

Narrating International and National Trends in US Science Education: An autobiographical approach showcasing Dr. Robert Yager

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This biographical piece is based on a conversation involving Bob Yager, Geeta Verma, and Lisa Martin-Hansen which took place at the National Association for Research in Science Teaching (NARST) conference in March, 2008. The unique aspect of this autobiographical piece is that it highlights Dr. Yager's account about the emergence of the science education field of study and his engagement with the field over a period of more than 50 years. The piece is organized using conversation topics through a biographical narrative format that starts at the beginning of Dr. Yager's career, establishing science education at The University of Iowa, the emergence of Science, Technology, and Society (STS) ideas, existing intersections between STS and Socioscientific Issues (SSI) ideas, his reflections on work with doctoral students, and a consideration of the goals and aims for future directions in the field.

Keywords: Career, Science Education, Science, Technology and Society

FOREWORD

Robert (Bob) Yager is a professor emeritus of science education at The University of Iowa. Dr. Yager received his Ph.D. in Plant Physiology in 1957 from The University of Iowa; an MS in Plant Physiology in 1953 also from The University of Iowa; and a BA in Biology from the University of Northern Iowa in 1950. Interestingly, Dr. Yager was awarded an Honorary Doctorate in Humane Letters from the University of Northern Iowa in December 2008. Dr. Yager began his professional career as a laboratory assistant at the University of Northern Iowa in 1948 as an

undergraduate student. After graduating, Bob took a position as a Biology and English high school teacher in Chapin, Iowa, that he held for two years. Soon after, he was hired as a life sciences instructor at The University of Iowa while he worked full time on his MS in Plant Physiology. Following that he served as a basic education instructor in the US Army for two years beginning in 1953. While he worked on his Ph.D. in Plant Physiology, Bob was first employed for a year as a teaching assistant in Botany starting in 1955 and then was hired as Acting Head of Science Education and chaired the science department at the University High School (the laboratory school) at the University of Iowa starting in 1956. Bob began working at The University of Iowa as an Assistant Professor in Science Education after finishing his doctorate degree in 1957. Over the years, Bob earned tenure and promotion as an Associate Professor in 1963 and then full professor in 1967 at The University of Iowa. He continues to be affiliated with The University of Iowa as professor emeritus and work with Visiting Scholars as well as a staff from a five-year

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research project focusing on science teacher preparation and continuing education.

This brief biographical narrative highlights a few key items and is by no means a comprehensive account of his career. A sampling of Dr. Yager's professional awards, funded projects, and other professional contributions including his work with various professional organizations and students are listed here. Bob has received several awards in recognition of his scholarly contributions including the Lifetime of Distinguished Contribution to Science Education through Research Award, National Association for Research in Science Teaching. He received the Carleton Award in 1977—the most prestigious award given by the National Science Teachers Association. He received the Brady Award for Distinguished and Sustained Service to the University of Iowa, in 2001. He received the outstanding Mentor Award from the Association for Education of Teachers of Science, in 2000. Other awards include the Lifetime Distinguished Service, Mathematics/Science Coalition, State of Iowa, in 1999; Significant Scholarly Contributions to the Field of Education, Iowa Academy of Education, in 1999; Vasconcelos Education Award of the World Cultural Council, Victoria University of Wellington, New Zealand, in 1998; and the Distinguished Service Award, International Council of Associations for Science Education, in 1997.

Bob directed nearly 200 funded projects encompassing national and international work including Instructional Improvement Implementation Programs, Leadership Development Programs, Chautauqua Science in Professional Development Projects, and Salish Research Focusing on Science Teacher Education. Some of his national projects included Iowa Project ASSIST as a Mechanism for Curriculum Implementation, 1974-78; Honors Workshops for Teachers of Exemplary Science Programs funded by the National Science Foundation, 1984-90; An Iowa Chautauqua on Kit-Based Science, Title IIA Grant, Iowa Board of Regents, 2001; Changes in Classrooms Supported by Concerned Communities: Authentic Illustrations of Science Education Reform in Iowa, Annenberg/Corporation for Public Broadcasting, 1995-1997; National Diffusion Network Developer Demonstrator Program for both the Iowa Chautauqua Program, and the Iowa Scope, Sequence, and Coordination Project, 1982-95. Both projects were funded by NSF grants, 1982-2004 for transplanting Staff Development Projects in a dozen other states. Other key projects included Salish 1, 2 and 3 focused on Secondary Science and Mathematics Teacher Preparation Programs: Influences on New Teachers and Their Students, 1992-1997; and Physics, Earth Science, Chemistry (Korean Science Teachers), 1991-2008 and Iowa IMPPACT a study of science teacher education in

collaboration with Syracuse University and North Carolina State, 2004-2010.

Bob's professional contributions are various and numerous. His mentoring of graduate students includes being a Chair for 130 Ph.D. Dissertations and Chair for 256 Masters student from 1958-2008. He was the director for Future Scientist of America from 1960-67 and the director and National Secretary, Association for the Education of Teachers of Science from 1961-70. Additionally, he was the director of the Iowa Science and Culture Project from the 1965-70; He served on the Editorial Review Board, National Association for Research in Science Teaching from the 1965-78. He served as president of several associations including: School Science and Mathematics Association, 1969-70; National Association of Biology Teachers, 1970-71; Association for the Education of Teachers in Science, 1973-74; Iowa Academy of Science, 1973-74; National Association for Research in Science Teaching, 1974-75; National Science Teachers Association, 1982-83; and International Association for Science, Technology and Society, 1992-93, 1996-99.

