers should be informed about the influence of feedback on student learning and educated about the types of feedback and how the use them to help their students. Substantial, constructive and focused feedback is more effective than answer oriented, wordy and unfocused feedback in supporting learning. Thus use of these types of feedback during both alternative certification and traditional teacher education programs can be practical ways to support teachers` understanding and use of such feedbacks. Furthermore, changing instruction and assessment in a way to meet students' needs is also important but hard for novice teachers and alternatively certified teachers. So teachers should be equipped with a range of discipline-specific pedagogical strategies to differentiate their instruction to aid learning. The results of the study showed that because of her lack of teaching experience in chemistry, it was difficult for Sophia to change her instruction instead of re-teaching the concept in the same way. Thus, teachers need help in developing their repertoire of discipline-specific instructional strategies to address their students' difficulties and find ways to help them overcome. One way could be changing the requirements of teacher certificate to require teacher candidates to have both general and subject-specific science method classes related to the subject they will be teaching to gain a larger set of general and discipline-specific instructional strategies.

Acknowledgements or Notes

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Author Information

Kemal Izci
Necmettin Erbakan University
Eregli College of Education, Eregli-Konya, Turkey
Contact e-mail: *kemalizci@gmail.com*

Marcelle A. Siegel
University of Missouri-Columbia
College of Education, Columbia. MO, USA