The Teaching and Learning Nexus in Secondary School Chemistry Classes in Samoa

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Abstract

This paper reports on subsequent explorations of the findings of a recent study, which investigated the teaching and learning nexus in secondary schools' chemistry classes in Samoa. In particular, the report explores barriers and support factors that affect achievements in Year 12 chemistry. The exploration utilises classroom observations, archival records, work samples and semi-structured interviews, in order to investigate both students and teachers' perceptions of barriers and successes to the students' achievements. The aim of the paper is to stimulate educators and policy makers to become aware of the relatively large number of factors, which contribute to students' achievement in Year 12 chemistry in Samoa secondary school classrooms. The research also aimed to support the Samoa Development Strategy 2016/17—2019/20 (SDS), in relation to improving access to and quality of education. The examination of the data suggests that barriers include teaching and learning expectations, motivating factors, classroom teaching practices, and learning styles.
Keywords: Science Education, Teaching Chemistry, Contextual learning, Learning expectations

Introduction

Low achievement by Samoan students in science and maths has become a national concern. Having spent a number of years teaching secondary school chemistry in Samoa, the researcher realised that many Year 12 chemistry students find learning chemistry to be problematic and they struggle with applying the principles of chemistry to everyday situations. Some students fail to recognise any relationship between the chemistry taught in class and their surroundings and therefore, they do not perceive any value or relevance in studying chemistry —other than to pass exams. In Samoa, students' achievement level in chemistry is a concern. In addition, there has been a decrease in the number of students opting for science or chemistry at the higher levels. As a result the following questions can be asked: *What is going on in the classroom? Why, after so many years of teaching the same curriculum, students' learning of chemistry is still problematic?* These are two of the questions that guided this research paper.

This paper reports subsequent explorations of the findings from a recent research investigation that was conducted in Samoa secondary schools. The investigation was conducted in three government co-educational secondary schools; one located in a rural area and two located in the urban regions of Upolu, which is the most populated island of Samoa. Each of the three schools provided a case study of the schools' chemistry classroom. In each case, five chemistry students and one chemistry teacher were invited to participate. The teaching and learning of one of the units in the organic chemistry strand (on hydrocarbons) was investigated. The central aim of the investigation was to understand the teaching and learning processes found in Year 12 chemistry classrooms. The primary focus was to explore the nature of factors that contribute to achievements — including both barriers and support.

This paper is divided into three sections. The first section offers a brief outline of the background to the research investigation. It discusses a brief description of how the Samoa Development

Strategy 2016/17—2019/20 (SDS), in relation to education, is focused on improving the quality of life for all Samoans, thus ensuring that sustainable and societal progress is reflected in classroom interactions and achievements at secondary school levels. Subsequently, there is a brief description of the methods used for the data collection. The following section begins with an outline of the three themes, which are supported by the relevant literature. The final section is a summary of this presentation and several future directions for this project are suggested.

The Research

Background to the study

Education is central to the future well-being of Samoa. It teaches young people the virtue of reason and it plays a large role in maintaining and developing the cultural fabric of society. Education develops in students the skills and attitudes needed to succeed in an ever-changing world. Today, that role is expanding since education will not only continue to shape the nation's cultural future: it is also central to the nation's economic and social well-being.

Internationally, over a time span of more than 30 years, students have studied basic chemistry as part of their science curricula (Taber, 1995; 2015). However, despite the regular teaching and re-teaching of these concepts and the use of projects and external assistance, research on students in New Zealand and Samoa has shown that more than fifty percent of students, in their final year (Year 13) at high school, maintained misconceptions (Suaalii, 2007; 2013), which led to a constant rating of 'low level of achievement' (Government of Samoa, 2007, p. 147). To explain this phenomenon an in-depth understanding of the nature of the classroom interactions and experiences of both teachers and students (St. George & Bourke, 2008) is needed?.

A literature review shows that there has been a real concern about the conceptual understanding of chemistry in secondary school students (Johnstone, 2000; Taber & Coll, 2002; Suaalii, 2013). The findings from these researchers show that more authentic and meaningful learning takes place, when the learning is contextual and made more relevant to the students' own life (Bhattacharya, 2004; Suaalii, 2013). A study by Bhattacharya and Richards (2000) suggests that teachers need to become reflective thinkers and compliant with various effective teaching and learning tools, in order to engage students within collaborative and interactive learning environments. These strategies can improve the quality of students' learning, thus making their learning contextual, which will then result in an improvement in their academic achievement. However, the teaching and learning of chemistry in classrooms today appears to focus mainly on helping students to pass exams.