Other professional accomplishments included serving as director of research for the National Science Teachers Association from 1978-81; Director, NSTA-ERIC/SMEAC Study of Accomplishments and Needs of Science Education in the United States from 1979-81; Member, Executive Committee, National Science Teachers Association from 1980-84; Chair, Section Q, American Association for the Advancement of Science from 1981-84; Commissioner, Science Manpower Commission, American Association for the Advancement of Science from 1982-85; Associate, Center for Educational Competitiveness, Washington, DC from 1989-94; Member, Advisory Board, Scholastic SuperScience, National Science Foundation from 1989-1995; Member, Exemplary Science Materials, U.S. Department of Education from 1998-2000; and Member, Science Advisory Panel, Educational Resources Information Center (ERIC), 2004-present.

INTRODUCTION

We recently published an article, “A *conversation between Dana Zeidler, and Geeta Verma and Lisa Martin Hansen; Exploring further possibilities in science education*” in *EURASIA Journal of Mathematics, Science & Technology Education* to document Dr. Dana Zeidler's professional career and contributions. Such published pieces contribute to scholarly chronicling of prominent science educators and researchers. At a recent Association of Science Teacher Education (ASTE) meeting in Costa Mesa, California (2001), attendees were asked to stand if they had been a doctoral advisee and/or an ‘academic grandchild’ of Dr. Bob Yager. Over one-third of the attendees in the room stood up acknowledging the sheer

number of scholars that were impacted by being a member of the academic lineage of Dr. Yager. Therefore, we felt that it would be of immense value to document and narrate Dr. Yager's personal and professional career and to note his contributions to the science education field. Re-constructing the history of the science education field through these personal interviews and other narrative approaches allow the readers to identify and examine the research issues, trends, themes, and directions in the science education field. In preparation for constructing this biographical narrative, we interviewed Dr. Yager at the 2008 International Conference of National Association of Research in Science Teaching (NARST) in Baltimore, Maryland.

Biographical Topics

We used the following biographical topics to illustrate the highlights of Dr. Yager's professional career. These topics emerged out of our audio-taped structured conversation with Dr. Yager. The biographical narrative includes our elucidation and construction of his professional events supported by verbatim quotations from Dr. Yager. The topics include:

- ✓ Dr. Yager's career
- ✓ Establishing science education at The University of Iowa
- ✓ The emergence of Science, Technology, and Society (STS) ideas
- ✓ Existing intersections between STS and Socioscientific Issues (SSI) ideas
- ✓ Reflections on working with doctoral students
- ✓ Considerations of the goals and aims for future directions for the field

Beginning of Dr. Yager's career

We asked Dr. Yager to describe his career path, indicating the nature of his ongoing engagement with the science education community. He started out by sharing the beginnings of his professional career, which eventually led him to science education. As he shared, "actually I have lived and been a professional teacher for much more than 60 years. But, I have been 50 years on the faculty at the University of Iowa. I did my graduate work all at the University of Iowa and so in a sense that was not all one stretch, because I have been teaching in Iowa [in 1950] after completing my Bachelor's degree and receiving a license to teach. I actually decided, unlike many people that I work with in teacher education, to be a teacher when I was in 7th grade. My mother was a teacher and I grew up on a farm in [Western] Iowa. She had gone off to then the Iowa State Teachers College, which is where I went to get my degree. Everyone in Iowa, if you [have] thought

of teaching you would have actually thought of Cedar Falls [now the University of Northern Iowa]. [But, it is important to remember] that I was also very young when I graduated from high school".

Bob's elementary school didn't have kindergarten when he started first grade. When kindergarten was started, they split the first graders into two parts. Bob's Mother would not have him being in the first grade again – even though he "was among the youngest. My mother indicated that she did not want her son to repeat first grade". This all meant that he graduated from the high school a month after the age of seventeen. He was anxious to get his college degree and into teaching. He "graduated from my bachelor's degree by going a summer and a half, in 3 years. That together, I had my teaching certificate and I was ready for a job at the age of twenty". Bob minored in English where he enjoyed grammar and drama in high school. So here he was, "at age 20, teaching at a small town (Chapin, Iowa), teaching [students] biology, physics, and English [some of whom] were one year younger than me; the only thing that separated me from the students was, quite frankly, my dress. I never thought of ever going to school without a suit and a tie. And I did get messed up in the first year when they took pictures for the annual. All the kids came dressed up. It was rather embarrassing when the photographer stuck me in the middle of the row. I had to say 'just a minute. I am not one of the kids'".

"After my first year of teaching, I thought [immediately] of graduate school. At that point in time the University of Northern Iowa (UNI) had no graduate program; it was strictly an undergraduate place; so I had to find another institution. And I went with my father, across the state of Iowa, from western Iowa to eastern Iowa, and talked to the dean of the graduate college [at the University of Iowa], who happened to be a plant physiologist, about enrolling after one year of teaching in the graduate program. I was there just for the summer because I was going back to [my second year] of teaching... but interestingly, after my that first summer at Cedar Falls [at the University of Iowa] I had the faculty saying 'Why would you want to go back to teaching?' because I did so well in those first courses of graduate school. [I even was enticed to accept a teaching assistantship]. But, I did go back for year 2 at Chapin! However, after a second summer for my master's degree program, I decided to spend the next whole academic year with full time study and teaching at the U of I and completion of a Master's thesis. The Korean War was in full swing! I found myself being called (drafted) in the U.S. Army".

