AN ABSTRACT OF THE DISSERTATION OF

Chi-Chang Liu for the degree of Doctor of Philosophy in Science Education presented on April 9, 2012.

Title: Serious Fun: Life-Deep Learning of Koi Hobbyists

Abstract approved:

______________________________________________________________________

John H. Falk

Hobby activities can be viewed through the lens of informal, free-choice learning. A wide range of hobbies combine fun and learning-intensive practices, and can contribute to scientific literacy. Hobby learning involves clear goal orientation, persistence and effort, and often results in more richly and strongly connected knowledge; traits highly valued in both in and out-of-school science learning. In this study, I used koi hobbyists as subjects to discover and explore hobbyists’ information-seeking strategies under different learning scenarios. I approached koi hobbyists’ learning about koi and their koi hobby in both quantitative and qualitative ways. I designed a Stage of Engagement Model to illustrate koi hobbyists’ engagement with their hobby, and adapted Falk and Dierking’s Contextual Model of Learning to explain how personal, socio-cultural and physical contextual factors affect koi hobbyists’ learning.

An instrument was developed to assess koi hobbyists’ experience with keeping koi, knowledge about the hobby, motivation/goals, interaction with other hobbyists, and the
information-seeking strategies they used under different learning scenarios. I administered this questionnaire to koi hobbyist communities in the U.S. Pacific Northwest and online. Based on the quantitative analysis, the results supported my hypotheses that koi hobbyists chose different information-seeking strategies based on personal contextual factors such as previous experience, motivation and learning goals; socio-cultural contextual factors such as interactions with other koi hobbyists; and physical contextual factors such as the nature of the problems they encounter. Koi hobbyists also chose different information-seeking strategies based upon their stage of engagement with their hobby. The long-term potential of this study is to offer insights into how learners construct their knowledge by applying different learning strategies under different personal, socio-cultural and physical circumstances, and to provide a framework for the future study of other kinds of hobbies and hobbyists that will help to promote public scientific literacy.
Doctor of Philosophy dissertation of Chi-Chang Liu presented on April 9, 2012.

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_______________________________________________________________________
Chi-Chang Liu, Author
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Chapter One: Introduction

In the twenty-first century, an understanding of science serves not only to satisfy people’s curiosity about the environment surrounding them, but it also enhances their ability to succeed in a fast-changing, technology-based society. In order to “survive well” in the modern world, people need to continually learn, adopt, and utilize new skills and information. Therefore, scientific literacy has been emphasized for all Americans and has been seen as a goal to be achieved for science education in the U.S. since the 1990s (e.g., National Research Council, 1996; Rutherford & Ahlgren, 1993). However, we still have much to do to achieve the goal of functional scientific literacy, which focuses on people’s ability to participate in modern society in scientific ways (Anderson, Reder & Simon, 1997); particularly to meet the needs that individual’s deem important (Falk, Storksdieck & Dierking, 2007).

Formal science education mainly focuses on pre-college and college education in schools, and on learning professional skills in a work environment. Learning, however, is a lifelong activity (Banks et al., 2007), and learning in schools (K-12, college and graduate) only occupies three to five percent of our lifespan (Falk, Dierking, & Adams, 2006). In contrast, people spend considerable time learning outside of school, though the public may not always think of this type of learning as “education.” Even there has not been enough data to support the claim that this type of free-choice learning contributes to public science understanding more than formal education, there are increasing number of studies pointing in that direction (Falk & Dierking, 2010; Falk & Needham, in press).
However, such out-of-school, free-choice learning (FCL) activities often seem to catch people’s interest and imagination more easily than classroom lessons, and thus “fire up” passions and motivations to learn. Learning under such circumstances has been well documented, and hobbies are among these activities.

Hobbies are classic examples of activities that combine fun and learning-intensive practices (Azevedo, 2005). Unlike in-school learning, hobbyists engage in their chosen activities for relatively longer periods of time than are allotted to classroom activities. The time and effort expended by hobbyists usually includes searching for various types of information about one subject, applying multiple learning skills, and learning complex contexts. Thus, hobbies may fit into the classification that Papert (1980) described as “hard fun”—activities from which the practitioners gain fulfillment, and in which they work hard to learn and to achieve their goals. Individuals engaged with their hobbies are self-motivated (Azevedo, 2005). Hobbyists develop projects on their own, and create a plan to achieve the goals of those projects. The projects they develop should be challenging enough that the hobbyist will feel a sense of accomplishment and satisfaction upon the project’s completion, and will want to conduct another; and yet should not be so difficult that the hobbyist becomes frustrated and gives up (Stebbins, 2007). Hobbyists also develop “learning programs” (Azevedo, 2005), choosing what, how, when, where, from whom, and with whom to learn based on their interests, prior knowledge, and needs. Hobbyists also are noteworthy for largely relying on themselves, rather than someone else, to motivate them to find all the necessary information and resources they need to pursue their hobby. Intrinsic interest drives the hobbyist to pursue the hobby, and the
hobbyist experiences some rewards both during the process, and when achieving his/her goals.

Among researchers, there has been interest in how hobbyists become interested in and begin engaging with their hobbies, as well as how they gain the information they need to achieve their goals. According to Hidi and Renninger (2006), when a person encounters a new idea, subject or activity, his/her situational interest sometimes will be triggered, and if this situational interest can be maintained in a supportive environment, personal interest will develop which, in turn, can lead to a long-term behavioral change.

The central variables of the behavior change include knowledge, attitude, affect and behavior (KAAB). Early studies assumed that there was a linear and hierarchical relationship between these central variables: after gaining knowledge, attitude and affect will change, this then leads to the behavior change (Hoogstraten & Moltzer, 1893; Park, Kang, & Kim, 2003). However, recent studies have reported more complicated interactions between the variables, and the importance of each variable to the behavior-changing process. In fact, the relation of variables varied considerably across individuals, depending on factors such as his/her background and the situation where the change occurred (Dierking, Adelman, Ogden, Lehnhardt, Miller, & Mellen, 2004; Dierking, Chan, Kubeck, Cone, & Wolters, 2009; Pletzke, Henry, Ozier & Umoren, 2010).

Prochaska’s Stage Model of Behavior Change (Prochaska & DiClemente, 1984) suggested that a person’s behavioral changes in response to a new idea are very personal and may vary widely for different people. Falk and Dierking’s Contextual Model of Learning (2000) provides a general framework for thinking about these variables,
suggesting that free-choice learning is always a complex activity involving a variety of personal, socio-cultural and physical factors. Hobbyists, while engaging with their hobbies, will exhibit different behaviors according to their personalities, their goals and purposes, the people with whom they work, the people from whom they learn, their partners, and the situation or environment in which they engage with their hobby. In other words, hobbyist learning is always situated (see also, Lave & Wenger, 1991).

In the U.S. alone, over 14.5 million households own fish (American Pet Products Association, 2008), and “wet pets” are becoming more and more popular around the world (American Pet Products Association, 2008). Wet pet owners soon discover that they need to acquire a great deal of knowledge in order to take good care of their fish right after (sometimes even before) they purchase their fish (Livengood & Chapman, 2007). They need to learn about fish biology, aquatic ecology, aquatic chemistry, physics, microbiology, and life support systems. For those who intend to breed their fish, they even need to know about genetics (Forlines, Marks & Schmidt-Nielsen, 2003) in order to select the proper parent fish and develop confirmation and color of the offspring they want. Motivated wet pet owners join clubs, visit shows, and attend workshops and conferences to learn how to take better care of their pets. They also gain knowledge from the internet, books, and magazines, and seek information from friends, pet store employees, and other people who are experts in wet pet husbandry. Similar to other professionals and hobbyists, wet pet owners become motivated to learn more about their pets, and develop clear goals regarding what they want to learn about the breeding, care, and background of their pets.
Koi are a domesticated type of the common carp (*Cyprinus carpio*) and come in a rainbow of colors and range in size from 3 inches to 3 feet. Koi, which originated in Japan, is a popular species among ornamental fish keepers here in the U.S., due to its colorful varieties, friendly behavior, long lifespan and its ability to live in outdoor ponds and water gardens with minimal care. Koi is actually a Japanese term, which means common carp. A more specific name is *nishikigoi*, which means brocaded carp. The common carp was first aquacultured for food purposes in about the fifth century in China (Balon, 2006), and was first bred for their color in Japan in the 1820s (Jordan, 2006). Koi varieties are distinguished by coloration, patterning, and scalation. Some of the major colors are white, black, red, yellow, blue, and cream (Figure-1). Koi owners often develop a strong emotional connection with their fish, making them comparable to other common domesticated pets, and are willing to spend time, money and effort to keep their fish healthy and “happy.” Other cultural and personal characteristics associated with koi ownership are a taste for Japanese and/or Asian culture, a relaxed lifestyle, and personal expression (James, 1985).