Development of Samoa's Education System

Over the past 20 years Samoa's education system has been reformed; changing from a selective system in which only the highest achieving students progressed beyond Year 10 to an open system in which 13 years of education are provided by all Samoa's government secondary colleges. The Samoa Development Strategy (SDS) 2016/17—2019/20, in relation to education, is an integral part of the government's overall economic strategy, with its focus on "improving the quality of life for all Samoans and boosting productivity for sustainable development" (Ministry of Finance Economic Policy and Planning Division, 2016, p. 17). Thus, the Samoan government has acknowledged the vital role of education in achieving its vision (Government of Samoa, 2006). New school improvement

programmes have been developed to reinforce the four goals of Samoa education, which encourage (i) the development of comprehensive and enriching curricula; (ii) the development of active, interactive and creative pedagogies; (iii) the development of impartial evaluation and assessment methods; and (iv) support for individuals and society, through a humane education system (Dr. Taufe'ulungaki & Nako, 2005; Western Samoa, 1995).

The four goals were, in turn, addressed through four key principles: (i) *equity,* which requires the fair treatment of all individuals, in the provision of educational opportunities; (ii) *relevancy,* which is defined through a system which is meaningful, recognisable, applicable and useful; (iii) *efficiency*, which is demonstrated through management practices that ensure optimum use of resources, efficient services delivery, effective communication and co-ordinated decision-making; and (iv) *quality* (Government of Samoa, 2006, 2018; Ministry of Finance Economic Policy and Planning Division, 2008). Quality refers to the demonstration of high standards of academic achievement, with results coming from a complex interplay of professional and technical factors and social and cultural practices (Government of Samoa, 2006, 2018; Thaman, 1988, 2001). Students' achievement refers to the level of intellectual growth which a student has attained whilst being involved in the learning process.

Despite these praiseworthy national objectives, the review of the accomplishments of the first 10 years of educational policies and strategic plans (1995-2005), by the Pacific Regional Initiative for the Delivery of Basic Education (PRIDE), identified many deficiencies in the area of educational quality (Government of Samoa, 2000). These included a relatively high student 'dropout' (Government of Samoa, 2006) and 'repeaters' in Year 8 (Government of Samoa, 2000). There was also a high demand for comprehensive teacher development (McMurray, 2006) and the implementation of a quality improvement programme (Government of Samoa, 1995, 2000, 2006, 2018). Students' achievement in science subjects and mathematics has continued to be a concern for a number of years (Government of Samoa, 2000, 2006), at both primary and secondary school levels. In 2007, the GOS urged MESC to "find the cause(s) of students' low achievement levels" (Government of Samoa, 2007, p. 21).

Recent reforms to the secondary school system in Samoa included an implementation of a four (4) year level (Years 9, 10, 11, 12) instead of 5 as in the past 20 years (Ministry of Education, Sports and Culture, 2021).The expectation from such development was mainly to reduce the "growing rate of early school leavers" (Ministry of Education, Sports and Culture, 2021, pg. 1) as well as improving learning pathways. Basically, the students will be streamed into four (4) learning pathways including Commerce, Arts, Technical and Vocational Education and Training (TVET) and, Science based on their strengths and interests (Ministry of Education, Sports and Culture, 2021).

Methods used in the study

The data collection techniques included archival records and work samples from student participants, classroom observations and semi-structured interviews, for all participants. Fifteen Year 12 chemistry students and three chemistry teachers participated in this study. The sequence of data collection in Table 1 below indicates that the first three methods were overlapping: this ensured the completion of data collection before the semi-structured interviews were conducted. This also ensured that the information gained from the first three methods was collected and further explored in the semi-structured interviews, which were flexible in nature.

Table 1: Sequence and duration of data collection

Method of data collection	***Sequence and duration of events***									
	Week	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
Collecting archival records										
Classroom observation										
Collecting work samples										
Semi-structured interviews										

Findings and the Literature

The examination of the data suggests that the most important factors are (i) teaching and learning expectations, (ii) motivating factors and classroom practice, and (iii) teaching and learning styles. These three findings are discussed in detail below in relation to literature on the issues identified.

Finding 1: Teaching and Learning Expectations

Some of the student participants were not reaching their potential because their teachers' expectations were low, which led to difficulties in understanding scientific concepts. The students were unable to perceive any connection between scientific concepts and the usefulness of what was being taught in the classroom. The teachers' expectations of their students' achievement were often based on beliefs about the students' ability (Zheng, 2016). For instance, teachers felt 'insecure' about students who had scored very low in previous unit tests: and they believed that they would not be able to cope with the school certificate examination at the end of the year.