"I was a not a happy camper at the thought of carrying a gun, going abroad and shooting people!" Bob shared that, "I did serve and went through basic training and all that against my will. I was very thankful that my

first orders included going to Germany rather than to Korea. I served two years in the army in Frankfurt, Germany. And my job, because I had my master's degree and had been a teacher, was actually to be a teacher at an [army education] center". Bob worked with army recruits who did not have a "4th grade equivalency". Bob shares, "so here I was teaching army recruits, who wanted to stay in the army and teaching them simple reading and math [skills] to at least at 4th grade equivalency or they would be released from the army. I was just anxious to get out of the army as soon as I could and to return [to PhD studies]".

Bob recognized the importance of this experience as he says, "in a way it was gaining special education preparation" on the job. This experience provided him with meaningful pedagogical experiences for adult learners with the methods being used to teach the recruits were very much "drill and practice". Bob recognized the importance of having people learn to think and conceptually understand versus simply reciting information and/or doing simple math drills with flash cards.

The army wanted him to stay on as a civilian and he considered it as he enjoyed Europe, especially the 3-day passes. After visiting over 18 different nations, which he says, gave him "very interesting insights", he was tempted to stay. However, he chose romance over a job offer and returned to Iowa to get married. They had dated while both he and his wife had been students at ISTC! He and his wife chose to live in Iowa City where his wife first taught at a nearby town: Washington, IA. Later his wife became the first diversity chairperson and "Family Living" instructor with the Iowa City public schools while completing M.A. and PhD degrees. Later she worked at Grant Wood Education Agency and headed diversity efforts there. That's the reason why following her fatal car accident, the University of Iowa sponsored and continues to sponsor a diversity conference in her name.

At the time, Bob applied for a PhD program at The University of Iowa. There was no science education PhD program. He was offered a teaching position in the biology department as a doctoral candidate. As he shared, "both of my graduate degrees are in Plant Physiology and have nothing whatever to do with education". His graduate studies for his Master's Degree focused on cell elongation of 'oat coleoptiles'. However, the more he thought about pursuing this line of research (his advisor's specialty), he wondered, "Do I want to spend the rest of my life dealing with enzymes and what makes cells grow and elongate and all that sort of thing? It didn't appeal to me at all. [I decided teaching was more challenging and fun!] And, I enticed my advisor to move to another area of research – the chemistry of abscission. But, Bob also decided to talk to some of the College of Education administrators where he found

great interest in his talents [but with no enticements to change his major]. I moved from the coleoptiles to tobacco plans in the greenhouse. I wanted to be, where there were other people around rather than in a dark room; I got very interested in floral abscission in tobacco plants. The idea was worth pursuing and got me to two sunny rooms in the greenhouse".

Establishing science education at The University of Iowa

While he was pursuing his Ph.D. in Plant Physiology, there was a vacancy at The University of Iowa Laboratory School. In the lab school all the department heads were the only permanent teachers. He had struck a chord with the director of the lab school. The science faculty had been depleted because there were no faculty members (3 over a ten year span) who had not achieved tenure. There were no remaining teachers and no one to chair the department. The lab school was used as a field setting for research in education and for practicum experiences for teacher education majors – and even student teaching. Not many publications were coming out of such a setting even in other departments with well known faculty department heads. The director of the lab school was struggling to employ people with a Ph.D. to both teach and conduct educational research. Therefore, Bob found himself working toward his Ph.D. in Physiology while also acting head of, "the science education program at The University of Iowa, in 1956 before I had my PhD. I was employed full-time without a PhD but in charge of a [science education] program with a master's degree [program and several students in progress]".

His teaching at the lab school impacted his views on college science teaching. As he shared his experiences in the lab school, "now getting back to the lab school experiences, it was such a rich place. Unique to our program was my tie to the sciences. Many of our early graduates [in science education were] really prepared to be college science teachers. I like to think mainly that I was one of the greatest contributors to that; you could be interested in teaching and teaching differently at the college level instead of just giving lectures and passing on. Bob enjoyed his experiences at the lab school as he had, "the luxury of having an idea that could be tried the next day". The science program was enlarged and at its peak there were ten PhD students who were faculty members in the science department. As he reflected on the intersection of pedagogy and intellectual engagement with students in the lab, he shared the paradox of doing experimental research with children could almost be interpreted as cruel to the children who were denied participation in any labs. In the lab school, they compared learning of students who only were given lectures and textbooks, others with only

teacher demonstrations, a third section with many student-centered labs. It came as a shock to Bob that there were no differences on test performances. He shared his concerns about the ethics of education research in the lab school but he learned and shared his learning through publications.

The University of Iowa enticed T.R. Porter, a professor at Penn State University, to come to the University of Iowa to head the program in 1958. He was considered a national figure who could chart new pathways to excellence in science education. He wanted to head a Liberal Arts Core Service in the Basic Sciences, the elementary program that consisted of more than one methods course; he wanted a formal Center that was not simply part of the lab school or a facet of the College of Education. He wanted nothing to do with the lab school and/or the secondary teacher preparation program. Lastly he wanted Bob to stay on as a new assistant professor in charge of preparing secondary science programs and the science program in the lab school. T.R. Porter was instrumental in creating an entire graduate program focusing on science education per se. Bob explained the importance of this move to the university which gave T.R. Porter everything he wanted before accepting the new position at Iowa, i.e., over a full year of negotiation. “Science Education at The University of Iowa wouldn’t be where it is today in science education without Porter’s power to provide what he needed for developing an innovative program”.