*Figure-1.* A picture of a group of colorful koi in a pond, Boise, Idaho, USA.
In using ornamental koi hobbyists as my subjects, my research questions were:

1) What resources do koi hobbyists use to meet their hobby needs/interests?
2) How do personal or socio-cultural contextual factors influence the use of these resources?
3) What role does the stage of a koi hobbyist’s engagement with their hobby play in the use of various learning resources?

My research goal was to understand how hobbyists learn within FCL activities and situations, and what may affect their learning by either limiting or facilitating it. My objectives were:

1) to find and explore the ways hobbyists develop the knowledge to maintain their hobby at a personally determined standard;
2) to identify key factor(s) that motivate and/or limit the pursuit of this hobby; and
3) to understand the cognitive changes that arise for hobbyists during the pursuit of their hobby, focusing particularly on the learning/development of scientific knowledge about their hobby.

My hypotheses for the research questions were 1) hobbyists’ learning is influenced by personal, such as motivation and prior knowledge, socio-cultural, such as interactions with other hobbyists, and physical, such as the problems they encounter during their engagement with their hobby, contextual factors; 2) personal and socio-cultural contextual factors integrally influence hobbyists use of sources of information; and 3) the stage of a hobbyists’ engagement will also influence their use of various learning resources.
In the current knowledge age, there will be increasing associations and interactions occurring between leisure activities and learning (Falk, Ballantyne, Packer & Benckendorff, 2012). Understanding learners’ interest in, and motivation for, engaging in a learning activity has been of interest in the fields of both formal and FCL education. Because hobbyists’ learning processes share some similar characteristics with other types of FCL activities and with learning in formal settings, knowing how hobbyists learn could contribute to our understanding of learning theory and mechanisms, learning psychology, and interactions between learners and educators. The in-depth knowledge gained from studying hobbyists’ learning has the potential to be applicable to a wide range of informal and formal learning environments.

Moreover, from the educators’ point of view, it is important to discover the ways learners will most effectively achieve their learning goals, and the most important factor(s) affecting learning in FCL settings. With the understanding of learning patterns and factors that contribute to overall learning success, educators of all types, including outreach agencies can make decisions about the design of educational interventions, including when and how to best facilitate learner scaffolding. They can also determine in what ways, types, and formats information should be delivered in order to maximize the effectiveness of learning interventions aimed at professionals and hobbyists.
Chapter Two: Literature Review

Leisure and hobbies

Almost everyone (96% of U.S. citizens aged 15 and over) engages in some kind of leisure activity (United States Bureau of Labor Statistics, 2010). For many people, leisure is a source of “joy, happiness, and physical health” (Argyle, 1996, p. 6). Leisure is part of what makes life meaningful and enjoyable. Leisure also provides opportunities for individuals to have a life with “. . . the space of friendship, much parenting and nurture, community interaction and the family” (Kelly, 1983, p. 23). It is true that leisure is a significant component of everyday life (Argyle, 1996; Robinson & Godbey, 1997). Stebbins (2007) defined leisure as “uncoerced activity engaged in during free time, which people want to do, and in either a satisfying or a fulfilling way (or both); use their abilities to succeed at the activity.” Here, an uncoerced activity is an activity based on a person’s free choice, and is driven by his/her intrinsic motivations. Being satisfied and fulfilled during the process is an important characteristic of leisure activities.

Stebbins (2003) defined a hobby as “the systematic and enduring pursuit of a reasonably evolved and specialized free-time activity that leads to the acquisition of knowledge, skill, or experience” (p.7). According to Stebbins (2011), amateurs also participate in specialized leisure but with more serious professional goals. So, an amateur is at the transitional stage between hobbyist and professional but leaning more toward the professional side, depending on whether their pursuit of the activity is more professionally or recreationally oriented. Although hobbyists usually have specific learning goals and expect some outcomes, feeling pleasant, satisfied and fulfilled during
the engagement is usually considered as one of the most important intrinsic motivations which drives a hobbyist to pursue the activities, and what motivates them to stay with the hobby before they reach their learning goals (Stebbins, 2007). Hobbyists also receive intrinsic or extrinsic rewards while conducting activities related to their hobbies (Stebbins, 2007). In order to receive the rewards listed above, a hobbyist must work hard to develop certain skills and knowledge, and participate in some, if not all, of the activities that are required for the hobby (Stebbins, 1993). There has been increasing interest in knowing how people pursue and participate in their hobby and how they learn about the information and knowledge they need in order to keep this kind of leisure activity enjoyable, and this interest has been reflected in an increasing body of research worldwide on topics such as gourmet cooking (Hartel, 2006), knitting (Prigoda and McKenzie, 2007), photography (Cox, Clough and Marlow, 2008), quilt making (Gainor, 2009), backpacking (Chang, 2009) and food blogging (Cox and Blake, 2011).

**Hobbyists’ learning**

U.S. citizens spend a relatively large amount of time (5.25 hours per person per day on average) participating in leisure activities, including sports, exercise, watching TV and hobbies (United States Department of Labor, 2010). Moreover, hobbyists spend a substantial amount of time “thinking” about their hobby while they are not “doing” it (Gelber, 1999). Learning happens both while people are doing and thinking about their hobbies. All kinds of leisure activities, including hobbies, involve searching for and using information to different degrees (Hartel, 2007). Individuals engaged with their hobbies are self-directed and self-motivated (Azevedo, 2005). In order to learn and to achieve
their goals, hobbyists develop “learning programs” (Azevedo, 2005), choosing what, how, when, where, from whom, and with whom to learn, and they rely on themselves to find all the information and resources based on what they have already learned and what they need to know. They may join hobby clubs, read books, search for information online, or just talk to someone who knows more about the subject in order to gain knowledge about the hobby. The hobbyist might not be able to learn all the subjects related to the hobby as a package all at once; s/he selects what to learn next according to what s/he already knows, and constructs the knowledge in a framework that makes sense to her/him. Because this type of learning is self-motivated, the hobbyist’s learning is driven by intrinsic motivation such as interest, although at times there might be some extrinsic benefit. For example in the case of koi hobbyists, when a koi belonging to an ornamental fish hobbyist wins a grand champion award in a koi show, the hobbyist might feel pride and a sense of achievement (intrinsic rewards). He might also be admired by other hobbyists, or could sell the koi and make money (extrinsic rewards).

**The roles of interest and motivation in hobbyists’ learning**

Hobbies are classic examples of activities that combine fun and learning-intensive practices (Azevedo, 2005). Hobbyists engage in their chosen activities for relatively longer periods of time compared with other types of free-choice learning—such as museum or aquarium visiting, or watching a television special on the universe. Thus studying the learning process of hobbyists offers opportunities to understand a very different type of lifelong, free-choice learning than has been traditionally studied. The time and effort expended by hobbyists usually includes searching for various types of
information about one subject, applying multiple learning skills, and learning complex contexts.