Classroom observations confirmed that these students appeared to remain quiet during discussions and only became active when copying notes from the board. Passive and rote learning was evident amongst these students in these classes, despite the fact that the teachers continued to provide explanations and relevant procedures, to help them answer examination questions. Some of the student participants in this study, however, were very confident and they felt that the teaching of chemistry was fair, appropriate and challenging, as they prepared for their school certificate examination. These particular students, whose interest had been captured, participated and posed questions during class discussions and they were often given opportunities to respond.

What the Literature says about Teaching and Learning Expectations

This finding has been widely studied by educationalists. Teacher expectations are seen as a significant determinant of students' achievement (Crawford, 2007; McKinley, 2007; Zheng, 2016). In addition, Koballa and Glyn (2007) confirmed that teachers' expectations can influence students' performance in science and other areas. The significance between teacher expectations and student achievement is viewed as both a reason and a solution to the achievement gap (Darling-Hammond, 2000; Gay, 2000). Teacher expectations reflect teacher beliefs and together this influences what the teacher attempts to elicit from the students — and what the students expect of themselves (Brophy, 2000; Gay, 2000; Zheng, 2016).

Science teachers' expectations of students (and the strategies they use that are based on these expectations) play an important role in increasing or reducing students' motivation to learn (Bircan, & Sungur, 2016). Researchers have found that teachers, who have high expectations of students, give cues and prompts that communicate to them their belief that the students can perform well (Good & Brophy, 2003; Rob, 2003; Rubie-Davies, 2006; Zheng, 2016). Furthermore, teachers who have high expectations of students are less likely to accept poor answers from them (Koballa & Glynn, 2007; Zheng, 2016). In addition, students who are perceived by their teachers to be high-ability learners more frequently receive positive non-verbal feedback from teachers, such as smiling and eye contact (Vishnumolakala, Southam, Treagust, Mocerino, & Qureshi, 2017).

Good and Brophy (2003, 2008 suggested that teachers with low expectations of students are more likely to provide them with inconsistent feedback, sometimes praising inadequate answers, sometimes criticising them and sometime ignoring them. In many cases, those students who are believed to be low-ability learners are asked fewer and less challenging questions: they also receive less feedback and they have less time to respond and less praise. Across a set of studies, Seiler, Tobin and Sokolic (2001, 2003) and Tobin, Seiler and Walls (1999) outlined how normal practices of schooling, such as tracking, teaching to the test, rote learning, drill-and-practice activities and curricula (geared towards minimal achievement) led to a culture of low expectations in science for students. Students exposed to these low expectations were complicit in reproducing the culture of low expectations by engaging in multiple forms of resistance to high expectations of their learning from their teacher, such as skipping class and other behaviours, even when the science instruction was being led by a competent, experienced and caring teacher (Griffard & Wandersee, 1999).

Students are sensitive to teachers' beliefs about them. In cultures where low achievement is attributed to low ability (and ability is believed to be unalterable), low-ability students often come to believe that their performance will not change, regardless of their level of effort (Cruickshank, Jenkins, & Metcalf, 2006). In cultures where the students' level of work and effort is considered to be directly related to their learning, high expectations for all students lead to higher achievement, through more work and effort by students of all abilities (Carin, Bass, & Contant, 2005). This however, requires science teachers to be more effective and to use strategies to set and maintain high expectations. Staver (2007, p. 19) discussed some of these strategies:

- monitoring and analysing students' work and taking corrective individual and group action as needed;
- helping students believe in their ability to learn effectively and raising their awareness of positive outcomes as a result;
- helping students to view themselves as capable learners;
- building learners' confidence by breaking difficult tasks into smaller steps that can be viewed as more manageable and achievable;
- providing assistance but not doing the tasks for the students;
- giving learners a reasonable level of control over their learning ;
- helping learners become aware that their own efforts, strategies and persistence, are important to their successful learning; and
- helping learners to experience the satisfaction of successful learning.

Finding 2: Motivating Factors and Classroom Practice

A lack of motivation to engage with the subject was observed. Some students seemed naturally enthusiastic about learning, but many appeared to need (or expect) their instructors to inspire, challenge, and stimulate them. As Ericksen, (1978, p. 3) pointed out: "Effective learning in the classroom depends on the teacher's ability ... to maintain the interest that brought students to the course in the first place". The challenge is to develop motivation among students because whatever level of motivation students bring to the classroom, may be transformed — for better or worse — by what happens in that classroom. As Bircan, & Sungur (2016) found, motivation is one of the most important impulsive power sources, which gives some guidance to the behaviour of students in determining behaviours and strengths and stability in learning.