Over the years, Bob considered moving to other universities where he was offered faculty appointments. But, then he thought, “I guess there is no point in going to those [other places and starting new program features; he had already developed cooperative efforts across the whole state of Iowa]; and establishing working relationships with teachers and schools across the state. Every time I thought about it, I would say ‘Look what I have got going here! I know the state! I know the university! I know the power of not having a degree in education! I know people who are willing to work with me! How long would it take to develop these kinds of relationships anyplace else?’” T.R. Porter developed and established a Ph.D. in science education separate from the Curriculum and Instruction Ph.D. programs in the College of Education. At that time, Bob shared, “having a PhD program with nothing to do with the College of Education was a problem, in some ways -- interesting questions were raised over time -- a truly unprecedented action that lasted for several decades. Currently, science education is part of the Teaching and Learning Department within the College of Education at The University of Iowa. “How that happened and how it is working remains outside my control or knowledge base – especially with Emeritus Status”.

The emergence of Science, Technology, and Society (STS) ideas

Bob’s experiences in the lab school shaped his ideas about curriculum and student-centered learning. These experiences got him interested in STS ideas, which were originally proposed by other researchers in the field (Joe Piel from Stony Brook, Rustum Roy from Penn State, Janice Koch, Glen Aikenhead, Steve Cutcliffe). His ideas about STS were influenced by his experimental implementation of dozens of non-traditional curricula at the lab school. As he shared, “I am really fundamentally opposed to curriculum; [too often it is something to impose on teachers]. Even though I took the money [for field testing curricula] and probably directed over 150 NSF programs [to help teachers and schools to use them], I was enthralled with the efforts of the 60’s [and how they promoted student learning]...and unfortunately, I think a lot of people want to return to that. I think it’s an insult that you need a curriculum [developed by others] and applauded by others and the belief that you need a textbook. We have to [help] our students to see that is important to have something that they can refer to and I’d like to think... find problems with it... several researchers [have] done basically [that]; often times in chemistry & physics [texts] which are not my primary area [of expertise], where somebody can pick up a typical high school book and find 150 errors in it [The same is true for college science texts as well]! I am not smart enough to know the difference and obviously most teachers aren’t; I really don’t know [how] you can [experience and learn real science] with a [textbook]. I don’t know why we pay them [textbook companies] money to try to [provide frameworks for courses and materials for teachers to use with students]”.

One of the most enjoyable times during Bob’s professional career was testing curriculum guides and materials. As he excitedly shares, “every new curriculum [that] comes out, we would [want to try it in the lab school and/or with teachers in professional development efforts]. The further it was away from tradition, the more we want[ed] to try it. So we really had not thought about doing anything that was completely open in different contexts. And, the turning point for that for me was work with the Project Synthesis effort. I think [many are] familiar with it. What *Research Says to Science Teachers*, Volume 3, from the National Science Teachers Association (NSTA) [provided reviews of relevant research that was designed to assist teachers]. [It was a great time] because at that point in time I was president of NSTA and work[ed] with Paul Hurd, Rodger Bybee, Jane Kahle on the Biology part of it... we shared, we pointed new directions, [and noted problems from the current research]. [Although I focused most on biology, my real

fascination] was with STS, (Science, Technology, & Society) [which was identified primarily as -- an effort in U.K. and other European countries]. It [the STS effort for the synthesis research was] headed by Joe Piel from Stony Brook. There were several teams who had worked synthesizing the case studies [available research, and the 1977 National Assessment of Educational Progress]. “Joan Solomon [became a popular STS enthusiast] who is still alive and working; [she collaborated directly with many STS students and Glen Aikenhead, Canada]. Solomon’s husband [is credited with] coining the name-STS (Ziman, 1980). I got very fascinated about what it means; what it could [look like], and what the current reforms [have in common]”. Bob’s interpretations and applications of STS ideas created much controversy in the science education field as other scholars in the field disagreed with him about the society emphasis and questioned the technology emphases in STS conversations. Often others did not approve of bringing in societal controversies into science programs. Bill Aldridge, the Executive Director of NSTA, would debate with Bob. He was willing to add technology, but seemed agitated and loudly proclaims that Society was not science!

Bob reflected on his understandings of the scientific enterprise and its connection with the STS ideas. He gives examples such as, Surely, *You’re Joking, Mr. Feymann* and his ideas of what science is. He identifies the following: 1) Science is what scientists do to answer questions about the objects and events that characterize the natural world; 2) Science is also dealing with the explanations of the natural world that are not so; 3) Science is dealing with the things we do not even know that we do not know. Bob reported that he continues to use such ideas as those shared with Feymann. Bob continues by sharing that he feels that science is trying to respond to your own questions [not those of teachers or those included in textbooks!]. Scientists are doing that, I mean, and we tend to revere them [for it]. They [are seen as] knowing it all. Well, [shucks], they’re not doing research if they already know the answer and they are sharing with you their previous answers. The bottom line is dealing with those things [we are curious about]. And I loved when AAAS Science journal came out with the 125 most significant things that we don’t know [as part of] their 125th Birthday. Where [and how] do we deal with ‘typical [unknowns],’ especially if we got a text book [to follow]; if we got a state curriculum guide or whatever else with the things the student doesn’t know – [but teachers and/or others want them to know]”.

