WHEN SCIENTISTS' LIFE STORIES ARE TOLD: THE IMAGES OF FILIPINO SCIENTISTS IN BIOGRAPHIES

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ABSTRACT

Although research has long argued that the portrayal of scientists in films can positively and/or negatively construct the image of science and scientists, their description in a nonfiction medium, such as published biographies, is rarely studied in the Philippines. Thus, this study attempts to document how locally written and published biographies of Filipino scientists usually create the image of a "scientist". A content analysis of 80 life stories of 71 Filipino scientists published in six biographical books from 1975 to 2007 was done to determine the (1) aim of local science biographies; (2) description of scientists in the biographies; and (3) structure of narrative the biographers follow in telling the scientists' life stories.

Results show that: first, local science biographies aim to honor the local scientists by making their intellectual contributions known to the public and to encourage the readers, mostly students, to pursue science-related careers; second, Filipino scientists are described in local biographies as a poor kid, a dreamer, a disciplined youngster, an achiever, an unintentional scientist, an excellent apprentice, a dedicated worker, a strict educator, a well-rounded researcher, a prolific thinker, an inspiring mentor, and a nurturing family man/woman; and lastly, data suggest that the narrative of local science biographies resemble the rules of Bildungsroman genre, or the narrative of self-transformation (or self-development).

Suggestions to science communication researchers in starting collaborative research with other disciplines about investigating local science biographies are offered.

Keywords: biography, scientists, Filipino scientists, Bildungsroman, history of science

INTRODUCTION

The writing of life stories of scientists serves two basic functions: (1) as an avenue to (re)tell the history of science in a more artistic way (Nye, 2006) and (2) as a tool to communicate science, particularly to non-scientist public, by introducing the "people" behind them (Carneiro, 2007). The former aims to document the historical facts of a field while balancing the accuracy with the human drama; the latter aims to paint for the readers the picture of how the scientists live their lives, which would inspire them to emulate these scientists and pursue careers in science.

Of course, biographies are not at all a truly objective narration of a scientist's life. The story depends on how much personal and historical information about the subject is accessed, controlled, and included in the writing process; how the author frames the stories based on his/her style, gut feel, and interpretation of the facts; and how the audience interpret and make meanings of the story (Nye, 2006). This ability of the biographer to construct the image of a scientist opens the question of how biographies actually describe them in the narrative. These descriptions lead to image constructions, which nonetheless affect how the readers construct their understanding of what a scientist is and should be.

However, studying biographies often do not receive much attention at least in local science communication research, for several reasons. A quick look at a typical local science communication curriculum (offered under the BS Development Communication degree) offers some convincing explanation. For one, students being trained in science communication do not attend courses on writing biographies and thus are not adequately trained to read, write, and research about this genre. Although they are trained to write personality profiles in courses on journalism, they do not receive much training on

historical writing and researching. They do not have a course on history of (local) science in the first place. Second, the focus of training in science communication is on science popularization, which implicitly puts premium on highlighting the science concept rather than the science personality. And third, the role of biographies either in discussing science history or using it as a tool in communicating science is hardly being discussed in science communication courses. Thus, the lack of scholarly discussions about science biographies put this research strand out of the sight of science communication researchers.

This study was conducted to determine the aim of local science biographies, how biographers describe scientists, and what structure of narrative do they follow in telling the scientists' life stories. This study hopes to stir the interest of future science communication scholars and researchers to take serious efforts in understanding and doing research about our local science biographies.

REVIEW OF RELATED STUDIES

The nature and aim of science biography

"Biography" is simply defined as "an account of the life of something" although in most cases, it refers to a "written history of a person's life" (Merriam Webster, n.d.). This genre is noted as one of the most popular forms of writing (Shortland & Yeo, 1996) and has been one of the most popular categories of nonfiction book at least in other countries (e.g., Nye, 2006; Muurlink & McAllister, 2015). Science biographies primarily aim to assist in documenting science history and so science historians usually write biographies of scientists. However, many non-historians also tried to write and publish in such genre (Nye, 2006). And while it has long been used to communicate science and image of scientists usually to non-expert public (Shortland & Yeo, 1996[i], the practice of writing about science personalities started to ascend during the 1960s (Nye, 2006).

Although in general, the life story of a scientist is not significantly different from other non-scientist subjects in terms of its objectives and writing style (Wirtén, 2015), the literature labels this kind of biography as "scientific biography". Some scholars though, like Söderqvist (1996), argued that the more appropriate term should be "science biography," as life story of a scientist does not necessarily make it more "scientific" than the life stories of a non-scientist subject (Wirtén, 2015).

A quick on-line search about biographies of scientists reveals that most of the science biographies available online are biographies of western male scientists. It is also interesting to note that the big names in science – or the most popular ones, in the likes of Charles Darwin, Louis Pasteur, and Albert Einstein – tend to have more versions of biographies written by different biographers[ii]. This somewhat supported Nye's (2006) observation that "biographies of superhero [scientist] celebrities… continue to appear and fulfill the demands of an apparently insatiable readership" (p. 323). In the 1970s, the rise of biographies of scientists who are regarded as "less famous" but equally able began, after some science historians criticized the perpetuation of "writing the history of science as the biographies of great men and great ideas" (p. 323).

The elements of science biographies

Greene (2007) suggests that every biography is a historical novel following a specific set of rules that would make it "scientific". In writing and evaluating the narrative of a science biography, the following four elements or rules should clearly be present (pp. 730-731):

1. The rule of veracity: "all characters and events must be real";
2. The rule of sequence: "all the events in the life of the subject… must be told in the order in which they transpired and may not be reordered for dramatic impact or effect";

3. The rule of entirety: "all important acts and events must be present and may not be excluded, altered, minimized, or exaggerated"; and
4. The rule of verifiability: providing "access to documents demonstrating the reality and order of the events presented"

These rules, according to Greene (2007) must be followed as these are the basic "criteria which distinguish this special form of the historical novel from its less restrictive forms" (p. 731). Hankins (1979) had long preached to biographers to be very careful in writing any biography, taking note of accurate details to the extent of working "with a surgical precision" (p. 2). The best science biographies, Hankins said, is the story that "includes not only [the scientist's] personality, but also his scientific work, and the intellectual and social contexts of his times" (pp. 13- 14).

A science biography, however, should not only function purely as a historical document written plainly without human drama. After all, scientists are people who experience hardships and challenges too.

The way science biographies were written changed in the mid-1960s when biographers start to include in the stories the scientist's passion, motivations, and other human drama of everyday lives rather than just projecting an image of a "person pure of reason" and using a mechanical narrative of how the subject's life events transpired. Influenced greatly by the philosophy of Michael Polanyi, biographers start to picture how the subject's passion, frustration, joy, and creativity have played crucial roles in the achievement of his/her dreams (Nye, 2006). Although the tension between whether or not the story should focus on the technical science rather than the human drama (and vice versa), this kind of writing has given freedom to the biographer on how the subject's character is built up, and how the plot of the life story should be narrated.