Although Samoan students behave in a manner that is culturally respectful within the classroom, there was no indication that learning was associated with such behaviour. In this study, it was determined that this impulsive power source was deficient in all three cases. In each case the teacher gave instructions for almost everything the students have to do in class. For instance, when the students had completed their copying of notes, the teacher would then ask them to work on an activity/task. This was often followed by more instructions from the teachers on what activity they could do in class or at home. The students, in these case studies, said they thought it was best to wait for instructions, because they often get scolded by the teacher if they do things on their own. Although I did not see students being scolded during the investigation, the teacher did constantly gave instruction after instruction, which appeared to be a traditional practice in these classrooms.

Unfortunately, there is no single magical formula for motivating students. Many factors affect a given student's motivation to work and to learn (Sass, 1989) including interest in the subject matter; a perception of its usefulness; a general desire to achieve; self-confidence and self-esteem; and patience and persistence. In addition, of course, not all students are motivated by the same values, needs, desires, or wants. Some of students will be motivated by the approval of others and some by overcoming challenges.

What the Literature says about Motivating Factors and Classroom Practice

Teacher motivation is an equally important factor. Teachers do make a difference to the motivation of students in relation to learning. Teachers can make school life miserable for their students or alternatively, they can make it appealing, by filling their classroom with excitement and hope. In the latter situation, students will be interested in learning and search for even more knowledge, under the guidance of enthusiastic teachers (Wlodkowski & Jaynes, 1990). Such teachers care about what they teach and they communicate this to their students, so that the students understand that the knowledge they are gaining is important for further studies and job applications. These students are motivated to learn, since they keep in close touch with their teachers, in relation to topics discussed in the classroom.

Students' perceptions of the importance of achieving science competence are related to students' motivation to learn and to their future aspirations: and ultimately their achievement in science subjects (Bircan & Sungur, 2016). For instance, Lau and Roeser (2002) found that, although cognitive ability was the strongest predictor of high school students' performance in science achievement tests, students' perceptions about the value of science competence was a significant predictor of engagement, achievement and future aspirations (Bircan & Sungur, 2016). Specifically,

this factor predicted students' test and classroom engagement and achievement, as measured by science tests and classroom grades and students' anticipated pursuit of science-related college majors and careers.

Given that a student's future academic and career aspirations influenced their motivation, and achievement, it is important for science educators to develop a more complete understanding of student beliefs and perceptions. For instance, most children begin school with a positive attitude: they are enthusiastic about learning and participating in classroom activities. They are optimistic about their abilities and they anticipate success and view their expanding efforts and practice as the key to overcoming difficulties (Freedman-Doan, et al., 2000). Such attitudes and beliefs are integral to their classroom achievement and are associated with subsequent motivation, concurrent and future achievement and decisions to continue learning particular subjects (Marsh & Craven, 2006). When students lose self-belief it affects their motivation Peer-groups may also influence the learning motivation amongst students. A student with a close group of classmates, who like to study, will eventually join in the class discussions. On the other hand, a student whose closest friends often 'skip 'classes are likely to feel peer group pressure to behave the same way. Students who feel 'cool and smart' by hanging out with their peer group, rather than following the advice of their elders, are often the victims of others with a closed mind set.

Finding 3: Teaching and Learning Styles found in the Classrooms

The case studies found that the different learning styles of the chemistry students were not acknowledged by their teachers. It was obvious that the teaching and learning styles used within the classrooms appeared to be contradicting with the students' preferred learning styles. In all of the lessons observed, lecturing style of teaching was used by all teachers. The teachers showed great confidence in the ways they presented the lessons while the students sat quietly and stared at the front of the classroom. Basically, the teachers began the chemistry lessons by standing in front of the classroom and verbally presented explanations and demonstrations of the focus of the lessons using diagrams and models of scientific concepts, whilst the students sat and listened. Sometimes the lessons began with students copying notes into their note books from either hand-outs or textbooks before any further teaching was offered. When asked about these kinds of teaching and learning styles, the students claimed that they did not acquire much meaning from those lessons but rather tiring of copying huge amount of notes as well as feeling sleepy as the teachers talked for so long. The teaching and learning styles reflected teacher-centered approach which emphasised the teachers' ways of doing things in the classroom rather than the students. However, these students expected chemistry lessons to be more practical oriented where they get to touch, observe and actively discuss scientific ideas.

Discussions with the teacher participants focused on their teaching and learning styles as well as their understanding of the students' learning experience. The teachers acknowledged the importance of students' activities, experiments and group tasks; however they were more concerned with the limited time they had to complete the syllabus before the national examinations. Basically, the teachers' priority was to ensure full coverage of the chemistry curriculum through the use of lecturing style of teaching, which they referred to as the simplest and quickest method. In this sense, it appeared that the teachers' selection of this teaching and learning style was basically to ensure that the scientific ideas were presented to the students to regurgitate for exams.