“John Dunkhase [a former Geologist who is a current science educator at Iowa] is one who was just this year going down the hall and looking very glum; I said ‘John, what’s wrong? You look so sad’ and he said, ‘I just found out today that two of the things that I knew yesterday, are wrong!’ But how many times does

that really happen? We even joke about that now. We have not begun to understand everything [about the objects and events] found in the whole universe. We don’t even know how big it is and we miss the point of what science is”. Bob felt that for most people science is the stuff in books, in courses, in curriculum guides all of which are labeled “science”. Bob continued, “Teachers I think are too anxious to simply share what they know [while also working to look like they] can go further than the book”. Bob lamented over the situation where we as teachers are too bound by standards, curriculum materials, and grade level expectations. He shared concerns of the science education community that teachers feel the pressure of needing to “cover” the curriculum, being accountable to various stakeholders, and creating learning experiences that are often shallow for deeper understandings due to these constraints. He reflected on his experiences as a research scientist, “I got very fascinated with it... I love plants and trying to understand how they grow. The thought was [initially that], I could be in the lab school and could still keep up with some abscission research. I have 12 or 15 [publications] in the most prestigious journal of plant physiology”. His work in the lab school was innovative and exciting in his professional career where he could ‘experiment’ with new ideas similar to his experiences in doing research in Botany. He was able to coalesce the idea of “teacher as researcher” promoted by NSTA since he himself played that dual role in the lab school. He criticized teachers who make excuses for not attempting innovating ideas on their own -- they do not view their teaching as something from which they can learn. If every teacher would work on one problem a year or a month (or every day), we would have a revolution! Bob recognized the challenges placed upon the teachers by the federal and state guidelines and the feeling that they must do what they are told! But, they do not have to do it smiling!

He expounded on the implementation of STS workshops including his Chautauqua efforts beginning in 1983 -- and emphasized that he doesn’t consider them to be “his workshops” because “[we started with] from the very first one, it was the idea of teachers helping [other] teachers [and] not being prescriptive but [instead] opening opportunities”. An example of a teacher who embraced the ideas of exploring STS was a woman from Davenport, Iowa, who later became the editor of *Science and Children*. Joan McShane conducted many investigations with STS approaches including tooth brushing and toilet flushing. Her science students enthusiastically investigated scientific ideas guided by STS to the extent that she became famous in the Quad cities where she was known as the “Flush Queen”. As Bob shared, “Joan was able to get her students to investigate science phenomena all over town [and] emphasize [how] local issues such as water pollution

[and other environmental issues indicated real problems on which students can work]”.

Another example is of a teacher who attended STS workshops who realized that several students in his class were interested in becoming hair stylists. This teacher shared with Bob that one of his students initiated questions about ozone depletion as a result of their interest in hair styling products such as aerosols. This group of academically low-performing students got so interested in the topic that they wanted to explore deeper investigations for the rest of the year. In essence, all the information in the standard text was needed – but for a purpose other than being the next chapter to “go over”! The students at that time enrolled in the college preparation sections complained about doing just worksheets and wondered why the low-performing students got to do the fun activities.

“[Many people] didn’t understand what many of us are trying to do ‘how we define STS?’ and many people have, in my opinion, defined it wrongly. They are just adding chapters to the book dealing with some issues. The issue doesn’t become the organizer for the course. I would say the people [who] say that they are doing STS with the textbook or that they have a unit at the end; it is [just] a ‘tack on’ thing. They are missing the point even though they claim to be STS [enthusiasts]! They are missing the point of its [real] value [as an invitation to thinking and learning] ”. The examples of how in Bob’s views cast STS as an educational philosophy and an approach to teaching are important and indicate the problem of “their being add-ons to an existing curriculum. STS affects teaching more than influencing the curriculum. How teachers teach is more important than what they choose to teach”.

Existing intersection between STS and Socioscientific Issues (SSI) ideas

We sought Dr. Yager’s opinions about the existing intersection of STS and the emerging SSI conversations in the field. He responded, “I think it’s fine. My bias is that we [in the STS community] have been interested in that... in fact being interested in social issues, is what turned a lot of [many] people [off] initially. As a matter of fact, they said that ‘you are not teaching science unless you have a physics course and so we were criticized for being too far out. Now some of these people, having written articles on ‘Beyond STS’ [encourage us] to go beyond; it is almost like [when] Ron Good wrote an article against STS because it had nothing to do with learning theory and constructivist practices. So, we responded to that in a whole SUNY Monograph (STS as a Reform in Science Education). Martha Lutz wrote one chapter in the monograph which she stated that ‘you don’t understand STS’; that’s

[when someone says] ‘Let’s go beyond. I am willing to go beyond it’”. But, what do you think it is?

“And, there is nothing wrong with taking that little step with your moral values and socio-cultural [values], and ethics... I think the problem is [that] many people view STS in a curricular sense only. To me, the far greater way of looking at STS is a new way of teaching. I like to say that is why the teaching standards are first in the standards because [they are] the most important aspect of the needed reforms. ‘Do what you do as a teacher’ in a different way than just transmitting the information or following the curriculum or whatever else. Again, I don’t have any quarrel with any [one] moving into this social/cultural area. I say ideally STS people should be doing that. Joan McShane [Davenport, Iowa] was doing that. Jim Coleman was doing it in Denison, Iowa. And, in their minds they view STS [as going] a little too far with it...And, [as mentioned earlier], Bill Aldridge went nuts with the word ‘society’.”