The image of science and scientists in print and audio-visual media

Montemayor (2013) analyzed five different studies that identified how "science" was portrayed in entertainment media. He found that the categories of representation offered by these studies reveal two general "definitions" on how the term "science" is viewed and used in the context of these studies: (1) how science, as a body of knowledge, functions (e.g., magical, mysterious, dangerous); and (2) how science, as a human enterprise (i.e., as a way of knowing), is carried out (e.g., ethical and gender issues). For example, Locke (2005) argued that science is usually portrayed as something that both enchants and disenchants us, as we regard science as "sacred and extra-ordinary, as more than human" (p. 42), but at the same time alienating people from the ordinary world as we discover more on the cosmic world. This ambivalence of science both as magical and sacred produces a tension that shapes how the public perceives science.

Jones (2001) and Weingart, Muhl, and Pasengrau (2003) both argued that science becomes only "bad" if researchers fail to establish human boundaries (i.e., playing as "God"); if their motivations are against the generally accepted norms; and if their methods violate ethical norms. Steinke and Long (1996) said that science is portrayed in TV programs as paternalistic, patriarchal, and gender-biased; while in another study, they found out that science as a body of knowledge in mainstream media is usually portrayed as either mysterious, magical, and dangerous, but at the same time truth, omniscient, and solution to societal problems.

LaFollette (1990) offered an extensive analysis of Western scientists' biographies published in popular magazines. She analyzed primarily the use of metaphors in describing the scientist in focus and his/her works, which were instrumental in constructing and (re)creating the image and stereotypes of scientists that were in accord with the non-scientists'

expectations. She identified four general portrayals of scientists in this medium:

1. The magician or wizard – scientists were associated with wizards who used "magic" to create new inventions. One common way to reinforce the "magic" in a scientist's activities aside from directly associating them with wizardry is the unusual emphasis on serendipity involved in any scientific discovery. LaFollette noticed that "Writers frequently explained how scientists, who have thought of discovering one thing, had discovered something else...'" (p. 99), picturing scientists as accidental discoverers;
2. The expert – This was somewhat an extension of the "wizard/ magician" image, but this time, non-scientists regarded them in awe, believing that they have the appropriate knowledge and skills to solve all human problems "in a rational, deliberate, and efficient manner" (p. 100);
3. The creator/destroyer – This involved a special kind of ambiguity since biographers explicitly showed the two sides of the coin in any scientific discovery that a scientist has produced. In most instances, a scientific discovery was generally commended first, but later on criticized for its potential to destroy the natural human setting;
4. The hero – Regarded as the most positive portrayal of scientists among the four themes, biographers usually described this kind of scientists as people who possess remarkable "diligence, intelligence, creativity, and luck," and are "athletic or outdoors type who are self-reliant and strong, competitive but fair; a self-made man..." (p. 106)

Among these portrayals, the most common for a science biography is portraying the subject as a hero who has emerged victorious after all the tests that he/she overcome (Hankins, 1979; Shapiro, 1986; Nye, 2006).

Torres (2006) profiled 42 Filipino scientists, which incidentally is similar to how local biographies describe scientists. Most of the scientists who consented to participate in the exploratory study were male, belonged to a middle-class family, and were most likely a child of a working professional (e.g., medical doctor, lawyer, engineer, academic professor, etc.). Improving life's economic condition was the most common motivation in excelling in the sciences and academe, coupled by a well-rounded upbringing of a nurturing parent who valued education strongly.

Results also show that scientists have demonstrated strong intellectual abilities early in life, excelled both in science and mathematics during their elementary years, and showed a developed interest in reading way ahead of their contemporaries. The interest in science and math was developed in their high school years, and their choice of career paths was strongly influenced by their mentors who were described as "the epitome of good teaching and models of excellence and good behavior" (p. 8). They are also described to be very hard working. They had a strong sense of leadership and management, and they had clear visions and goals. They also created an image of a service-oriented scientist with a strong sense of nationalism.

The narrative structure of science biographies

As far as biographies are concerned, there has been regarded as the perfect formula for a good life story – it should follow the rules of Bildungsroman sub-genre. *Bildungsroman* is a literary concept introduced by Wilhelm Dilthey in 1870, and it gained prominence for the biographers since then (Boes, 2006). *Bildungsroman*, in its simplest sense, is characterized by a plot the focuses on how the subject's character is transformed into maturity by overcoming adversities along the way (Thamarana, 2015). Although similar in many ways with the "hero's quest" narrative, a story following the *Bildungsroman* sub-genre focuses on the intellectual, psychological, moral, and emotional development of the character. In the beginning, the character

is shown to have a shy and curious personality, a person who wants to independently embark in a journey to a novel, unknown territory to search his/her self. Then, the character goes on through experiencing and overcoming difficulties in the process, transforming him/her into a better person. "Maturity" is achieved when he/she gained his/her unique personal identity by parading his/her accomplishments as his/her hard-earned prize. Then, the character goes back to his/her start, but now he/she has become a better person than he/she was before the journey (Milne, 1998; Boes, 2006; Thamarana, 2015).

Muurlink and McAllister (2015) said that this kind of plot almost always appeals to readers because they are interested to see how the subject is transformed by his/her experiences. Fictional stories use *Bildungsroman* also and so, if applied to "factual" biography, the story becomes more engaging as the readers begin to see themselves like the subject who reaps the good after overcoming everyday adversities. This kind of "transformation" is akin to the universal experience of growing up or "coming of the age", which explains why *Bildungsroman* has a universal appeal (Thamarana, 2015).

Synthesis

All in all, studies from the west suggest three things. First, science biographies mainly function as an aid in documenting history of science, and that it follows literary rules that makes it different from other kinds of writing. Second, science is portrayed as magical, leading to the portrayal of scientists as a magician, an expert, a creator/ destroyer, and a hero. Third, science biographies almost always follow the rules of *Bildungsroman,* a literary genre that focuses on how the character transforms itself as it overcomes a series of tests and challenges.

Needless to say, studies in the west about science biographies had been thriving and relatively well-established for two reasons, something that local science communication scholarship

seemingly lacks: (1) publishers actively produce biographies of western scientists written by western science historians; and (2) there is an active and healthy debate about science biography scholarship in the west.

To stir interest in starting scholarly discussions about local science biographies, which may lead to its more in-depth investigation and research later on, this descriptive study aims to answer the following questions: (1) Do these local science biographies primarily function as a tool to narrate local science history? (2) How do biographers describe the scientists in their biographies? (3) Do these descriptions support the formulaic narrative plot of *Bildungsroman* genre?