Although there seemed to be a conflict in terms of styles of teaching (by teacher) and learning (students), the case studies revealed that the dominant culture within these chemistry classrooms was that of the teacher. Such culture promoted passive learning (students), lectured style of delivery (teacher) and the continuous exploitation of teacher-centred approach (classroom practice).

What the Literature Says About Teaching and Learning Styles

Research findings have shown that learning styles differ significantly and therefore in the academic achievement of students. Samoan students, in particular, also have different learning styles and their approaches to learning are often a reflection of their family's influence. For example, Anae's study of Samoan students in New Zealand (1998, 2010) noted that some Samoan families encouraged cultural practices in which a child or teenager was given information to be learned and remembered, not questioned or discussed. This approach taught Samoan students to learn as individuals and therefore, they chose not to partake in group tasks and activities which required discussion. This finding shows that educators need to be aware that Samoan children may need time, effort and special encouragement to learn the more student-centred methods that result in deeper understandings.

Students' learning style preferences refer to the ways in which they respond to learning stimuli and to their characteristic ways of acquiring and using information (Sloan, Daabe, & Giesen, 2002). Learning styles recognise not only that individuals learn in different ways, but also that individual characteristics (such as personality) influence learning (Dunn & Dunn, 1991; Harris, & Smith, 2017). It is argued that students' learning styles differ (Entwistle, 1987, 2000; Richardson, 1990; Harris, & Smith, 2017). This recognition is in line with constructivist notions of learning (Bodner, 1986), which recognise that factors, such as learning styles and prior knowledge may (for example) influence judgements on the importance of information presented and it may also influence the interpretation given to that information (Bailey & Garrat, 2002; Kelly & Sezen, 2010). Furthermore, constructivists believe "that meaningful learning is a cognitive process in which individuals make sense of the world in relation to the knowledge which they already have constructed, and this sense-making process involves active negotiation and consensus building" (Fraser, 1998, p. 13). In addition, it is sometimes claimed that knowledge of learning styles and the use of educational resources (Kelly & Sezen, 2010), which are relevant to learning styles, will lead to efficient learning (Gadzella, Stephens, & Baloglu, 2002) and an increase in the motivation to learn (Moore, Grabsch, & Rotter, 2010; Nolen, 2003; Stipek, 1998; Bircan & Sungur, 2016).

Irrespective of a student's learning style, the teacher has a significant influence on the student's learning experience (Ministry of Education Sports and Culture, 2006). It is a fact that teachers are most helpful when they help their students to learn in a way that suits the student's style preference (Allen, 2002; Dunn & Dunn, 1991). However, the question is whether adapting a teaching style to the learning style of each student will result in improved academic achievement in chemistry or science? A large amount of research has been focused on the effect of matching and mismatching teaching and learning styles (Mugler & Landbeck, 1997; Uzuntiryaki, 2007; Harris, & Smith, 2017). Different approaches have been suggested, including matching instructional methods (Suaalii & Bhattacharya, 2007), media and assessment to learner preferences and tendencies; mismatching styles in order for the learner to develop a broader approach to learning (Sadler-Smith & Riding, 1999); providing the initial contact with the material in the learner's preferred mode and then moving to broader

exposure with subsequent material (Reinert, 1976); or teaching to all styles (Felder, 1991; Felder & Brent, 1999).

There is still a general lack of creativity in teaching approaches in Samoan schools, despite a significant number of professional development programmes, which have been conducted over the years. In addition, the Samoan Curriculum recognises that, for students to succeed, curriculum experiences must relate to student interests, needs and learning styles, in order to engage students in their learning (Ministry of Education Sports and Culture, 2006). More group activities are needed, which allow students to personally experience scientific ideas within a wide variety of contexts. Students need to be encouraged to share ideas openly with one another. In this way, students will engage in a variety of strategies and learning styles.

However, most teachers still dominate the teaching and learning process and, as a result, the students' various learning styles are not well catered for within education services in general, or science classrooms in particular (Government of Samoa, 2006). This finding is consistent with other research on effective teaching, which suggests that effective teachers adjust their teaching to fit the needs of different students and the demands of different instructional goals, topics and methods (Darling-Hammond, 1999).

Summary

This study of science teaching has provided some useful information on the teaching and learning of chemistry in Samoa secondary schools. It demonstrates the foundations for some of the factors (particularly within the classroom) that affect students' learning of chemistry in Samoa. The discussion of findings in this paper demonstrates that, above and beyond the differences in student characteristics, students' achievements in chemistry and science were positively linked with the support of their teachers.