Hobbyists have a high personal interest in their subjects and strong motivation to learn. To achieve the goal of having fun with their hobbies, hobbyists have to devote quite a large amount of effort to learning. For example, an ornamental fish hobbyist has to possess knowledge about biology, water chemistry, fish taxonomy, physics, and health management, as well as skills such as plumbing and electrical wiring, in order to keep his/her hobby to a particular standard of enjoyment. A hobbyist is also very motivated to learn. There is intrinsic interest that drives the hobbyist to pursue the hobby, and the hobbyist experiences some rewards during the process, as well as when achieving his/her goals. For example, a recreational angler may just enjoy the peace of fishing amidst beautiful scenery and feel fulfilled by that (intrinsic reward), or he may be able to catch some fish for dinner (extrinsic reward). A goal when engaging in hobby activities is something a hobbyist has in mind to accomplish. As the example of a recreational angler above, his goal for the fishing trip that day is to catch something for dinner. When his goal is achieved, he will have an extrinsic reward (fish for dinner), but he will also feel intrinsic fulfillment such as self-actualization and self-gratification (more described later in this chapter) during the process while he is pursuing his goal. Hobbyists tend to have particular goals, are motivated to learn, and emphasize the importance of learning outcomes (Stebbins, 2007). Their learning is usually driven by interests related to their hobbies (Stebbins, 2007). An “interest” shows when a subject or topic has identifications (Dewey, 1913) or meanings (Blumenfeld, 1992) for an individual. “Interest” is one of the
intrinsic motivators present when someone is satisfied by engaging in an activity without any additional reward, and it creates a tendency to respond to certain stimuli, to become involved in certain activities and to acquire certain specific skills and/or knowledge (Joseph & Edelson, 2004). According to Edelson & Joseph (2004), learning motivated by interests is of 1) natural appeal (Renninger, 2000), 2) mastery goal orientation (Shiefele, 1991), 3) persistence and effort (Hannover, 1998) and 4) more richly and strongly connected knowledge (Renninger, 2000). There are two kinds of satisfaction connected with learning a topic or subject with interest: the immediate fulfillment upon engaging with the subject or topic of interest, and the long-term benefit of developing a new skill or knowledge base and the ability to experience the interest more deeply in the future (Joseph & Edelson, 2004). When an individual has gained satisfaction from engaging with a topic or subject, s/he naturally wants to learn more about that topic or subject and becomes a motivated learner (Renninger, 2000). When learners are motivated by interest, they will be looking to gain knowledge which particularly applies to that subject, and will learn with a goal of mastering that subject, which will result in a positive effect on learning outcomes (Meece, 1991).

Hobbyists also receive rewards while conducting activities for their hobbies. Stebbins (2007, p.14) listed the personal rewards of hobbies, which are: 1) personal enrichment; 2) self-actualization; 3) self-expression; 4) self-image; 5) self-gratification; 6) re-creation of oneself through serious leisure after a day’s hard work; and 7) financial return. There are also social rewards for hobbyists, according to Stebbins’ listing (2007): 1) social attraction; 2) group accomplishment; and 3) contribution to the maintenance and
development of the group. In order to receive the rewards listed above, a hobbyist must work hard to develop certain skills and knowledge, and participate in some, if not all, of the activities that are required for the hobby.

In Stebbins’ studies (1979; 1993), hobbyists ranked personal enrichment, self-gratification, and self-actualization as the three most important rewards for themselves. This indicated that hobbyists emphasized the process of engaging with activities and events related to their hobbies. Csikszentmihalyi (1990) proposed the theory of optimal experience to illustrate the idea of what he called “psychological flow.” Flow is the sensation which comes from engaging with an intrinsically rewarding activity. It is usually self-evident, and people usually recognize the feeling but have difficulty objectively comparing it to other feeling states. A key characteristic is that the activity needs to be moderately difficult for the hobbyist. If the activity is too easy, the hobbyist would not feel any challenge and might lose interest. If it is too difficult, the hobbyist will feel frustrated or lost during the process and might lose interest as well. The hobbyists’ learning fits into this niche; it is challenging but doable and brings fun and rewards to the hobbyists while they are engaging with the hobby.

Throughout the engagement with their hobby, the hobbyist might encounter situated problems or have various projects in mind to accomplish. In order to solve the problems and complete those projects, hobbyists need to acquire information and construct knowledge. They may not be able to gather all the information and learn all these subjects all at once; they select what to learn next according to what they already know and what they need to know, and construct all the knowledge as a framework that makes sense to
them. The hobbyists gain either intrinsic rewards such as the feeling of being able to finish something or extrinsic rewards such as admiration by other hobbyists.

**What is an expert? What is a hobbyist and how is a hobbyist different from other experts, such as scientists?**

Expertise is often discussed in situated learning theories. In communities of practice, newcomers learn and become experts through interacting with other members, engaging in community events, and taking on increasing responsibilities in their involvement with their communities (Lave & Wenger, 1991). Chi (2006) defined expertise as “the manifestation of skills and understanding resulting from the accumulation of a large body of knowledge” (p. 167). Marathe, Hmelo-Silver and Liu (2007) then supplemented this definition with the idea of not only accumulating a large body of knowledge and skills, but also knowing the ways to use them, and suggested that the ways of using such knowledge and skills may vary according to the situation. There are various ways to develop expertise; one of the common ways is through formal education (Chi, Feltovich & Glaser, 1981). Professionals and hobbyists, with expertise in particular fields which might be developed in informal educational settings, are also considered to be experts (Hmelo-Silver et al., 2007).

Since hobbyists’ learning is driven by their own intrinsic motivations, and they usually develop their own packages of learning based on their needs and are free to choose any topics and subjects to learn, the ways hobbyists learn and the ways they make sense of information should be different from those of other types of experts trained by formal education systems, such as scientists. Hmelo-Silver, Marathe and Liu (2007)
conducted a qualitative study to document the differences between ornamental fish hobbyists and scientists in understanding aquariums. They found that during the interviews, the hobbyists focused more on the components of the system, whereas the scientists focused more on the abstract system, which might reflect the ways they learned the information and the goals of their learning about this subject. The ornamental fish hobbyists’ learning goal is to keep their fish healthy, while the scientist receives a more complete, systematic training in biology. Hobbyists’ purposes for learning differed from those of students in a formal classroom studying the same topic. For example, hobbyists learned the nitrogen cycle because they needed to know how to get rid of harmful waste in order to keep their fish healthy. So their learning focused on the portion of the cycle taking place within the components and the ways in which they could manipulate the water quality. However, Hmelo-Silver et al. (2007) also noted that both scientists and hobbyists were flexible in the ways they viewed aquariums; they could demonstrate both component and abstract knowledge systems when necessary. For purposes of my study, my interest lies in the ways hobbyists learn in free-choice settings rather than the ways they apply their knowledge. When studying hobbyists’ learning, many theories, methodologies and analytical approaches could be adapted from the research on expertise, since hobbyists and experts share much similarity. However, the differences between these two groups should also be seriously considered when doing such adaptations.

**The Contextual Model of Learning**

When studying hobbyists’ learning, it is important to know what factors will most affect their learning experiences, what the relationships are between these factors, and
how these factors interact. Models are usually required in order to address the above questions, to monitor how other factors contribute to successful and/or satisfying learning, and to make predictions about the outcomes in free-choice learning settings such as museums (Martin, 2004). When studying how people learn, researchers tend to consider only a single or a small number of factors which might affect the learning process. However, learning is such a complicated process that often, if not most of the time, such simplified models cannot realistically and precisely describe the phenomena (Falk & Dierking, 2000). Therefore, Falk and Dierking provided the Contextual Model of Learning as a tool to organize the complexities of learning happening in free-choice environment and this model also provides the general idea that free-choice learning is a complex activity which is driven by a variety of personal and socio-cultural factors and physical situations (Falk & Storksdieck, 2005).