METHODOLOGY

A content analysis of 80 life stories of 71 Filipino scientists published in six biographical books from 1975 to 2007 was done to find out how biographies "talk about" the lives of scientists. The author included 44 male scientists and 27 female scientists in the analysis.

To answer research question (RQ) #1, the book's preface and foreword were content analyzed, with the aim to understand the purpose for writing and publishing the (compendium of) biography. To answer RQs #2 and #3, a coding sheet was used for the document analysis to highlight the scientists' characters, behavior, and values as reflected in the available literature, as well as the current profiles of Filipino scientists by surfacing themes on how they are portrayed in these literatures. Selected biographies of scientists were analyzed to see how these materials picture our local scientists. Patterns and similarities across the six biographies were noted.

RESULTS AND DISCUSSION

The function of local science biographies

A close reading done in all the books' prefaces and forewords reveal that unlike the western purpose of science biographies, local biographies seem to not primarily function as an avenue to tell the local history of science. Rather, these biographies serve two basic purposes: (1) to honor the local scientists by making their intellectual contributions known to the public; and (2) to encourage the readers – which the books target elementary and high school students – to pursue science related careers.

Honoring the scientists. The title of one of the books says it clearly – "A tribute to the first three National Scientists" [italics mine]. Its first pages show how the national government, being led by the then President Ferdinand Marcos, prepared a grand event to honor the scientists. A wide angle shot of the first three National Scientists and the first ten "Academicians" of the National Academy of Science and Technology during their oath taking in 10 July 1978 was shown in the first page. Interestingly, the citation in the plaque was also shown in the next page. Another monograph, the *Compendium on Outstanding Filipino Women in the Fisheries Sector,* also has the same implicit purpose – this time to tell the life stories of the featured scientists who received institutional awards as an "Outstanding Filipino Woman". In the foreword of the book edited by Jamias and Mendoza (2000), the then DOST Secretary William Padolina writes that there is a need "to remember and honor the outstanding achievements and lasting contributions of a select group of heroes" and that the book is a "tribute to the country's National Scientists" (p. v). In these monographs, biographers focused on the life of the "hero" (the scientist) and his/her accomplishments. These do not elaborate much on the socio-political and economic context where the hero's journey took place, a historical element that should be present if the biography's main purpose is to be usable in the analysis of local history of science (Hankins, 1979).

Encouraging readers to pursue science careers. The forewords of the two books written and edited by Queena Lee-Chua (2000; 2006) both argued that the first step to compete globally is to encourage students to pursue a career in science. This however will happen if they appreciate the local science and the people behind them, with a clear aim to emulate the attitude, passion, and discipline of these well-renowned scientists. Interestingly, in the preface of Jamias and Mendoza's (2000) book, the then President of the National Academy of Science and Technology Conrado Dayrit said that the biographies written in this book will "provide present and future generations with models and examples of what diligence, perseverance and hard work can do," implying that learning from the scientists' life lessons and experiences will help the readers imbibe the same characters in order to be successful scientists in the future.

Scientists' images in local science biographies

The Poor Kid. When biography writers start describing the roots of the scientist, they tend to highlight the physical living conditions during the time the "future" scientist was being raised up. Due to this, most of the scientists were portrayed to have come from a humble family, living a simple life, and having tasted the effects of poverty early in their childhood. Scientists who were described as "poor kids" tended to strive hard to uplift their family from poverty. They faced many obstacles in achieving that dream. In fact, the "poor kid's" childhood story was full of descriptions of different, sometimes complex problems that seemed to hinder them from achieving their goals.

There were at least three indicative reasons why the "poor kid" experienced poverty. In some instances, the child's parents lacked opportunities to have a high-paying job. For example, Dr. Casimiro del Rosario's father was a farmer, her mother was a housewife; Dr. Anacleto del Rosario's mother was a fruit and vegetable vendor; Dr. Pedro Escuro's and Dr. Francisco Fronda's respective parents were farmers; and Dr. Dioscoro Umali's mother was a vendor. In some instances, the sudden death of the

kid's parents was used to show why their family experienced poverty. For example, Dr. Eduardo Quisumbing's family can be said to have enjoyed a prosperous life, but their world suddenly changed when his father was ambushed and beheaded. His work since then included scavenging "for waste food… to feed his hogs" (Jamias, 2000, p. 165). Six other scientists all lost their respective fathers while they were still young and were left to the care of their mothers who implicitly seemed to be unprepared for their husbands' untimely demise. Having a big family seems to be another implicit way to describe the kid's living conditions during his/her childhood. At least fifteen scientists have at least seven siblings; Dr. Julian Banzon had 17.

"The poor kid" also tended to experience problems that may impede his/her aspiration to get out of poverty. In some cases, the "poor kid" had finished elementary, secondary, and tertiary education through the help of a concerned relative, scholarships, or student assistantship. In other cases, there were "kids" who had to work just to survive with the meager financial allowance from their parents while they studied. Dr. Jose Oclarit for instance had to travel 12 kilometers everyday to finish his secondary education. While studying, he had to help his father in farm works at day or in fishing at night just to meet their needs. He survived high school by having packed corn grits for lunch, and when there was some extra money, he had bagoong as his viand. Dr. Ernesto Luis suffered from polio since childhood; and Dr. Geminiano de Ocampo had myopia. Despite these hardships, the narrative portrayed the scientists to emerge "triumphant" after all these struggles in life.

The Dreamer. Another way to portray the future scientist is to paint a picture of an idealistic child who is full of dreams of becoming successful in the future. S/he is someone who shows potential of becoming the scientist in a certain field mainly by showing an interest in it. S/he also knows very well in what field s/he would go. As early as in childhood, "the dreamer" shows very clearly that s/he was likely to be successful in his/her studies and career because of his/her unwavering determination, utmost focus, and desire to strive hard for that dream. For

example, Dr. Julian Banzon was said to have set his focus on becoming a chemist, because "as far back as he could remember, he had always been interested in chemistry" (Guillen, 2000, p. 54). Dr. Alfredo Santos was also said to have shown early signs of becoming a pharmacist, as "he had a penchant for tinkering with the leaves and cuttings of trees," during childhood (Andaya, 2000, p. 13). Dr. Lourdes Cruz wanted to be a chemist early in life, as she wanted to follow the footsteps of her dad. Dr. Paulo Campos had always wanted to serve the marginalized by becoming a medical doctor for the poor.