Bob expressed that in terms of societal and technological aspects of STS many people have difficulty understanding how these aspects relate to the science found in textbooks and curriculum frameworks. He believes that we haven’t been specific enough in our definitions of these key terms and ideas. As he shares, “the terms in and of themselves don’t have meaning – [meaning must first be established among the discussants]...I always have to keep [this] in mind that [perhaps it is only my interpretation]. God has not specified [his/her definition on us as some die-hards continue to search for the ‘real’ meaning of a term like inquiry]. [It seems to me] that we [must remember that we humans give] them [words] meaning. And, I guess in terms of these kinds of conflicts, I would say we haven’t specified enough [i.e., meaning-making]. I don’t know how many people really deal with the term ‘Science’ or ‘Technology’”. He argued that science educators (both university and at the k-12 level) don’t have much preparation in the “sociology of science, history of science, philosophy of science, and/or economics of science”. He elaborated, “many of these people assume right up front that when you say science [that] you mean understanding rocks better or knowing what [a] living system is or whatever else; there remains much disagreement! Again, I think most linguistics experts agree that no term has any meaning until meaning is first established. And so, it’s our fault that we have not been able to delineate very well”.

Bob began discussing how many people including scientists agree that, “science is an exploration/explanation of the material universe seeking explanations for their objects [and events encountered]. So that means [that] anything that you encounter, objects [in and/or around the earth] almost cover everything and I sometimes jokingly, too say, it just leaves out heaven and hell and places we haven’t

[encountered] yet. We don't even know that they even exist at the edge of the universe. And, then with the [term] technology, one of my bones of contention is that too many people who when dealing with the design world think only of computers...we [build] bridges and [this brings] engineers into [the picture]. I think we were dead wrong in the 60's saying 'leave out the technology [in texts and curricula, it is NOT Science]'. Now we are saying it is 'science and technology'. Of course, I think that's the reason I don't even like the [term] STS because with science and technology [being] up front... and a lot of the people ignore one or the other. I like [including] 'society' because science involves people and their brain[s] at work and people working with each other or fighting each other. All these are ways that we increase [understanding of] where we are going [and provides real experiences with the essence of science]".

Reflections on work with doctoral students

Bob has worked as the chair for 130 Ph.D. dissertation committees and 256 Master committee in his prolific career at The University of Iowa. He has helped form one of the most active programs in science education. He shared the long history of the Ph.D. program saying that, "our program changed over the years, as well. Many of the early [graduates] were on the science faculty at UNI; many [others] went to colleges [and K-12 schools as science teachers]. I am proud of that, although frankly, people like Fletcher Watson at Harvard criticized [me] for that...because science education leaders at NARST were meant to prepare teacher [researchers]...and here was a large program in Iowa that was preparing people who weren't going to be primarily science education researchers. But you see, I don't like to separate science education research from action research by teachers or whatever. I think the mind should [ask] questions and [that we] should be dealing with them".

Having worked with numerous Ph.D. students, Bob offered advice to doctoral students in the field. First and foremost, he believes that doctoral students need to be curious; secondly, it is highly advisable for them to become a part of a research team during their doctoral studies. Additionally, he recommends that doctoral students seek out a faculty member who is in the same research field in which a student has an interest. However, he cautions doctoral students about working with faculty who may not be open to diverse research methodologies and findings. For example, he shared a story of a Ph.D. student who worked closely with a faculty member on the faculty's line of research in microbiology with two other graduate students. The dissertation topic was assigned to this student and after two years of doing research, the student just gave up as the faculty member disagreed with the findings. Bob

strongly advocates that both students and faculty must have open minds and to allow students to explore their research interests within a broad framework of faculty expertise. For future doctoral students seeking an entry into the field, he recommends exploring a broad research line of inquiry and guarding against being pigeonholed by faculty into a very narrow and confining focus.

Considerations of the goals and aims for future directions for the field

In reflecting on his association with the science education community, Bob shared a bit of history of a professional organization such as NARST. He shared, "as I see NARST is an organization [now] and fifty years ago where it was like a fraternity, [i.e., a small prestigious group]. I mean, you were invited to join NARST! One of the first things that T.R. Porter did was try to get me into [NARST]. Even as late as 1970's or 1980's, there were only 35 institutions in the U.S. that had a Doctoral program [in science education] with more than 5 students". Thereby, Bob felt that The University of Iowa had prominence because of the 12 faculty members in science education all with varied interests, expertise, and involvement outside of Iowa. Bob described 'the fight over' research journals in the science education field. He recalled, "JRST as being relatively new, mainly because the old one *Science Education* was an early editor's 'property'... After, the death of this long time editor, his wife sold the journal to a publishing company who continues to appoint editors to accomplish the needed focus on valid research to make the journal competitive. Now it is a competing journal to the NARST publication, *Journal of Research in Science Teaching* with the same publisher [Wiley-Blackwell]". Bob recalled about the growth of the journals in science education by sharing that *Science Education* and *Journal of Research in Science Teaching* have been serving science education researchers. Both journals have undergone many changes and each has matured and has become more professional.