It demonstrated that teachers must embrace the evidence that effective teaching means constantly being aware of, and attending to, their students' struggles to learn chemistry. Teachers need to continually adjust their teaching strategies and techniques, in order to help their students work through any difficulties. In doing so, teachers should set high learning expectations and focus on core scientific ideas. In addition they should aim for a deep, integrated understanding of scientific inquiry and the core body of scientific knowledge. In order to help students reach their teachers' aims and expectations, the teachers must understand how learners actively construct new knowledge, in addition to an understanding of the complexity of the learning process, the importance of the students' interests and the student's potential anxieties and conflicts in relation to science concepts

The barriers and kinds of support needed to teach chemistry were identified in this study, that emphasise the need to look into the factors which cause these barriers across various secondary schools in Samoa. Although the Government of Samoa has put so much emphasis and funds towards the improvement of education in Samoa, there is evidence for an on-going concern about low achievements and high school drop-outs. Three case study classrooms in Samoa suggests that that notes can be handed out for students to study and revise, while classroom time could be more effectively used in teaching practices that engage students. There is a need to refocus efforts away from rote learning towards engagement with and demonstration of principles of chemistry, as well as other subjects in science and mathematics.

References

Allen, R. H. (2002). Impact Teaching: Ideas and Strategies for Teachers to Maximize Student Learning. Boston: Allyn and Bacon.

Anae, M. (1998). Fofo i Vaoese: Identity Journey of New Zealand-born Samoans. Auckland: The University of Auckland.

Anae, M. (2010). Research for better Pacific schooling in New Zealand: Teu le va – a Samoan perspective. Auckland:The University of Auckland.

Bailey, P. D., and Garrat, J. (2002). Chemical Education: Theory and practice. University chemistry Education, 6, 39-57.

Bhattacharya, M. (2004). Creating a computer-based constructivist learning environment. Computers in New Zealand Schools, 16(2), 51 -54.

Bhattacharya, M.,and Richards, C. (2000). Why all Teachers should be PBL "Action Researchers" in the Internet Age.Second Asia-Pacific Conference on Problem Based Learning, Singapore, December 2000.

Bircan, H., and Sungur, S. (2016). The Role of Motivation and Cognitive Engagement in Science Achievement. Science Education International, 27 (4) 509-529

Bodner, G. M. (1986). Constructivism: A Theory of Knowledge. Journal of Chemical Education, 63, 873-878.

Brophy, J. (2000). Dispelling the myth: Teaching educational practices, series 1. Washington, DC: International Bureau of Education.

Carin, A. A., Bass, J. E., and Contant, T. L. (2005). Teaching science as inquiry. Upper Saddle River, NJ: Pearson Merrill Prentice Hall.

Crawford, B. A. (2007). Learning to teach science as inquiry in the rough and tumble of practice. Journal of Research in Science Teaching, 44(4), 613-642.

Cruickshank, D. R., Jenkins, D. B., and Metcalf, K. K. (2006). The act of teaching (4th ed.). New York: McGraw-Hill.

Darling-Hammond, L. (1999). Teacher quality and student achievement: A review of State policy evidence. Retrieved from http://www.politicalscience.uncc.edu/godwink/PPOL8687/WK11March%2029%20Teachers/Darling-Hammond%20Review%20essay%20on%20teacher%20quality%20and%20outcomes.pdf

Darling-Hammond, L. (2000). Teacher quality and student achievement: A review of state policy evidence. Education Policy Analysis Archives, 8(1).

Darling-Hammond, L. (2017). Education for Sale? Nation, 304(10), 16–20.

Darling-Hammond, L. (2016). Research on Teaching and Teacher Education and Its Influences on Policy and Practice. Educational Researcher, 45(2), 83–91.

Dr. Taufe'ulungaki, A. M., and Nako, A. (2005). Government of Samoa Education Sector Evaluation Study/PRIDE Project. Apia: Ministry of Education, Sports and Culture.

Dunn, R., and Dunn, K. (1991). Teaching students through their individual learning styles: A practical approach. Virginia, USA: Reston Publishing.

Entwistle, N. (1987). A model for the teaching-learning process. In T. E. Richardson, M. W. Eysenck & D. W. Piper (Eds.), Student Learning: Research in Education and Cognitive Psychology (pp. 13-28). England: Open University Press.

Entwistle, N. (2000, November). Promoting deep learning through teaching and assessment: Conceptual frameworks and educational contexts. Paper presented at the TLRP Conference, Leicester.

Ericksen, S. C. (1978). The lecture. Ann Arbor: Center for Research on Teaching and Learning, University of Michigan.

Felder, M. R. (1991). It goes without saying. Chemical Engineering Education, 25(3), 132-133.

Felder, M. R., and Brent, R. (1999). How to improve teaching quality. Quality Management Journal, 6(2), 9-21.