The Disciplined Youngster. As a kid, the future scientist had also been described as having been brought up by a meticulous and conservative parent, who most of the time instilled discipline and values that eventually helped him/her became a famous scientist. Because of the parents' caring but strict way of raising them, s/he had become a perfectionist, a hard worker, pliant, contented, determined, resourceful, and humble. With these traits, s/he has developed an ardent desire to excel academically and to make a difference in his/her chosen field. Sometimes, it helped if the scientist's parents were scientists themselves. For example, Dr. Luz Oliveros-Belardo's character of frugality and humility were said to have come from the discipline that she received from her mother, while her passion to excel in the academe came from his father. Dr. Geminiano de Ocampo was said to have learned to live a pious and frugal lifestyle because of his mother who taught him "that wealth is more often a handicap than an asset" (Manza, 2000, p. 121). The young Dr. Pedro Escuro was trained to put up his best in every work, especially when performing simple everyday chores like maintaining the cleanliness and shine of their house's floor, while flexing his muscles to draw water from a nearby deep well for domestic use. Dr. Rafael Guerrero III claimed that he was trained by his father to be self-reliant by instructing him to milk and tether goats. His grandmother, who was described in the biography as a "remarkable woman" and a "disciplinarian", required the young Rafael to clean the bathroom and kitchen every time he stayed in her house. Later on, during his college days, he was able to use these skills and values when he worked as a dishwasher in a cafeteria.

The Achiever. As achievers, the young future scientists exhibited a certain level of maturity ahead of their age, and they were projected to excel in their studies early in childhood. They showed a large potential to do extremely well in whatever field they would choose in the future. They also stood out from their childhood peers. Most of the time, they usually landed as topnotchers in their class. They also tended to be book lovers and wide readers because of their natural curiosity, extreme passion for learning, and keen interest in answering their own questions in life. In many instances, humble achievers were a product of both "nurture" and "nature", as many had pushed themselves to excel either because their parents were educators themselves, or they wanted to get out of poverty. Although some scientists were "late bloomers" (i.e., excelling academically only after finishing their postgraduate degrees), biography writers seem to highlight the idea that successful scientists had been "successful" during their childhood years, at least in school. A number of scientists' biographies explicitly mentioned their academic merits during their early years, and this had been given special emphasis in the narrative.

Dr. Glenn Gregorio painted the perfect picture of this type of scientist. In his life story, he reported that he received the Outstanding Scientist award given by the National Science and Technology Authority when he was only 16 years old after he invented a technology known as "pyramid-type solar dryer." He was also able to publish his first scientific paper in a journal during that time. He developed several other "inventions" after that, which included a refrigeration system, a strategy to estimate live weight of swine through its body measurements, and the nutritional value of pili rinds. A year after receiving the Outstanding Scientist award, he was given another award: the Sigham (Voice of Science) award. Table 1 shows the early academic achievements of some of the scientists that are explicitly mentioned in each of their biography.

Table 1. Some of the scientists' early academic achievements (as mentioned in their respective biographies)

Scientist	Elementary	High School	College
Campos, Paulo	Valedictorian	Valedictorian	*No mention*
Cruz, Jose Bejar Jr.	*No mention*	*No mention*	Summa cum laude
de Ocampo, Geminiano	Valedictorian	Valedictorian	4th honors
del Mundo, Fe	*No mention*	With honors	Valedictorian
del Rosario, Casimiro	First honor	Valedictorian	With honors
Escuro, Pedro	*No mention*	*No mention*	Magna cum laude
Lara, Hilario	Valedictorian	Valedictorian	3rd honors
Lim-Sylianco, Clara	*No mention*	*No mention*	Magna cum laude
Luis, Ernesto	First honorable	Valedictorian	Cum Laude
Oliveros-Belardo, Luz	Valedictorian	Valedictorian	With honors
Pateña, Lilian	Valedictorian	Valedictorian	*No mention*
Primavera, Jurgenne	*No mention*	Valedictorian	Cum laude
Salcedo, Juan Jr.	Salutatorian	2nd honors	2nd honors
Velasco, Jose	*No mention*	Salutatorian	Cum laude

The Unintentional Scientist. Unintentional scientists are those who did not have any intentions of becoming scientists, but eventually became one. In many cases, these scientists dropped their original career plans because they were either moved to contribute to solving a pressing social problem (e.g., helping people to receive inexpensive health care) or their career decisions were influenced by life's circumstances (e.g., poverty), and/or people significant to them (e.g., parents). In the latter reason, the "significant others" influenced the future scientist's decisions either directly (i.e., they explicitly intervened in the decision by at least suggesting to them what to do) or indirectly (i.e., the significant person did not explicitly intervene in the

scientist's decision to change plans). In most cases where the "significant others" directly influenced the scientist's decision to change plans, the scientists' biography writers pointed out health, lack of financial capability to sustain their education, or lack of possible job opportunities as major reasons why the "significant others" influenced the future scientist to forego their original career plans. Interestingly, there were also sub-narratives in the biographies that focus on candid admissions of scientists regarding their average academic performance during childhood. This narrative implicitly showed the amusement of the scientist who eventually excelled in science despite not displaying the expected values of a scientist.

In Dr. Luz Belardo's case, her biography said that she "never thought of becoming a scientist but dreamt of becoming a known writer or journalist" since she excelled in this field, having been the editor-in-chief of her school's organ and bagging many awards in essay and story writing back in her high school years (Tenorio, 2000, p. 33). However, her father strongly discouraged her in pursuing journalism. She ended up taking courses on phytochemistry and received a BS degree in Pharmacy, thus starting her path of becoming an expert in the field. Dr. Carmen Velasquez was forced to give up her dream of becoming a medical doctor after she suffered from an illness undisclosed in her biography. Her father discouraged her to continue her medical study for fear that she would not be able to bear the work demands of a doctor. She then shifted to Zoology, and started her career as an expert in fish parasitology. Dr. Rhodora Aldemita also dreamed of becoming a doctor but was forced to give up her dream when her father died when she was 11 years old. She was hired in a research institution as student assistant, and that started her career in science. Dr. Elvira Tan's biographer noted that she "never even dreamed to be involved in fisheries and oceanography" as she received her undergraduate degree in Pharmacy (Fernandez, Ricafrente & Ilagan, 2007, p. 2). Her first work at the Bureau of Fisheries, coupled with working in several internationally-funded projects led her to go into the field of marine science.

The Excellent Apprentice. Biographers did not fail to include the intellectual mentors of the budding scientists who greatly influenced their academic careers. They highlighted the challenges that the future scientists experienced under the mentorship of such great minds. Their working relationships with their professors demonstrated what it was like being mentored by these "intellectual legends". It likewise established credibility to the image of the budding scientists – having received the best trainings possible. Thus, biographers tended to discuss the scientists as excellent apprentices who were humble enough to learn from their professors, but competent enough to earn the respect of their mentors. This student-mentor relationship paved the way for more fruitful research collaborations later on. Most of the time, these budding scientists worked with their mentors either by being their thesis advisees or students in class.