The learner him/herself provides the largest number of variables in the learning process in a free-choice learning setting. How a learner learns in a free-choice learning institute such as a museum is significantly influenced by his prior interest (Adelman et al., 2000; Falk & Adelman, 2003), prior knowledge (Dierking & Pollock, 1998; Falk & Adelman, 2003) and related learning experience on similar subjects or environment (Falk, 1983; Falk, Moussouri, & Coulson, 1998). The degree of choice and control that a visitor has when participating in a learning event also plays an important role in the learner’s learning (Lebeau, Gyamfi, Wizevich, & Koster, 2001). The factors above, including prior interest, prior knowledge and degree of choice in learning are among the personal factors which influence the learning outcome, and should be considered when studying learning
in a free-choice learning setting. Also, free-choice learning is heavily affected by the socio-cultural aspects of learners, especially by the interactions and collaborations among the group (Schauble, Gleable, Lehrer, Bartlett, Petrosino, & Allen, 2002) and outside the group (guides, other people with expertise, etc.), which would affect the learning outcomes (Crowley & Callanan, 1998; Grenier, 2009; Koran, Koran, Dierking, & Foster, 1988). Moreover, the physical settings of the learning environment affect the learning experience (Falk & Dierking, 2000; Phipps & Rowe, 2010). For example, when there is no koi club available in the immediate area, a koi hobbyist can join an online koi hobby discussion forum and learn about koi in a different type of physical setting. In fact, the PEW/Internet in American Life research project (2010) reports that on a daily basis, 29% of people search for information about their hobbies online.

Taking into account the personal, socio-cultural factors and physical setting of a museum, a model with the following variables could be constructed to monitor and predict visitors’ learning outcomes (Falk & Dierking, 2000, p.137):

**Personal context:**

a. Motivation and expectations

b. Prior knowledge, interest and benefit

c. Choice and control

**Socio-cultural context:**

a. Social interactions within the visiting group

b. Facilitated mediation by others

**Physical settings:**
a. Advanced organizers and orientation

b. Design

c. Reinforcing events and experience outside the institutes

The variables listed above contribute to the learning experience in a free choice learning setting such as a museum, but can also be applied to hobbyist learning, with minor modifications. When a hobbyist learns about the hobby, his/her interest, motivation, expectations and prior experience will affect the learning process. He/she also has the control to develop his/her own learning program and has the choice about what strategies to use and what resources to learn from. He/she may also join hobby groups, or just pursue the hobby with his/her friends or family, and the interaction between him/her and other hobbyists will definitely influence the learning process and outcomes. The hobbyist can choose various sources of information to learn from, such as books/magazines, shows/exhibits, workshops, the internet, hobbyist clubs, etc., and the strength of each variable acting on the learning outcomes may differ in different hobbyists and different types of learning situations. Also, these variables should all be considered together when building models.

**Prochaska’s Stage Model of Behavior Change**

As described in the Contextual Model of Learning, previous experience/ knowledge and expectation/ learning goals, as part of personal contextual factors, play important roles in learning (Falk & Dierking, 2000). There have been studies on people’s attitude and behavior change after they gain advanced knowledge about one particular subject. For example, while evaluating attitudes toward protecting the environment and measured
attitude-relevant knowledge, Kallgren and Wood (1986) found that attitudes based on high amounts of knowledge were a better indicator of environment-related behavior than attitudes based on low amounts of knowledge. Another study done by Falk, Moussouri & Coulson (1998) showed that individuals visiting a natural history museum who strongly oriented towards the goals of both “education” and “entertainment” learned more than those who focused on either “education” or “entertainment” alone. Thus, hobbyists with different levels of experience and knowledge about their hobbies and with different goals toward to their hobbies may approach learning about their hobby differently, and their ways of learning may change when their experience and knowledge accumulate through time, potentially influencing their hobby goals.

Based on an analysis of different theories of psychotherapy, Prochaska and DiClemente (1986) developed the Stage Model of Behavior Change. The model proposed that there is actually a continuum of behavior change for any particular kind of behavior. The continuum of behavior change includes: 1) Precontemplation—not intending to take action in the near future; 2) Contemplation—intending to change in the near future; 3) Preparation—intending to take action in the immediate future; 4) Action—having made specific lifestyle changes and taken action; 5) Maintenance—evidence of long-term change; and 6) Established behavior change—will not return to the former lifestyle with 100% self-efficacy (Prochaska & Velicer, 1997). During the early stages of behavioral change, people apply cognitive, affective, and evaluative processes to progress from one stage to another, and people rely more on commitments, conditioning, contingencies, environmental controls, and support as they move toward maintenance or established
behavior change (Prochaska, Redding & Evers, 2008). Moreover, Relapse (return to the former lifestyle) might also happen at any stage of behavior change (Prochaska & Velicer, 1997). When moving toward the next stage, people will weigh the “comparative potential gains and losses,” and decide whether or not to change (Janis & Mann, 1997). When studying learning processes, a researcher must consider each learning situation is as being contextually unique, and thus which behavioral change stage the learner is in may affect the ways in which that individual behaves and applies learning strategies. The same individual may learn differently when s/he is at different stages and in different situations. For example, in their study at the National Aquarium in Baltimore (2000), Adelman, Falk and James found that when analyzing data, grouping people with similar knowledge, experience, behaviors and attitudes prior to entering the aquarium made understanding changes in visitor knowledge, attitude and behavior easier to identify and observe; these changes were not usually apparent when analyzing all samples as a whole. In their study on changes in visitors’ intentions to get involved in conservation-related activities after visiting Disney’s Animal Kingdom (DAK), Dierking et al. (2004) documented different changes in visitors who were in different stages of self-reported conservation action, and concluded that grouping visitors according to their position along the intention of conservation action continuum would be a better way to measure the impacts of a conservation-related exhibit. In addition, Dierking et al. (2004) pointed out some challenges in their efforts to apply Prochaska’s Model in the context of FCL at DAK. For example, the vast majority of the visitor samples in this study fell into a single category, the Preparation Stage (committed to conservation-related activities in general, but only
involved in a few activities), which made it difficult to analyze visitor learning and behavior change as a function of stage. Modification of this model, by creating finer scales, sub-levels within a stage or even re-scaling of the stages, were proposed as likely to be helpful for studies in the field other than public health (Dierking et al., 2004).

**Hobbyists’ situated learning**

In their Contextual Model of Learning, Falk & Dierking (2000) described not only personal contextual factors, but also socio-cultural and physical contextual factors should be considered when studying learning in free-choice learning situations. During the engagement with his hobby, a hobbyists’ learning is always situated within an environment (including both physical settings and socio-cultural interactions). For example, when a problem or situation arises, a hobbyist might join a hobbyist group or interact with other hobbyists to solve the problem. Alternatively, s/he might seek online or printed tools to deal with the problem/situation – either way, the physical and socio-cultural context of what s/he learns will be quite different in these different situations.

Tennant (1997) proposed four common themes of situated learning: 1) high-level or expert knowledge and skill can be gained from everyday experiences at work, and in the community or family; 2) domain-specific knowledge is necessary for the development of expertise; 3) learning is a social process; and 4) knowledge is embedded in practice and transformed through goal-directed behavior. The learning process of hobbyists shares some similarities with the situated perspective of learning. It is fundamentally learner-centered and need-based, and focuses on process rather than content (Lifelong Learning
Council Qld Inc. 2002, p. 1). Situated learning of hobbyists integrates four elements—content, context, community and participation:

**a. Content:**

The content is basically what is to be learned. Fine and Holyfield (1996) documented that mushroom hunting hobbyists usually learned crucial knowledge from classes which were offered by their mushroom society or an environmental agency. When attending those classes, they learned taxonomy, identification skills, cultivation ecology, and the role of the mushroom in history and culture. It is noticeable that hobbyists are self-directed (Azevedo, 2005) in choosing and developing these “learning programs” (p.2). In the mushroom hunting hobbyists’ example, though the hobbyists’ society and the environmental agency designed the courses, the hobbyists had the freedom to choose which courses to take. With ornamental fish hobbyists, the subjects might include biology, ecology, water chemistry, fish taxonomy, physics, and veterinary medicine, as well as skills such as plumbing and electrical wiring, and possibly the standards of judging different varieties of koi if the hobbyists are intending to enter contests.