Fraser, B. J. (1998). Classroom Environment Instruments: Development, Validity and Applications. Learning Environments Research, 1(1), 7-34.

Freedman-Doan, C., Wigfield, A., Eccles, J. S., Blumenfeld, P., Arberton, A., and Harold, R. (2000). What am I best at? Grade and gender differences in children's beliefs about ability improvement. Journal of Applied Developmental Psychology, 21, 379-402.

Gadzella, B. M., Stephens, R., and Baloglu, M. (2002). Prediction of Educational Psychology Course Grades by Age and Learning Styles Scores. College Student Journal, 36, 62-69.

Gay, G. (2000). Culturally responsive teaching: Theory, research, and practice. New York: Teachers College Press.

Good, T., and Brophy, J. (2003). Looking in classrooms (9th ed.). Boston: Allyn & Bacon.

Good, T., and Brophy, J. (2008). Looking in classrooms (10th ed.). Boston: Allyn & Bacon.

Government of Samoa. (1995). Western Samoa Education Policies.

Government of Samoa. (2000). Educational For All. Assessment 2000: Samoa Country Report.

Government of Samoa. (2006). Ministry of Education, Sports and Culture: Strategic Policies and Plan 2006-2015.

Government of Samoa. (2018). Ministry of Education, Sports and Culture: School Management Policy 2018-2023.

Government of Samoa. (2018). Ministry of Education, Sports and Culture: School Governance Policy 2018-2023.

Government of Samoa. (2007). Education For All: Mid-Decade Assessment Report, Samoa 2007.

Griffard, P., and Wandersee, J. (1999). Challenges to meaningful learning in African-American females at an Urban Science high school. International Journal of Science Education, 21, 611-632.

Harris, P and Smith, L. (2017). Using puppets as story props for read-alouds: addressing reading/learning styles. Reading Improvement, 54(1), 6-22.

Johnstone, A. (2000). Teaching of chemistry-logical or psychological. Chemistry Education: Research and Practice in Europe, Vol.1, No.1, pp 9-15

Kelly, G. J., and Sezen, A. (2010). Activity, Discourse, & Meaning Some Directions for Science Education. In W.-M. Roth (Ed.), Re/Structuring Science Education (Vol. 2, pp. 39-52): Springer Netherlands.

Koballa, T. R., and Glynn, S. M. (2007). Attitudinal and motivational constructs in science learning. In S. A. Abell & N. G. Lederman (Eds.), Handbook of Research on Science Education (pp. 75-102). Mahwah, NJ: Lawrence Erlbaum Associates, Inc. Publishers.

Lau, S., and Roeser, R. W. (2002). Cognitive abilities and motivational processes in high school students' situational engagement and achievement in science. Educational Assessment, 8.

Marsh, H. W., and Craven, R. G. (2006). Reciprocal effects of self-concept and performance from a multidimensional perspective: Beyond seductive pleasure and unidimensional perspectives. Perspectives on Psychological Science, 1, 133-163

McKinley, E. (2007). Postcolonialism, indigenous students, and science education. In S. K. Abell (Ed.), N. G. Lederman (pp. 199-226). Mahwah, NJ: Lawrence Erlbaum Associates, Inc. Publishers.

McMurray, C. (2006). Samoa, A Situational Analysis of Children, Women and Youth. Suva, Fiji.

Ministry of Education, Sports and Culture. (2006). National Curriculum Policy Framework.

Ministry of Education, Sports and Culture. (2021). Press release: New 4 year level for all secondary schools (Year 9, Year 10, Year 11, Year 12). Retrieved from https://mesc.gov.ws/press-release-new-4-year-level-for-all-secondary-schools-year-9-year-10-year-11-year-12/

Ministry of Finance, Economic Policy and Planning Division. (2008). Strategy for the Development of Samoa 2008-2012: Ensuring Sustainable Economic and Social Progress. Apia: Government of Samoa.

Ministry of Finance, Economic Policy and Planning Division. (2016). Strategy for the Development of Samoa 2008-2012: Accelerating Sustainable Development and Broadening Opportunities for All. Apia: Government of Samoa.

Ministry of Finance, Economic Policy and Planning Division. (2016). Strategy for the Development of Samoa 2016/17-2019/20: Accelerating Sustainable Development and Broadening Opportunities for All. Apia: Government of Samoa.

Moore, L. L., Grabsch, D. K., and Rotter, C. (2010). Using achievement motivation theory to explain student participation in a residential leadership learning community. Journal of Leadership Education, 9(2), 22-34.

Mugler, F., and Landbeck, R. (1997). Learning in the South Pacific and Phenomenography Across Cultures. Higher Education Research & Development, 16(2), 227 - 239.