What makes the "excellent apprentice" different from the "inspirational mentor" (to be discussed later) is that the former centers on the scientist as the apprentice; the latter focuses on the scientist as the mentor. On the other hand, what makes the "excellent apprentice" different from the "prolific thinker" (to be discussed later on) is that the former assumes the distinct relationship between the mentor and the mentee. The apprentice is treated as having a "lower" academic status than the mentor, thus the mentorship usually happens during their postgraduate studies. The latter assumes equal academic status of the Filipino scientist and other scientists whom they collaborate with. This usually happens after the scientist received his/her PhD degrees and had already established him/her self as an expert in the field.

The mentoring starts as early as in pre-college days. For example, Dr. Fabian Dayrit admitted that he developed his love for science, chemistry in particular, because of his chemistry teacher in high school. Dr. Ramon Barba's interest in biology was kindled by one of his laboratory instructors in high school, Dr. Helen Valmayor. Dr. Mari-Jo Ruiz developed her love for mathematics because of her "great" high school physics teacher,

Ms. Lilia Baltasar. Dr. Ma. Alicia Aguinaldo admitted to have been influenced by one of her college teachers in appreciating research works and in pursuing graduate studies. She was also "mentored" by Dr. Clara Lim-Sylianco (National Scientist) and Dr. William Padolina (former DOST Secretary).

The Dedicated Worker. A scientist described as a dedicated worker demonstrates notable diligence, tenacity, and zealousness either in studies, in doing research, in practicing the field, or in performing administrative work. Biographers often connected this trait of being a serious worker to the scientists' success later in life, implicitly sending a message that successful scientists did earn their reputation through real hard work. Due to their utmost dedication to whatever task they did, the scientists received high regard from their peers and co-workers. Biographers also often implied that these scientists acquired this trait from childhood, having been raised by loving but disciplinarian parents who may have instilled in them the value of seriousness and focus in work. This may have kindled their instinctive desire to excel.

The depiction of a "dedicated researcher" usually consisted of either describing them working late at night in the laboratory or working in the field without resting just to answer their research questions. Although working in the laboratory late at night sometimes depicts an image of the scientist working in isolation, there was not a single biography that implied that these scientists avoided social interaction. Dr. Julian Banzon's children referred to their dad's makeshift laboratory in their house as "the dungeon", but they never depicted their father as a "mad scientist" type who never conversed while doing his stuff in his "nook." Dr. Gregorio Velasquez, has also been described to stay late at night in his laboratory, because "when he wanted to find something, no one could stop him" (Siar, 2000, p. 67).

Due to their dedication coupled with clear tinges of nationalism, the scientists also tended to choose to work in the Philippines despite having already established their academic niches in prestigious universities abroad, and/or in spite of the lucrative offers of better opportunities to practice their profession abroad.

For example, Dr. Casimiro del Rosario became his class' top graduate among 48 international students in Yale University, when he finished his master's degree in Physics. He was awarded several research grants, all of which were in the U.S., and the results of those grants were published in several journals. He continued to finish his doctorate degree, and he was even invited to teach at Howard University in Washington because of his strong academic credentials. However, he went back to the Philippines and chose to teach here.

As part of their dedication, many scientists also "went out" of their laboratories and started sharing their knowledge. Some started their public engagement activities by establishing an organization devoted for their fields of expertise, and then using these organizations to do extension work. Some accepted administrative positions that may give them opportunities to directly work with policy makers or with marginalized groups. Serving was an opportunity for them to be publicly visible and to enable the public to benefit from scientific knowledge.

The Strict Educator. Another notable description of scientists is their being strict educators. Since most of the scientists were academicians themselves, they trained apprentices who were either their students or their laboratory/ research assistants. However, because of their innate characteristic of being detail-oriented and disciplined, they demanded high standards from their students, most of the time expecting them to have the same motivation, work ethics, and values like them. As such, they always have a reputation of being strict and frank disciplinarians who wanted to instill the ideals of an excellent researcher.

In the earlier discussion, these scientists' "strictness" was described differently depending on whether they were teachers or researchers. As a teacher, strict educators were described as "terrors" in class, who gave very difficult exams, and who imposed strict class rules. However, as a researcher, they were noticeably described in a more positive tone. They were described as loving fathers/mothers who guided and disciplined

the apprentices in their research studies and led them to eventually excel in their field. This will be tackled later under the theme "Inspiring Mentor".

One scientist who received the most vivid description of a typical strict educator was Dr. Clara Sylianco. Her exams in chemistry were described as follows: "She gave difficult and punishing examinations… [It] consisted of five or six questions requiring roughly four hours to answer. The output was 10 pages or more of long yellow pad… Her students raced against time as they coaxed the most logical answers from their brains and memory, and their hands began to feel the cramps only halfway through examination" (Santos-Mendigo, 2000, p. 44). Dr. Isabelo Concepcion has also been described as a "terror" teacher. His biographer described him as a teacher whom his students found "hard to deal with. His well-dressed figure commanded respect even before he would ascend the instructor's rostrum. And once he started his lecture, he would not tolerate inattention or misbehavior in class" (NSDB, 1975, p. 51, 52).

The whole aspect of mentoring by strict scientists usually had good results. This implied that the tough training from the strict educators was bound to pay off later. Biography writers tacitly put emphasis in this discourse by quoting interviews from the scientists' former students and/or apprentices who themselves have made a name in their field. These apprentices usually conveyed in the interviews, albeit indirectly, that their teachers were worthy of receiving gratitude and recognition because of their guidance. These apprentice-interviewees believe that they might not have been successful now had they not been given the rare opportunity to work with, learn from, and imbibe the characters of these "strict" educators.

The Well-rounded Researcher. Well-rounded researchers are those who appreciated and oftentimes excelled in extracurricular activities such as in sports or arts. Biographers may have highlighted this portrayal so that they could make a balanced description of a scientist who has time to take a break from his/her hectic schedule and enjoy hobbies and/or interests that

may have nothing to do with science. This seemed to remind the readers that scientists are also ordinary human beings who do what most common people also do and enjoy. In fact, one biographer started to introduce a scientist's extracurricular interest by saying "Scientists can be vibrant and warm human beings contrary to the general perception that they are insensitive and cold. They too have passion for things other than science" (Tenorio, 2000, p. 37). By revealing their hobbies and extracurricular activities in the narrative, biographers can construct the scientists' image of being "normal" persons whom common people can connect with and emulate.

For example, Dr. Luz Belardo was noted for being a good writer; in fact her poem "What Music Once Told Me" was transformed into a song, and its music was composed by National Artist Dr. Lucrecia Kasilag. A number of scientists are reported to have been good at playing musical instruments, like Dr. Josefino Comiso, Dr. Ma. Alicia M. Agunaldo, and Dr. Fe del Mundo. Dr. Rafael Guerrero III was reported to have a good singing voice, and he wrote one-act plays and short stories. A number of scientists also demonstrated a knack for sports. Dr. Orville Bondoc was part of a basketball varsity team, and he also played softball and football. Dr. Eduardo Quisumbing once qualified to be a member of the Philippine Olympic soccer team, while Dr. Jose Velasco joined sports competition in shot put and boxing.