When asked about his joys and struggles, Bob described the ongoing struggle of the identity of the science education program at The University of Iowa, including the program becoming an integral part of the new department of teaching and learning of the College of Education. This is opposed to its being an independent entity among the science department with a long time PhD in the Graduate College. In terms of his joys, he shared that he is enjoying his retirement and opportunities for travel outside the US for work related collaboration including places such as Estonia, Korea, Turkey, Taiwan, and Thailand.

As he reflected on the future of the science education field, Bob shared, "the future is bright"

although he is “very concerned that most of the state [science] standards actually do negate the national [science] standards. The national standards ‘didn’t come from God’ but he feels good about the quality of the national standards as so much time and money and hard work went into the development of them. Although, Bob recognizes the importance of reform documents, he shares his deep concerns with other policies such as ‘No Child left Behind’ as the implementation of these policies seem to now focus on teachers as factory workers. Teachers are individually being held accountable for their students’ performances on external tests with no ties to what visions for reform are like. Instead teachers are forced to teach from the text and not consider the needs and interests of their students. Bob strongly felt that, “there is no real collaboration” to solve these educational challenges. As he emphasized, “collaboration is the highest part of the education pyramid. True collaboration means everybody involved equally; not somebody on top telling other people what to do. And, the teacher in a building is often times a person, fighting the other departments, wanting more time”. He argued that if we continue to operate this way, then, ‘we are not a profession’”. He would like to see NARST as an organization reaching out more than it does, “we all need each other. The good is again that nobody is against education. Nobody is against teaching and [nobody is against learning]. But, what are our common goals? What are we after [with regards to more scientifically literate graduates]?...I don’t see many people debating [these efforts and then discussing what evidences we can provide for their validity]. So many people think that they know the answer”.

Concluding thoughts

We recognize that we have only touched upon Dr. Yager’s contributions to the field of science education. Hopefully, this article will enable members of the science education community to get a sense of his scholarly contributions and impact on the field.

Appendix: Selected Publications, Robert Yager**Referred Journal Articles**

- Yager, R. E. (2009). Research in the Classroom: Student Learning about Twelve Features of the Nature of Science. *School Science and Mathematics*, 101 (1), 57-61.
- Kaya, O. N., Yager, R., Dogan, A. (2008). Changes in Attitudes Toward Science-Technology-Society of Pre-service Science Teachers. *Research in Science Education*. On-line only: DOI 10.1007/s11165-008-9084y.
- Yager, R. E. & Akcay, H. (2008). Comparison of Student Learning Outcomes in Middle School Science Classes with an STS Approach and a Typical Textbook Dominated Approach. *Research in Middle Level Education*, 31 (7), 1-16.
- Yager, R. E. (2007). The Six "C" Pyramid for Realizing Success with STS Instruction. *Science Education International*, 18 (2), 85-91.
- Yager, R. E. (2007) STS Requires Changes in Teaching. *Bulletin of Science, Technology & Society*, 27 (5), 386-390.
- Lim, G., Yager, R.E. (2007). A Study on the Program Development for the Continuous Enhancement of Giftedness of Scientifically Gifted Students. *Journal of Korean and Japanese Education*, 11 (2), 1-19.
- Yager, R. E. & Akcay, H. (2007). What Results Indicate Concerning the Successes with STS Instruction. *Science Educator*, 16 (1), 13-21.
- Yager, R.E. (2006). Editorial: Expanding the Use of the National Science Education Standards in Accomplishing Needed Reforms. *School Science and Mathematics*, 206 (1).
- Kimble, L. L., Yager, R. E., Yager, S. O. (2006). Success of a Professional-Development Model in Assisting Teachers to Change Their Teaching to Match the More Emphasis Conditions Urged in the National Science Education Standards. *Journal of Science Teacher Education*, 17, 309-322.
- Yager, R.E. (2006) Hot Topic: Good Science Results in Understanding and Action. Education at Iowa, *College of Education*, 24.
- Yager, S.O., Lim, G., Yager, R.E. (2006) The Advantages of an STS Approach Over a Typical Textbook Dominated Approach in Middle School Science. *School Science and Mathematics*, 106 (5) 248-260.

Books

- Yager, R. E. and Falk, J (2008). Introduction: Using the National Science Education Standards for Improving Science Education in Nonschool Settings (ix-xv); In Robert E. Yager and John Falk (Eds), *Exemplary Science in Informal Education Settings*. NSTA Press, Arlington, Virginia.
- Yager, R. E. and Enger, S. K. (2006). Introduction: Implementing the changes in PreK-4 school programs envisioned in the National Science Education Standards: Where are we ten years later? (vii-x); Successes and continuing challenges: Meeting the NSES visions for improving science in elementary schools (pp. 163-167). In Robert E. Yager and Sandra K. Enger

(Eds), *Exemplary Science in Grades PreK-4*. NSTA Press, Arlington, Virginia.