**b. Context:**

The context includes situations, values, beliefs and environmental stimuli by which the learner gains and masters content. In Fine and Holyfield’s 1996 study, the newcomers usually did their first mushroom hunting with experienced hunters. The mushroom hunters agreed that learning from the workshops or classes was not enough; learning in the field is critical because the identifying cues also include the microhabitats of the
mushroom and the seasons in which the mushroom appears. In a study on woodturning hobbyists in Australia, Ehrich and Delahaye (2006) found that newcomers considered that the structured courses/sessions in which basic skills and safety issues of the woodturning hobby were covered and emphasized were very crucial and helpful in their learning experience. The satisfaction of learners to the learning process depends on the subjects and the situations they learn the subjects. The hobbyists also used some books and internet sites, such as woodworking forums, for further learning and discussion.

c. Community of practice:

Hobbyists usually join hobbyist organizations such as clubs, and participate in the club events with other hobbyists. The organizations can provide benefits such as equipment, information, and activities from which hobbyists can learn more about the hobby (Fine & Holyfield, 1996). In Baldwin’s (1999) research studying the hobby of dog sports, he documented that the learning of dog sport hobbyists usually begins with joining a local dog sport club. In the club, new members learn and practice dog handling skills, study the history and standards for various breeds, and learn to understand the rules of the AKC (American Kennel Club). They interact closely with other members, learn from members who know more than they do about the subjects they are interested in, and share their knowledge with other members. In the wood turners’ case (Ehrich & Delahaye, 2006), the hobbyists began their learning and got a feel for how to perform various skills by watching demonstrations by instructors and experienced hobbyists, and modeling them. They also practiced while being guided and monitored by conveners, and received
instant feedback when things did not go well. They received advice and help from peers as well.

d. Participation:

According to Lave and Wenger (1991, p. 36), newcomers learn by participating in community events and “understand through increasing involvements.” The dog sport hobbyists viewed attending dog shows and other related events as educational activities. The newcomers could find opportunities to interact with experts, and there were workshops for advanced learning (Baldwin, 1999). Light (2006) documented the social world of surfers in Australia and observed that newcomers were introduced to sources of information and resources and were encouraged to move toward fuller participation in club events as soon as they joined the club. The newcomers then learned the skills and knowledge of surfing from experienced club members as they interacted with each other.
Chapter Three: Materials and Methods

a) Method overview

In this study, I focused on ornamental koi hobbyists as an example of hobbyists in general, and their learning activities as an indicator of how hobbyists utilize FCL situation to support their learning. My research goal was to understand how hobbyists learn within FCL situations and while engaged in FCL activities, and what affected their learning, either limiting or facilitating it. My research questions were:

1) What resources do koi hobbyists use to meet their hobby needs/interests?
2) How do personal or socio-cultural contextual factors influence the use of these resources?
3) What role does the stage of a koi hobbyist’s engagement with their hobby play in the use of various learning resources?

My objectives are: a) to find and explore the ways hobbyists develop the knowledge to keep their hobby at a particular standard; b) to identify which factor(s) will motivate and/or limit their pursuing this hobby; and c) to discover the hobbyists’ cognitive changes during the development of their hobby, focusing particularly on the learning/development of scientific knowledge about their hobby. In this study, I explored koi hobbyists’ learning in both quantitative and qualitative ways. The quantitative study focused primarily on understanding the hobbyists’ motivations for pursuing the ornamental fish hobby, and assessing factors which would affect their engagement. I modified the idea of Falk and Dierking’s (2000) Contextual Model of Learning and built a model encompassing personal, socio-cultural and physical factors which affect koi hobbyists’
interest in the hobby (Figure 2). I have developed a questionnaire to evaluate koi hobbyists’ knowledge about their hobby, to determine the potential factors which affect their learning, and to assess the importance of these factors for the hobbyists when engaging with their hobby. The qualitative study focused more on the learning processes of hobbyists in daily settings, and how factors such as environment, other hobbyists, and the hobbyists’ organizations/clubs, as well as hobbyists’ participation in the activities associated with the hobby, affected hobbyists’ learning processes. I also conducted field observations of hobbyists during their engagement with their hobby in order to document and analyze their learning processes, and conducted in-depth interviews with hobbyists about their learning experiences.

*Figure 2.* A model illustrating the potential factors which affect hobbyists’ learning. This model was also used as a guideline when conducting in-depth interviews.
b) Instruments for quantitative and qualitative study

The questionnaire I designed for this study included three parts. The first part contained questions about the participants’ engagement with their koi hobby. This included information about years of experience with the hobby, and frequency of participation in activities such as joining koi hobbyist clubs, attending koi shows/competitions, and breeding koi. In this part, I also collected information about which information sources the participants used to seek answers to different types of questions/problems (selection or identification of koi varieties, pond construction, water quality, nutrition and disease) encountered while taking care of their koi. Based on my observation and interview with koi hobbyists in my pilot study (would be described later in this chapter), my previous work on ornamental outreach and a koi expert’s (Dr. Tim Miller-Morgan, DVM, Oregon Sea Grant Extension Veterinarian) suggestion, I summarized sixteen different kinds of information sources for the participants to select from, including: documentary web sources, online koi hobbyist discussion boards, books/magazines, friends in the koi business, friends who are considered koi experts, friends who are also koi hobbyists, chain pet stores, private pet stores, fish-only pet stores, koi-only retail shops, garden centers, koi hobbyist clubs, koi shows/events, educational programs such as workshops/conferences, fish vets and fish biologists. I was also open to any other options that I might discover over the course of the study.

The second part contained questions about how the participants viewed their koi hobby. I used a four-point Likert-rated scale from “strongly disagree,” and “disagree” to
“agree” and “strongly agree” to measure the participants’ responses. Questions in this part were about participants’ personal background, motivation, and their interaction with family, the koi hobbyist community and online koi hobbyist communities.

The third part contained questions to assess participants’ knowledge about koi and their koi hobby. There were twelve true/false, fill-in-the-blank and multiple-choice questions. The highest possible score was 41 points, which included 12 points for koi varieties, 9 for pond construction, 7 for water quality, 1 for nutrition and 12 for disease. Measuring a complex construct, such as knowledge, is challenging (Murphy & Woods, 1996), so I attempted to access koi hobbyists’ knowledge level about koi and koi keeping using the multi-dimensional learning constructs of extent, breadth and depth developed by Falk (2003). Accordingly, I sought the aid of koi experts in developing this part of the questionnaire; specifically Dennis Glaze, Curator of Animal Husbandry at Hatfield Marine Science Center, Tim Miller-Morgan, DVM, Oregon Sea Grant Extension Veterinarian, and Tony Prew (All Japan Koi), a local koi retailer. My goal was to ensure that I could accurately and reliably distinguish groups of koi hobbyists with different levels of knowledge about koi and koi husbandry.

To ensure the broadest possible participation in the survey, I designed an online version of this questionnaire (URL: http://ipmnet.org/koi/Part0.aspx). The fact that anyone, anywhere in the world could potentially answer the survey posed a potential problem given my goal of including only North American respondents. However, I was able to utilize the respondents IP addresses to exclude responses from individuals participating from outside the U.S. and Canada. In addition to the online version of the
survey, I also administered paper-based versions (Appendix A) when doing interviews and while at koi shows and koi hobbyist club meetings.