The Prolific Thinker. Prolific thinkers (and practitioners) are those who have exhibited untiring diligence both in creating opportunities to do research and actually executing these to advance their fields. They were characterized as having an exceptional desire to participate in disciplinary dialogues and not to stray from the "academic loop." They did this by publishing their research and keeping abreast in their field, either by participating in conferences, reading journals, finding opportunities to network, "connecting" with other scholars in their field, or applying for scholarship grants to study abroad. For them, pure diligence was not enough to satisfy their curiosity and produce scientific knowledge in the laboratory; the motivation should be deeper. If dedicated workers focus on what they should

produce, prolific thinkers focus on investing efforts to facilitate the process on how to produce it. As a result, these tenacious scientists were well-recognized, having received many local and international academic awards and citations later in life when they were already "reaping what they had sown," so to speak.

Another sub-characteristic of prolific thinkers is their ability to remain focused in their vocation as scientists in the face of many hardships. Scientists who have already been discussed earlier showed extraordinary assiduousness in their vocation as researchers and educators. But what made the prolific thinkers different from dedicated workers is that the former did not only show industriousness to be productive and to be of service to people. They continued to exert efforts to explore, make inquiries about nature, or perform their tasks even though there were a lot of hindrances that might seriously deter their will and desire to discover new knowledge. Table 2 shows some of the selected scientists' number of publications, number of awards and recognitions received.

Table 2. Indications of scientists being "prolific thinkers"

Scientist	Number. of Publications*	Number of Recognitions**
Fe del Mundo	At least 3 books, and more than 150 articles and treatises, some were published in *Journal of Philippine Islands Medical Association and Philippine Journal of Pediatrics*	Approximately 80
Francisco Fronda	At least 7 books, and more than 150 research papers and 500 articles, some were published in *Better Poultry and Livestock and The Philippine Agriculturist*	At least 9
Eduardo Quisumbing	At least 6 books and proceedings, and more than 136 research articles, some were published in *Philippine Journal of Science and Philippine Orchid Review*	At least 22

* Biography did not specify exact number of publications published, and awards and recognitions received throughout his/her career

** Worked with the Filipino scientist either as his/her research adviser or colleague

Table 2. Indications of scientists being "prolific thinkers" (continued)

Scientist	Number. of Publications*	Number of Recognitions**
Dolores Ramirez	At least 4 books, and at least 24 research articles, some were published in *Philippine Journal of Crop Science, and The Philippine Agriculturist*	At least 10
Juan Salcedo Jr.	More than 200 articles, some were published in *Science Review and Journal of the Philippine Medical Association*	At least 17
Clara Lim-Sylianco	At least 10 books and 134 research papers, some were published in *Asian Journal of Pharmaceutical Science and Asian Journal of Pharmacy*	At least 22
Gregorio Velasquez	47 basic and 77 scientific papers, some were published in *Natural and Applied Science Bulletin and Philippine Journal of Science*	At least 27
Gregorio Zara	At least 8 books, and several research articles published either as chapter in a book, or in *Feati Tech News*	At least 45

* Biography did not specify exact number of publications published, and awards and recognitions received throughout his/her career

** Worked with the Filipino scientist either as his/her research adviser or colleague

The Inspiring Mentor. Inspiring Mentors not only exhibited remarkable enthusiasm in doing research, but they also have the hearts to guide budding researchers. They saw their students and assistants as potential scientists, to whom they could possibly bequeath their works. Thus they acted as the younger scientists' academic parents who zealously trained and disciplined them to continue their legacy in the field and hopefully, as one scientist expressed it, "to do even greater things than what [the scientist] has already done" (Tenorio, 2000, p. 36). Mentoring may happen formally in the laboratory or in the field, or informally in casual dialogues. Apprentices may involve training the scientists' students or thesis advisees, laboratory or research assistants, and/or colleagues.

Because of their profound knowledge in the field coupled with their passion to share their wisdom, the scientists' apprentices were inspired and motivated to follow their mentors and to make their own names in their chosen fields. They felt very fortunate, honored, and thankful to be honed by such mentors who made a great impact on their careers.

Biography writers tend to highlight this scientists' image by giving noticeable emphasis on stories describing the mentor-assistant relationship. They do this by choosing to interview the former students of the scientist in focus, who themselves had become successful in their careers years after they have been mentored. Reading their testimonials, one can notice that biographers tend to portray the apprentices as greatly admiring and respecting their mentors, thus accentuating the scientist's characteristic of being an inspirational, passionate academic "hero". Table 3 shows how each selected scientist's biography highlighted his/her character of being an "inspiring mentor" by quoting some former mentees and the positions that they now hold, implicitly relating their "success" to the "mentoring" that they received from the scientists.

Table 3. The inspiring mentors and the list of some of their apprentices who excelled in their own fields (as mentioned in their respective biographies)

Scientist	Apprentice	Apprentice's Position
Ramon Barba	Lilian Pateña	Tissue culture expert, UPLB
Casimiro del Rosario	Melecio Magno	Professor (Physics)
Clara Lim-Sylianco	Lourdes Cruz	Scientist, Marine Science
Pedro Escuro	Emil Javier	Professor, Dept. of Agronomy, UPLB; former UP President
	Benjamin Ona	Plant breeder, Institute of Plant Breeding, UPLB
	Ruben Villareal	Former UPLB Chancellor
Jose Velasco	Marcos Vega	Weed expert, UPLB, and the International Rice Research Institute (IRRI)

Table 3. The inspiring mentors and the list of some of their apprentices who excelled in their own fields (as mentioned in their respective biographies) (continued)

Scientist	Apprentice	Apprentice's Position
Carmen Velasquez	Mauro Manuel	(Former) Dean of the College of Veterinary Medicine, UPLB
	Glorina Pocsidio	Outstanding Young Scientist (1986) in Zoology
Gregorio Velasquez	Magdalena Cantoria	Academician, National Academy of Science and Technology
	J.D. Soriano	Academician, National Academy of Science and Technology
	Mila Martinez-Goss	Professor (Botany)
	Ernesta Quintana	Professor (Horticulture)
	Benito Vergara	Senior plant physiologist; Director of Administration at IRRI; National Scientist
Dioscoro Umali	Fernando Bernardo	Former IRRI Deputy Director General for International Programs; President, Visayas State University
	Pedro Escuro	Professor (Plant Breeding); National Scientist
	Emil Javier	Professor, Dept. of Agronomy, UPLB; former UP President
	Ricardo Lantican	Professor, Dept. of Agronomy UPLB; National Scientist
	Ibarra Santos	Plant Breeder, Philippine Nuclear Research Institute
	Dolores Ramirez	Professor (Genetics); National Scientist
	Ruben Villareal	Former UPLB Chancellor and Dean, College of Agriculture UPLB