- Yager, R.E. (2005). Introduction: Implementing the changes in professional development envisioned by the National Education Standards: Where are we eight years later? (vii-xiii); Successes and continuing challenges: Meeting the NSTA visions for improving professional development programs (pp. 213-215). In Robert E. Yager (Ed), *Exemplary Science – Best Practices in Professional Development*. NSTA Press, Arlington, Virginia.
- Yager, R.E. (2005). Introduction: Implementing the changes in middle school programs envisioned in the National Science Education Standards: Where are we nine years later? (vii-xi); Successes and continuing challenges: Meeting the NSES visions for improving science in middle schools (pp. 209-213). In Robert E. Yager (Ed), *Exemplary Science in Grades 5-8: Standards-Based Success Stories*. NSTA Press, Arlington, Virginia.
- Yager, R.E. (2005). Introduction: Implementing the changes in high school programs envisioned in the National Science Education Standards: Where are we nine years later? (pp. vii-xiv); Successes and continuing challenges: Meeting the NSES visions for improving science in high schools (pp. 167-170). In Robert E. Yager (Ed), *Exemplary Science in Grades 9-12 Standards-Based Success Stories*, NSTA Press, Arlington, Virginia.
- Yager, R. E. (2004). The future of the science education game. In J. Weld (Ed.), *The Game of Science Education* (pp. 346-372), Boston: Allyn & Bacon.
- Yager, R. E. (2004). Mind engagement: What is not typically accomplished in typical science instruction? In E. W. Saul (Ed.), *Crossing Borders in Literacy and Science Instruction* (pp. 408-419). Newark: International Reading Association, and Arlington: National Science Teachers Association Press.
- Yager, R. E. (2004). Social issues as contexts for science and technology education, Samuel Totten & Jon E. Pedersen (Eds) *Addressing Social Issues Across and Beyond the Curriculum: The Personal and Pedagogical Efforts of Professors of Education* Lanham, MD: Lexington Books.
- Yager, R. E. (2004). Science is not written, but it can be written about. In E. W. Saul (Ed.), *Crossing Borders in Literacy and Science Instruction* (pp. 95-108). Newark: International Reading Association, and Arlington: National Science Teachers Association Press.
- Yager, R. E. (2002) Power of purpose in reforms in science education and the impossibility of transferring knowledge. *2002 Sino-America Science Education International Conference on Teachers Colleges*.
- Stepans, J. I., Shiflett, M., Yager, R. E. & Saigo, B. W. (2001). Professional development standards. In E. D. Siebert & W. J. McIntosh (Eds.), *College Pathways to the Science Education Standards* (pp. 25-26), Washington, DC: NSTA.
- Yager, R. E. (2001). The Diversity of Solutions for Science Education Reforms. *Proceedings of a National Forum on Thematic, Cross-disciplinary Approaches to Scientific and Technological Literacy in K-12 Education*. Washington, DC: Cosmos Club.
- Yager, R. E. (2001). Science-technology-society and education: A focus on learning and how persons know. In S. H. Cutcliffe, and C. Mitcham (Eds.), *Visions of*

- STS: Counterpoints in Science, Technology, and Society Studies*, (pp. 81-97). Albany, NY: SUNY Press.
- Yager, R. E., Enger, S., & Guilbert, A. (2001). Preparing new teachers for integrated-science classrooms. In D. R. LaVoie & W-M. Roth (Eds), *Models of Science Teacher preparation* (pp.177-194). Netherlands: Kluwer.
- Enger, S. K., Yager, R. E., (2000). *Assessing student understanding in science*. Thousand Oaks, CA: Corwin Press.
- Yager, R. E. (1998). Iowa Assessment Handbook. ERIC Clearinghouse on Assessment and Evaluation. #TMO29167. Columbus, OH: ERIC Clearinghouse for Science Mathematics, and Environmental Education.
- Yager, R. E. (Ed.) (1996). *Science/technology/society as reform in science education*. Albany, NY: State University of New York Press.
- Yager, R. E. (Ed.). (1993). *Promising practices in elementary school science*. Bloomington, IN: Phi Delta Kappa and National Science Teachers Association.
- Yager, R. E. (Ed.). (1993). *Promising practices in middle school science*. Bloomington, IN: Phi Delta Kappa and National Science Teachers Association.
- Yager, R. E. (Ed.). (1993). *Promising practices in high school science*. Bloomington, IN: Phi Delta Kappa and National Science Teachers Association.
- Yager, R. E. (Ed.). (1993). What research says to the science teacher, Volume 7: *The science, technology, society movement*. Washington, DC: National Science Teachers Association.
- Brinckerhoff, R. V., & Yager, R. E. (Eds.). (1986). *Science and technology education for tomorrow's world*. Washington, DC: National Science Teachers Association.
- Brinckerhoff, R. V., & Yager, R. E. (Eds.). (1985). *Science and technology for tomorrow's world: A report on the Exeter II conference on secondary school education*. Iowa City, IA: Science Education Center, The University of Iowa.
- Yager, R. E., & Penick, J. E. (Eds.). (1985). *Focus on excellence: Science in non-school settings*, 2 (3). Washington, DC: National Science Teachers Association.
- Yager, R. E. (Ed.). (1983). *Exemplary programs in physics, chemistry, biology, and earth science*. Washington, DC: National Science Teachers Association.
- Yager, R. E. (Ed.). (1983). *Centers of excellence: Portrayals of six districts*. Washington, DC: National Science Teachers Association.
- Bonnstetter, R. J., Penick, J. E., & Yager, R. E. (1983). *Teachers in exemplary programs: How do they compare?* Washington, DC: National Science Teachers Association.
- Gallagher, J. J., & Yager, R. E. (1982). Status of graduate science education: Implications for science teachers. In R.E. Yager (Ed.), *What Research Says to the Science Teacher*, 4. Washington, DC: National Science Teachers Association.