For the purpose of checking and establishing the validity of this study, multiple approaches were used to assess the learning processes of koi hobbyists while they were engaging with the hobby for methodological triangulation (Patton, 2002). In the qualitative part of this study, audio and video recording were conducted during the observations, as well as field note-taking. In-depth interviews were conducted as a guided conversation (Rubin & Rubin, 2005), in order to assess the koi hobbyists’ motivations to engage with this hobby, and the ways they think about learning about their hobby and learning about science. The guiding questions for interview were shown in Appendix B.

c) Locations and potential data collection participants

Data collection for this study was done between June 1 and October 31, 2011. The data for quantitative analysis were collected at koi shows, garden shows, and the Oregon Sea Grant extension outreach program in the greater Portland, Oregon and Seattle, Washington areas. Members of the Northwest Koi and Goldfish Club, the Washington Koi & Water Garden Society, the Idaho Water Garden & Koi Society, and the Oregon Koi and Watergarden Society were also selected for the questionnaire survey. I was personally present at all of these shows and club meetings when data were collected. I actively recruited and talked with people, explaining the importance of the study so that the participants would have an idea of what the survey was about. I distributed hard copies of the survey during the shows and meetings, as well as bookmarks with the URL link to the online survey. The participants had the choice of doing the survey on site or
doing it online. The URL link for the online version of my questionnaire survey was also sent to the chairpersons of the member clubs of the American Koi Club Association (AKCA), together with a letter explaining the purpose of this study and our privacy policy; all were invited to participate in the survey and to encourage their members to participate as well. There were 93 member clubs under AKCA. I posted a YouTube video of me presenting a seven-minute talk about my koi hobbyist survey, and invited koi hobbyists to participate on Koi TV (http://www.koi.tv/Play.aspx?videoID = 699). I also posted the explanatory letter and URL link on the following koi hobbyist discussion forums, encouraging the forum viewers to participate in the survey:

- The Pond Forum (http://www.thepondforum.com/forum.php)
- Koimag (http://members4.boardhost.com/koimag/)
- Koi-Bito (http://www.koi-bito.com/forum/main-forum/)

Furthermore, I registered as a member of The Pond Forum, logged on constantly and answered questions about the survey. There were 306 valid responses for the questionnaire survey collected during the data collection period. In order to compare the differences in knowledge about koi and the koi hobby between koi hobbyists and non-koi hobbyists, I also randomly selected five visitors to the Hatfield Marine Science Center (HMSC) who did not have koi to participate in the third part of my questionnaire.

Subjects for in-depth interviews were selected from the members of the Northwest Koi and Goldfish Club, the Washington Koi & Water Garden Society, the Idaho Water Garden & Koi Society, and the Oregon Koi and Watergarden Society, as well as from the
koi hobbyists I met at the shows I attended. I also interviewed a koi hobbyist that I knew from an online discussion forum (the Pond Forum). After the regular consent process, I interviewed the participants in the koi shows or at the club meetings, visited them at their houses or called them at their convenience. There were 12 koi hobbyists interviewed during the data collection period.

Subjects for field observation were selected during the club meetings and koi shows, and also from interactions on the online koi hobbyist discussion forum. I focused my observations on newer members of the four clubs, since newer hobbyists usually will perform a greater number of learning actions, and the learning trajectory of newer hobbyists should be steeper and more overt, and thus easier to document.

As for member check, I restated the interviewees’ answers back to them to ensure I received clear and correct information from them. Also, after transcribing the audio recordings, I sent the transcriptions of the interview back to the interviewees and asked them to change or add any information to ensure that I documented what the interviewees really meant to say. I would share the result of this study with my interviewees after this study is complete as a final member check.

d) Data analysis

Data from the questionnaire were used for the quantitative analysis. I modified James Prochaska’s (1980) Stages of Change Model to illustrate the stages of a person’s involvement in a hobby (Figure 3). I defined each engagement stage of koi hobbyists pursuing their hobby according to whether they currently have koi, used to have koi or do not have koi, their years of experience and their goals in koi keeping as following:
Stage 0. Non-hobbyists:

People do not have koi and have neither interest nor intention to have koi in the nearly future. Some day in the future, their thought of keeping koi might be triggered by intrinsic or extrinsic stimuli and they start to seriously consider about keeping koi, and then they move to Stage 1.

Stage 1. Consideration:

People do not yet have koi at home, but would seriously consider having them. Some will start to collect information about their future koi. Because they do not yet have koi, it is difficult for researchers to target this group. People in this stage might stop thinking about having koi for various reasons, without moving on to keeping koi.

Stage 2. Action:

People have kept koi for three years or less. They have been gathering information about their fish and have enough knowledge to start with. In time, they might become Stage 3 or Stage 4 hobbyists, depending on their goals for keeping koi. They might also give up keeping koi for various reasons and become Stage 5 hobbyists.

Stage 3. Maintenance:

People are continuing to keep their koi. They maintain their fish and fish habitats at an enjoyable standard, and may have added, or be planning to add, more fish or more tanks/ponds, or to expand or modify their existing tanks/ponds. Koi hobbyists might stay in this stage until they decide to stop this hobby, or they might consider moving forward and start entering their koi in shows or breeding their koi, and then become a Stage 4 hobbyist.
Stage 4. Becoming an expert:

People are actively attending professional events such as shows and contests, and they should at least win one award from those contests, by definition, to be Stage 4 hobbyists. Otherwise, they should intentionally breed their koi to be in this group. Koi hobbyists at this stage have to process wide varieties of knowledge such as knowledge and koi varieties (to know how to select a koi with potential to be turned into shows), koi disease and nutrition (to maintain their fish in a good showing standard), water quality and pond construction (to keep their fish healthy) in order to achieve their goals of showing fish or breeding fish. Some hobbyists in this group might give up this hobby and move to Stage 5. Some of the hobbyists in this stage may become professional koi keepers or breeders.

Stage 5. Termination:

People give up their hobby for various reasons. Even though they do not have koi at this point, similar to Stage 1 hobbyists, they are different from people in Stage 1 because they have gained experience and knowledge. They might become “active” again should circumstances change and move to Stage 1 and start the transition again.

Stage 6. Professional:

People turn this hobby into their part time or full time job and make financial benefit out of the hobby.
Figure 3. A model illustrating the hobby engagement stages of koi hobbyists. Stages 1, 2, 3, 4 and 5 within the shading are the subject of our discussion in this study. Stage 0 refers to people who are not considering keeping koi and Stage 6 refers to people who are professional koi keepers/breeders who sell koi for financial profit.

In this study, I only focused on the learning process of Stage 1,2,3,4 and 5 hobbyists, but also used some non-hobbyists (Stage 0) data to draw a baseline knowledge level about koi and koi hobby (would described in more detail later). I sorted the participants into the five-stage categories according to the definition I gave to each stage. I then described the characteristics of participants in each stage. I utilized ANOVA to compare
the difference between the total scores of participants in different stages on Part 3 of the questionnaire, and compared the mean differences between non-koi hobbyists, Stage 1, 2, 3, 4 and 5 participants using independent sample t-tests. I also did correlation analysis between the scores in Part 3 of the questionnaire and other factors such as number of years owning koi, membership in koi clubs, number of years of club membership, frequency of participation in club activities, attendance at koi shows, years of experience attending koi shows, frequency of koi show attendance in the past three years, whether or not participants had entered koi in the shows, awards won at shows, professional training, experience breeding koi, and experience selling koi.

To document information-seeking strategies, I listed 16 information sources including documentary web sources, online koi hobbyist discussion boards, books/magazines, friends in the koi business, friends who are considered koi experts, friends who are also koi hobbyists, chain pet stores, private pet stores, fish-only pet stores, koi-only retail shops, garden centers, koi hobbyist clubs, koi shows/events, educational programs such as workshops/conferences, fish vets and fish biologists, then asked participants to choose whether they regularly, occasionally or never use each source when they have questions on different subjects (koi varieties, water quality, pond construction, nutrition, and disease). From this analysis I generated an index of information sources used generally for a particular subject by calculating the number of information sources used (whether regularly or occasionally) by the participants under a particular subject. I generated an index of information sources used generally by calculating the number of information sources used (whether regularly or occasionally)
by each participant under different subjects and dividing by the number of subjects for which that participant listed sources. I also generated an index of information sources used regularly by calculating the number of information sources used by each participant under different subjects (only those marked as regularly used) and dividing by the number of subjects for which that participant listed sources. I tested the relationships between these indices and other factors such as Stage of Engagement, knowledge about koi, and experience with koi, koi clubs, and koi shows.

Data from the observations and interviews were used for the qualitative analysis. In the qualitative analysis, I selected koi hobbyists in each of the stages of involvement for in-depth interviews, as well as conducting field observations of such learning activities as building a pond, buying fish, or talking to other koi club members during club meetings. I also selected two distinctive cases, in which both interviewees were in Stage 2 of engagement both one’s goal is to be Stage 3 and the other’s is to be Stage 4, to illustrate how koi hobbyists learn differently when the personal, socio-cultural and physical contextual factors are different.