The Nurturing Family Man/Woman. Despite all the achievements and awards that scientists received, they still have time to perform their duties in the family. They were portrayed as having a remarkable ability to balance their work and their personal

lives as most of the scientists sampled were married and have their own families. These scientists were never portrayed to have sacrificed their family duties and responsibilities even though each was described to be very busy and productive in almost the entire biographical narrative. They were also portrayed to follow the social norm of a typical Filipino family, as father-scientists were depicted to be a loving disciplinarians, and the main providers of the family as in the cases of Dr. Gregorio Velasquez and Dr. Gregory Tangonan; whereas the mother-scientists were depicted to be a loving and caring mothers who did household chores and supported their husbands in making decisions at home, including raising their children as in the cases of Dr. Carmen Velasquez and Dr. Clara Lim-Sylianco. In this theme, scientists were also described as "God-fearing".

While the scientists knew the boundary between career and family, they apparently did not fully separate their two main duties of being a nurturing parent and an excellent scientist. In most cases, the scientists' biographers imply that the scientists used the values imbibed in their scientific activities in raising their children. These values included perseverance, obedience, tenacity, discipline, and hard work. In most cases, they also acquainted their children about their scientific works by randomly sharing about their experiments in informal settings. Table 4 shows how each scientist's biographer vividly described the scientist as a person who was successful both as a researcher and as a nurturing family man/woman. Notice the biographers' use of adjectives, as these help in constructing their images of being a nurturing parent.
see Table 4.

This part of the scientists' biography not only introduced to the readers the scientist's family members but also described how equally successful they were in managing their families. Most of the time, this discussion was on the last part of the biography after all the scientists' achievements and contributions have been discussed. This discussion gave the scientists' lives a human face. This part revealed that scientists also experienced typical successes and challenges that "common" people have while nurturing a family.

Table 4. Some descriptions used by scientists' biographers in describing the scientists as a nurturing family man/woman*

Scientist	Description
Luz Oliveros-Belardo	Quoting Alma, one of her children: "We were never pressured to follow our parents' footsteps nor compelled to be achievers like them. But they set the examples and values that were woven into our characters… all of which are important in our role as working and achieving individuals" (p. 38)
Casimiro del Rosario	"She (Dr. del Rosario's wife) became his constant inspiration and partner in all his endeavors, content to become a housewife while Dr. Del Rosario served as the family provider" (p. 8)
	"Mrs. Del Rosario vividly recalls… that she could count by her fingers the times when they had misunderstandings" (p. 8)
Juan Salcedo	"He would read weekend comics in the dailies to his children, he would also bring them to and back from school, movies and daily masses at Baclaran" (p. 115)
Alfredo Santos	"He was a religious and devoted husband, deeply attached to his family. While he was 'married' to his profession, he never neglected his family's needs, balancing his time and responsibilities between home and work" (p. 17)
Clara Lim-Sylianco	"For many young, struggling female scientists, the tug of war between family and career often results in the sacrifice of one. In Dr. Sylianco's case, both family and career flourished" (p. 48)

* All examples came from Jamias & Mendoza's *National Scientists of the Philippines (1978-1998)* published in 2000.

A general description of the structure of biographical narratives

Biographical narratives start by describing the living conditions of the "future" scientists from birth up to finishing their undergraduate degrees, pointing out how they overcome life's challenges on their way to achieving their dreams. In this part of the narrative, one can find the "signs" that make for successful scientists in the future, such as reports on their early academic

achievements, or descriptions on their demonstration of values needed for successful scientific careers. These signs implicitly paint a picture of a future successful scientist who is both book-smart and street-smart. This part also gives the reader a glimpse of the factors that might have affected how and why the "future" scientists have become successful in their fields, highlighting the scientists' innate abilities, the physical environment that contributed to their early interest in their fields, and the role of several significant others who either inspired them to succeed or taught them the values needed for them to flourish.

The next part of the narrative points out defining moments in their career after receiving their undergraduate degrees. Most of them were hired in the academe, which paved the way for their further studies abroad, often through scholarships. In this part of the narrative, the biographers highlight the new challenges that they experience abroad and point out how they excelled in their fields, both in class and in research. One can also find the people who honed and influenced their academic paths, usually professors who are regarded as "legends" in their own fields. This part of the biography usually ends by describing why they came back to the Philippines after being exposed to possible more fruitful opportunities abroad.

Towards the end of the story, the narrative then describes the subject's early careers once they got back to the Philippines with their PhD degrees. The biographers start to point out the scientists' defining contributions in their fields by highlighting the number of publications that they have published, and/or the number of graduate students that they have mentored. Furthermore, the biographers start to discuss how scientists conduct themselves when given an instructional and/or administrative post, shifting the discussion from a pure researcher to a scientist-manager. Aside from describing their academic life, biographers tend to highlight their efforts to make their knowledge put into practical use, either by communicating research results to non-scientists, spearheading extension projects on the ground, founding professional organizations, accepting posts in the government, and/or accepting consultancy

projects. The number of awards that they have received is also given much importance in the narrative, mainly to reinforce the scientists' credibility as experts and to put flesh in the old adage "you reap what you sow". These stories conclude by sharing other personal information about the scientists, such as their hobbies, and even their love life, and/or discussing their more personal roles in the family. This was seen as the standard outline for all biographical sketches included in the sample.

As seen from this structure and in the previous discussions, the local biographical sketches resemble the Bildungsroman genre. The images of scientists brought about by their descriptions in the biographical narrative seem to follow four different stages of the story – (1) struggle and exertion; (2) exploration and clarification; (3) achievement and glorification; and (4) mellowing and reflection.

The "hero" starts in a fragile state that struggles in living and exert efforts to survive and get by. Despite these toils, the hero has a dream that s/he wishes to fulfill. The hero then starts to embark in his/her journey of his/her own to explore an unfamiliar territory and find and clarify his/her purpose in life. The discipline that s/he received from his/her parents, and the moral boost that came from early indications of achievement and success provide enough impetus and courage to leave home and find him/her self.

As the hero transitions from child to teen to early adult, s/he experiences constant "tests" in the form of financial, health, and psychological struggles that later on proved to be beneficial in his transformation. The hero might have changed the course (i.e., changed career paths albeit unintentionally) of the journey due to some unexpected twists of fate. Along the way, s/he learns how to become humble to learn from his/her experience, and discovers how his/her previous attitudes and experiences – which were already honed due to previous struggles – can be used to survive in this new set of tests. As s/he survives in this territory through dedicated work and passion, s/he starts to see his/her identity that would lead him/her into physical, emotional, and intellectual "maturation".