Nolen, S. B. (2003). Learning environment, motivation, and achievement in high school science. Journal of Research in Science Teaching, 40(4), 347-368.

Reinert, H. (1976). One picture is worth a thousand words? Not necessarily! The Modern Language Journal, 60, 160-168.

Richardson, T. E. (1990). Reliability and replicability of the approaches to studying questionnaire. Studies in Higher Education, 15, 155-168.

Rob, C. J. (2003). Spontaneous inquiry questions in high school chemistry classrooms: Perceptions of a group of motivated learners. International Journal of Science Education, 25, 13-33.

Rubie-Davies, C. M. (2006). Teacher expectations and student self-perceptions: Exploring relationships. Psychological School, 43, 537-552.

Sadler-Smith, E., and Riding, R. (1999). Cognitive style and instructional preferences. Instructional Science, 27, 355-371.

Sass, E. J. (1989). Motivation in the college classroom: What students tell us. Teaching of Psychology, 16(2), 86-88.

Seiler, G., Tobin, K., and Sokolic, J. (2001). Design, technology and science: Sites for learning, resistance and social reproduction in urban schools. Journal of Research in Science Teaching, 38, 746-768.

Seiler, G., Tobin, K., and Sokolic, J. (2003). Reply: Reconstituting resistance in urban science education. Journal of Research in Science Teaching, 40, 101-104.

Sloan, T., Daabe, C. J., and Giesen, J. (2002). Mathematics anxiety and learning styles: What is the relationship in elementary school teachers? School Science and Mathematics, 102, 84-90.

St. George, A., and Bourke, R. (2008). Understanding Learning to Inform Teaching. In A. St. George, S. Brown & J. O'Neill (Eds.), Facing the Big Questions in Teaching: Purpose, Power and Learning. (pp. 123-133). Victoria, Australia.: CENGAGE Learning Australia Pty Limited.

Staver, J. R. (2007). Teaching Science: Educational Practices Series (Vol. 17). Geneva, Switzerland: International Academy of Education.

Stipek, D. (1998). Motivation to learn: From theory to practice. Massachusetts: Allyn and

Bacon.Suaalii, F. (2007). Misconceptions in Chemistry: A Comparative Study of Samoa and New Zealand High Schools to Identify their Different Origins and Approaches to Eliminate and Correct Them. Unpublished MEd Thesis

Suaalii, F., and Bhattacharya, M. (2007). Conceptual Model of Learning to Improve Understanding of High School Chemistry. Journal of Interactive, Research and Learning.

Suaalii F. (2013). Supports and Barriers to achievement in secondary school chemistry: Exploring teaching and learning of Year 12 chemistry in Samoa. PhD Thesis, Massey University Palmerston North, New Zealand.

Taber, K. S. (1995). An Analogy for Discussing Progression in Learning Chemistry. School Science Review, 76(276), 91- 95.

Taber, K. S. (2015). Exploring the language(s) of chemistry education. Journal of Chemistry, Education Research and Practice, 16, 193. DOI: 10.1039/C5RP90003D

Taber K.S., and Coll R.K. (2002) Chemical Bonding. In: Gilbert J.K., De Jong O., Justi R., Treagust D.F., Van Driel J.H. (eds) Chemical Education: Towards Research-based Practice. Science & Technology Education Library, vol 17. Springer, Dordrecht. https://doi.org/10.1007/0-306-47977-X_10

Thaman, K. H. (1988). Ako and Faiako: Cultural Values, Educational Ideas and Teachers' Role Perception in Tonga Unpublished manuscript, University of the South Pacific, Suva, Fiji.

Thaman, K. H. (2001). Towards Culturally Inclusive Teacher Education with Specific Reference to Oceania. International Education Journal, 2(5).

Tobin, K., Seiler, G., and Walls, E. (1999). Reproduction of social class in teaching and learning science in urban high schools. Research in Science Education, 29, 171-187.

Uzuntiryaki, E. (2007). Learning styles and high school students' chemistry achievement. Science Education International, 18(1), 25-37.

Vishnumolakala, V. R., Southam, D., Treagust, D., Mocerino, M., and Qureshi, S. (2017). Students' attitudes, self- efficacy and experiences in a modified process-oriented guided inquiry learning undergraduate chemistry classroom. Chem. Educ. Res. Pract., 18, 340Western Samoa. (1995). Education Policies 1995-2005.

Wlodkowski, R. J., and Jaynes, J. H. (1990). Eager to learn: Helping children become motivated and love learning. San Francisco: Jossey-Bass Publishers.

Zheng, L. (2016). Revisiting Teacher Expectation Effects: For individuals and for intact groups. International Journal of Education and Social Science, 3 (3) 49-57. www.ijessnet.com