Transcripts of field observation and interview data of the selected participants were then sorted by significant data fitting my guiding question and then coded by repeating ideas (Fossey, McDermott & Davidson, 2002). The coded data were then examined, modified and grouped. These coded data, together with quotes were used to enrich and qualitatively support the quantitative results.
e) Subjectivity statements

There were four phases in this study. In the first phase, I delivered questionnaires to the koi hobbyists and gathered information about the hobbyists from koi/water garden shows, pet stores, garden centers and the internet. I approached the study as an observer at this phase. I did not have any interaction with, or knowingly any effect on my subjects. In the second phase of this study, I observed the sample population when they were pursuing, engaging with and working on their hobby. I also approached the study as an observer at this phase. I did not have interaction with, or knowingly any effect on my sample population. In the third phase of this study, I joined an outreach program (Ornamental Fish Health Program, Oregon Sea Grant) as part of the expert team and observed the koi hobbyists when they were interacting with the experts. At this phase, I approached the research through participant observation (Spradley, 1980). In other words, I chose my subjects for this study when they were interacting with the settings in which the hobby activities took place. As Burgess (1984) stated, “the value of being a participant observer lies in the opportunity that is available to collect rich detailed data based on observations in natural settings” (p.79). One of the criticisms of this approach is that the participants’ behavior might be affected by the observers and so might be fundamentally different. Because of this, I followed Burgess’ (1984) recommendation that an observer-as-participant should keep some distance from the participants, so that the participants’ behavior would not be affected by me. In the last phase, I conducted in-depth interviews with the koi hobbyists. I approached the subjects as an interviewer and
asked mostly open-ended questions so that the interviewees had maximum control over describing themselves.

**f) Pilot study**

On June 30 and July 1, 2010, I attended the 30th Annual Goldfish and Koi Show of the Northwest Koi and Goldfish Club in Portland, Oregon to conduct my pilot work for this study. The main purpose of this pilot study was to gain general ideas about koi hobbyists and to test an instrument I had developed to assess factors that affect koi hobbyists’ motivations to engage with their hobby. I also used the pilot to determine how to categorize koi hobbyists into different groups according to their different levels of involvement with their hobby. There were 28 samples collected during the two-day period and 1, 6, and 21 samples were categorized into Stages 2, 3 and 4, respectively. There were no samples categorized into Stage 1 or 5. 21 of the hobbyists had joined a koi club and participated actively. The 28 hobbyists gained their knowledge from multiple sources including books/magazines, hobbyist clubs, shows/contests, koi-specific retail stores, and the internet. Only some of them (8/27) had related professional training. Most of them (25/28) thought their experience with keeping other types of fish as pets helped them when pursuing their koi hobby, and less than half of them (12/28) thought that knowledge they had learned in school was important to this hobby. Feelings of learning (23/28), of doing something well (22/28) and of relaxation (27/28) were important to these koi hobbyists, but only 1 out of 28 thought the financial return was important. There were 12 females and 16 males in this survey, and most of them (22/28) were over 50 years old.
With advice from Dr. Falk and help from Dr. Miller-Morgan, I made some changes to my instrument and developed another instrument to “measure” the knowledge level of koi hobbyists. With the knowledge level measurement (dependent variable), I was able to assess which factors (independent variables) affected koi hobbyists’ learning while pursuing their hobby. I tested this instrument at the 19th Annual Koi Show of the Washington Koi & Water Garden Society in Bellevue, Washington on September 11 and 12, 2010. There were 18 samples collected during the show; 10 were males and 8 were females. About half (10/18) of these hobbyists were over 50 years old. The scores these hobbyists received on the test showed a normal distribution which indicated that this instrument could be used to distinguish between hobbyists based upon differing knowledge levels. Because of the small sample size, I did correlation analysis in order to determine the trend of potential relationships. The results showed that those hobbyists who agreed more that they learned about koi from the internet, books/magazines, family members and other koi hobbyists tended to have a higher knowledge level than those who disagreed that they learned about koi from the internet, books/magazines, family members and other koi hobbyists, with Pearson’s R = 0.39, 0.46, 0.45 and 0.39, respectively. It also showed that those hobbyists who valued more their previous experience with keeping other fish, and the feelings associated with people visiting their ponds to enjoy seeing their fish, tended to obtain higher scores on the knowledge level test (with Pearson’s R = 0.51 and 0.40) than those who less value that their previous experience with keeping other fish, and the feelings associated with people visiting their ponds to enjoy seeing their fish.
Chapter Four: Results

Quantitative analysis

There were 306 valid responses to the questionnaire survey: 285 collected from the online version of the survey and 21 collected in person by the researcher from koi shows, koi club meetings, and while doing interviews.

Among the participants who currently own koi (n = 292), 59.2% had owned koi between 1 and 10 years (n = 173), 27.1% between 11 and 20 years (n = 79), 8.9% between 21 and 30 years (n = 26), 4.5% between 31 and 40 years (n = 13) and 0.3% over 40 years (n = 1). Among the valid responses, 72.1% (n = 220) of the participants are current or former koi club members, and 27.9% (n = 85) had never been a member of a koi club. For those who are current or former koi club members, 72.2% (n = 156) had participated in club membership for 1-10 years, 23.1% (n = 50) for 11-20 years, 3.7% (n = 8) for 21-30 years and 0.9% (n = 2) for 31-40 years. 30.5% (n = 63) of those koi club participants attended club activities fewer than 5 times per year, 21.9% (n = 46) attended between 5 and 8 times per year, 34% (n = 72) between 9 and 12 times per year, and 13.3% (n = 28) attended club activities more than 12 times per year.

Three-quarters (73.4%) of the participants had attended koi shows or had attended koi shows in the past, and one quarter (26.6%) had not attended koi shows. Among those koi show attendees, 79.2% (n = 168) had attended koi shows for 1-10 years, 17.5% (n = 37) had attended shows for 11-20 years, 1.9% (n = 4) for 21-30 years and 1.4% (n = 3) for 31-40 years. 60.2% (n = 130) of these koi show attendees attended fewer than 2 shows per year during the past 3 years, 30.1% (n = 65) attended 2-3 shows per year and
9.7% (n = 21) attended more than 3 koi shows per year. Among those koi show attendees, about half (49.8%; n = 111) had exhibited their koi in one or more shows and half (50.2%; n = 112) had not. For those who had exhibited their koi in a show, nearly all (93.7%; n = 111) had won awards.

Of the survey participants, 21.6% (n = 66) had had some kind of professional training related to koi and their koi hobby, and 78.4% (n = 239) had not. 14.1% (n = 42) of the participants had intentionally bred their koi and 85.9% (n = 256) had not. 14.4% (n = 43) of the participants had sold their koi and 85.6% (n = 255) had not.

Using the Stage of Engagement model, I categorized the participants into 5 stages according to the number of years of experience with their koi hobby, experience with intentionally breeding koi, and experience with selling koi. Among the 306 participants, 2.6% (n = 8) were categorized as Stage 1 hobbyists, 4.2% (n = 13) as Stage 2, 50.3% (n = 154) as Stage 3, 41.8% (n = 128) as Stage 4, and 1% (n = 3) as Stage 5 koi hobbyists. I also randomly selected five visitors to the Visitor Center at Hatfield Marine Science Center, Newport, OR, USA who do not had koi and had never considered keeping koi. I asked these five participants to take the questionnaire survey (Part 3 only) in order to compare the differences in koi hobby related knowledge between non-koi hobbyists and koi hobbyists. When comparing the scores obtained by this group in Part 3 of the questionnaire survey with those of other participants, I labeled the non-koi hobbyists as Stage 0 participants.