Sometime into adulthood, s/he created his/her niche and thus moved in his/her comfort zone, a safe territory where s/he can continue surviving. Now that s/he is in the height of his/her achieved dream, the hero starts to share his/her learning and train others to "think like him/her". Others now notice his/her hard-won achievements, and thus the hero is glorified. Part of his/her transformation into maturity is becoming more open-minded (or well-rounded) in balancing his/her secular and personal responsibilities, as well as being an inspiring mentor who will train the next heroes.

After all the struggles to find his/her purpose in life, the hero is now transformed into a more mature, better person unlike before. S/he finally returns home, mellowing from the hustle and bustle of his/her lifelong journey. Now that s/he has come full circle, the hero now enjoys his/her "new and renewed" life, reflecting on his/her life well lived, the journey that transformed him/her into a better "hero".
Greene (2007) said that every biography – even scientists' – are expected to follow this formulaic plot, as both the biographers and readers expect that the life story worth telling should highlight "courageous response to obstacles" until the eureka moment is experienced, something that *Bildungsroman* emphasizes. This is the reason why biographers tend to highlight the scientists' "ambitions, passions, disappointments, and moral choices" (Nye, 2006 p. 322). This is done as an attempt to address the misconception that scientists are solitarian, special humans "who are not like us", and that their character can be emulated by "ordinary" persons. This was what is seen from the local science biographies analyzed in this study.

CONCLUSION AND RECOMMENDATIONS

This study aims to provide a general description of how local biographers write scientists' biographies. This study shows that first, local science biographies do not primarily aim to document the local history of science but rather to honor the local scientists

by making their intellectual contributions known to the public; and to encourage the readers, mostly students, to pursue science related careers. Second, Filipino scientists are described in local biographies in 12 themes: as a poor kid, a dreamer, a disciplined youngster, an achiever, an unintentional scientist, an excellent apprentice, a dedicated worker, a strict educator, a well-rounded researcher, a prolific thinker, an inspiring mentor, and a nurturing family man/woman. And third, data suggests that the narrative of local science biographies resemble the rules of *Bildungsroman* genre, or the narrative of self-transformation (or self-development).

Of course, these claims open new questions: Are there local biographies that primarily aim to contribute to the history of local science? How would these 12 themes (or images) of scientists affect the way the readers construct their images of scientists and shape their attitude towards science? Would there be other ways to tell the scientists' life story other than following *Bildungsroman*?
To answer these questions, there is a need for science communication researchers in the future to engage in research about local science biographies. To prepare these researchers, it might be good to include science biographies in the classroom discussions in science communication courses and start introducing them this research stream. This also opens possibilities of collaboration with scholars in linguistics and the humanities.

Aside from the potential topics identified above, a more in-depth quantitative study about local science biographies, like that of Elliot's (1982), would inform us a more holistic picture of what a Filipino scientist is across time based on how biographers talk about them. Elliot's (1982) take opens another potential fruitful collaboration outside the science communication scholars' circle, as that paper is considered somewhat a crossover of historical and bibliographical studies.

Also, looking at the literatures in science education gives us novel ideas about possible research topics along this line. For example, there is a research stream in science education that looks into the role of storytelling in teaching science in primary and secondary schools. Many studies in the field of education show how narratives made by, and about, scientists affect students' interest in science learning (for discussions, see Hong & Lin-Siegler, 2012). In many cases, using stories to teach science is effective (for example, see Eshach, 2009; Akarsu, Kariper, and Coşkun, 2015), and can be used to change students' ideas and images of science and scientists (Erten, Kiray, & Şen-Gümüş, 2013). Moreover, the framing of life stories can affect students' perspectives about science. For example, Hong and Lin-Siegler (2012) found that stories that highlight scientists' struggles in creating scientific knowledge have positive effects in students' science learning, while stories that focus only on scientists' achievements have a reverse effect in students' perceptions about scientists, interest in lessons in physics, recall of science concepts, and ability to solve problems in physics. It would be interesting if these findings could be validated in local settings, such as relating the use of these teaching tools with the increase in enrolment in K-12's STEM strand.

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Alzona, Encarnacion A.
Amoroso, Victor V.
Azanza, Rhodora V.
Bantayan, Nathaniel C.
Banzon, Julian A.
Barba, Ramon C.
Binag, Christina A.
Bondoc, Orville L.
Calderon, Fernando
Campilan, Dindo M.
Campos, Paulo C.
Comiso, Josefino C.
Concepcion, Isabelo
Cordero, Paciente M. Jr.
Cruz, Jose B. Jr.
Cruz, Lourdes J.
Dacuycuy, Floresma A.
Dayrit, Fabian M.
de Ocampo, Geminiano D.
de Ungria, Ma. Corazon A.
del Mundo, Fe
Del Rosario, Anacleto S.
del Rosario, Casimiro
Delmendo, Medina
Encarnacion, Jose Jr.
Endoma, Mary Ann A.
Enriquez, Erwin P.
Escuro, Pedro B.
Fronda, Francisco M.
Gregorio, Glenn B.
Guerrero, Rafael D. III
Hechanova, Ma. Regina M.
Lagmay, Alfredo
Lara, Hilario DG.
Lee-Chua, Queena N.
Lim-Sylianco, Clara
Lopez, Cecilio F.
Luis, Ernesto S.
Ma. Guerrero, Leon
Mijares, Tito A.
Oclarit, Jose M.
Oliveros-Belardo, Luz
Ostrea, Enrique M. Jr.
Palmes, Patricio P.
Palomares, Ma. Lourdes B.
Pantastico, Julia B.
Pateña, Lilian F.
Pocsidio, Glorina M.
Primavera, Jurgenne H.
Quisumbing, Eduardo A.
Ramirez, Dolores A.
Reantaso, melba B.
Reyes, Cecilia P.
Romero, Gabriel O.
Ruiz, Mari-Jo P.
Salcedo, Juan S. Jr.
Santos, Alfredo C.
Santos, Francisco O.
Sebastian, Leocadio S.
Sotto, Filipina B.
Tan, Elvira O.
Tangonan, Gregory L.
Tubangui, Marcos A.
Umali, Dioscoro L.
Velasco, Jose R.
Velasquez, Carmen C.
Velasquez, Gregorio T.
Zara, Gregorio Y.

End notes

[i] *This first science biography was that of Tyco Brahe's, written by Pierre Gassendi and published in 1654 (Kragh, 2015)*

[ii] *An example of list of biographies of the following western "science heroes" can be found in the following URL: Charles Darwin – (https://www.nndb.com/people/569/000024497/bibliography/); Louis Pasteur – (https://www.nndb.com/people/580/000072364/bibliography/); Albert Einstein – (https://www.nndb.com/people/302/000022236/bibliography/)*