The mean score of Stage 0 participants was 15.4 ± 0.9 (n = 5). The mean score of Stage 1 participants was 29.43 ± 5.0; of Stage 2 participants, 30.04 ± 5; of Stage 3
participants, 30.4 ± 6.2; of Stage 4 participants, 34.8 ± 4.4; and of Stage 5 participants, 29.3 ± 3.8. Figure 4 shows the differences in koi knowledge level between koi hobbyists at different stages of engagement. The mean scores of these six groups of participants were significantly different from one another (one-way ANOVA, F = 20.647, n = 306, p < 0.001). Among each group, Stage 0 scores were significantly lower than all other groups, and Stage 4 scores significantly higher than all other groups (Table 1). Hobbyists at Stage 3 had slightly higher scores (mean = 30.4, n = 144) than those at Stage 2 (mean = 30.0, n = 23) and Stage 5 (mean = 29.3, n = 3), but those differences were not statistically significant (Table 1).

Figure 4. Differences between scores on the “koi quiz” (part 3 of the questionnaire) for koi hobbyists in different stages. Stage 0 hobbyists were participants with no experience in koi keeping, who have never considered keeping koi.
Table 1

*Sample Sizes and Mean Differences between “Koi Quiz” Scores for Hobbyists in Different Stages*

<table>
<thead>
<tr>
<th>Sample Size</th>
<th>Mean Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Stage 0</td>
</tr>
<tr>
<td>Stage 0</td>
<td>(n = 5)</td>
</tr>
<tr>
<td>Stage 1</td>
<td>(n = 8)</td>
</tr>
<tr>
<td>Stage 2</td>
<td>(n = 23)</td>
</tr>
<tr>
<td>Stage 3</td>
<td>(n = 144)</td>
</tr>
<tr>
<td>Stage 4</td>
<td>(n = 128)</td>
</tr>
<tr>
<td>Stage 5</td>
<td>(n = 3)</td>
</tr>
</tbody>
</table>

* indicates that the p-value is less than 0.01.

** indicates that the p-value is less than 0.001.

Participants’ scores in Part 3 of the questionnaire showed significant positive correlation to: their years of experience keeping koi (Pearson Correlation = 0.12, p = 0.033); how often they attended koi club activities (Pearson Correlation = 0.12, p = 0.036), and how many shows they attended per year in the past three years (Pearson Correlation = 0.15, p = 0.011). Participants’ scores in Part 3 of the questionnaire showed no significant correlation to their years of club membership (Pearson Correlation = 0.06, p = 0.346) or years of attending koi shows (Pearson Correlation = 0.08, p = 0.150). Participants who were or had been koi club members (independent sample t-test, t = 2.204, p = 0.028), who currently attend or formerly attended koi shows (independent sample t-test, t = 3.191, p = 0.001), who received koi-related professional training
(independent sample t-test, \( t = 4.047, p < 0.001 \)), and who entered their koi into shows and competitions (independent sample t-test, \( t = 5.100, p < 0.001 \)), had significantly higher scores in Part 3 of the questionnaire than other koi hobbyists (Table 2). However, there was no significant difference in the Part 3 scores of participants who won awards in koi shows, versus those who did not (independent sample t-test, \( t = 0.159, p = 0.874 \)).

Table 2

*Differences in Knowledge Levels among Hobbyists Attending Different Koi-related Activities*

<table>
<thead>
<tr>
<th>Activity</th>
<th>Mean (n)</th>
<th>t</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Club member</td>
<td>32.5 (220)</td>
<td>30.7 (86)</td>
<td>2.204</td>
</tr>
<tr>
<td>Attending koi shows</td>
<td>32.7 (225)</td>
<td>30.0 (81)</td>
<td>3.291</td>
</tr>
<tr>
<td>Receiving related professional training</td>
<td>34.3 (67)</td>
<td>31.3 (239)</td>
<td>4.047</td>
</tr>
<tr>
<td>Entering koi in shows</td>
<td>34.6 (111)</td>
<td>30.7 (112)</td>
<td>5.100</td>
</tr>
<tr>
<td>Receiving awards</td>
<td>34.8 (104)</td>
<td>34.4 (7)</td>
<td>0.159</td>
</tr>
</tbody>
</table>

As for information-seeking strategies, the mean of the index of information sources used generally for Stage 1 participants was \( 9.90 \pm 4.28 \); for Stage 2 participants, \( 5.92 \pm 2.06 \); for Stage 3 participants, \( 6.21 \pm 2.80 \); for Stage 4 participants, \( 8.03 \pm 2.39 \); and for Stage 5 participants, \( 6.46 \pm 1.21 \). Figure 5 shows the differences in the index of
information sources used generally between koi hobbyists at different stages of engagement.

Figure 5. Differences between the indices of information sources used generally and scores for koi hobbyists in different stages when they search for information to solve problems during their engagement with their koi hobby.

The mean index of information sources used generally showed significant differences between these 5 groups of participants (one-way ANOVA, $F = 11.170, n = 305, p < 0.001$). The mean index of information sources used generally of Stage 1 and Stage 4 participants was significantly higher than that of Stage 2 and Stage 3 participants,
but only slightly higher than Stage 5, that difference having no statistical significance.

The mean index of information sources used generally of Stage 1 was slightly higher than Stage 4, that of Stage 4 was slightly higher than Stage 5, that of Stage 5 was slightly higher than Stage 3, and that of Stage 3 was slightly higher than Stage 2, but there was no statistical significance to any of the differences (Table 3).

**Table 3**

*Differences between Index of Information Source Generally Used Scores of Hobbyists in Different Stages*

<table>
<thead>
<tr>
<th></th>
<th>Stage 1</th>
<th>Stage 2</th>
<th>Stage 3</th>
<th>Stage 4</th>
<th>Stage 5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stage 1</td>
<td>-3.98*</td>
<td>-3.69*</td>
<td>-1.87</td>
<td>-3.43</td>
<td></td>
</tr>
<tr>
<td>Stage 2</td>
<td></td>
<td>0.29</td>
<td>2.10**</td>
<td>0.54</td>
<td></td>
</tr>
<tr>
<td>Stage 3</td>
<td></td>
<td></td>
<td>1.81**</td>
<td>0.25</td>
<td></td>
</tr>
<tr>
<td>Stage 4</td>
<td></td>
<td></td>
<td></td>
<td>-1.56</td>
<td></td>
</tr>
<tr>
<td>Stage 5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Note: The ranking of mean scores of information source generally used is 2 < 3 < 5 < 4 < 1.*

* indicates that the p-value is less than 0.01.

** indicates that the p-value is less than 0.001.

The mean of the index of information sources used regularly of Stage 1 participants was $5.59 \pm 4.30$; of Stage 2 participants, $2.92 \pm 2.16$; of Stage 3 participants, $2.50 \pm 2.12$; of Stage 4 participants, $3.67 \pm 2.48$; and of Stage 5 participants, $4.33 \pm 3.21$. Figure 6 shows the differences between the indices of information sources used regularly of koi hobbyists at different stages of engagement.
Figure 6. Differences between indices of information sources used regularly and scores for koi hobbyists in different stages when they search for information to solve problems during their engagement with their koi hobby.

The mean index of information sources used regularly showed significant differences between these 5 groups (one-way ANOVA, F = 6.750, n = 305, p < 0.001). Among each group, the mean index of information sources used regularly of Stage 1 and Stage 4 participants were significantly higher than Stage 3 (t = 2.019, df = 7.179, p = 0.082 and t = 4.182, df = 251.343, p < 0.001, respectively). The mean index of
information sources used regularly of Stage 1 was slightly higher than Stage 5, that of Stage 5 slightly higher than Stage 4, and that of Stage 3 slightly higher than Stage 2, but there was no statistical significance to any of the differences (Table 4).

Table 4

*Mean Differences between Index of Information Sources Regularly Used Scores of Hobbyists in Different Stages*

<table>
<thead>
<tr>
<th>Stage 1</th>
<th>Stage 2</th>
<th>Stage 3</th>
<th>Stage 4</th>
<th>Stage 5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stage 1</td>
<td>-2.67</td>
<td>-3.09</td>
<td>-1.92</td>
<td>-1.26</td>
</tr>
<tr>
<td>Stage 2</td>
<td></td>
<td>-0.42</td>
<td>0.74</td>
<td>1.41</td>
</tr>
<tr>
<td>Stage 3</td>
<td></td>
<td></td>
<td>1.16**</td>
<td>1.83</td>
</tr>
<tr>
<td>Stage 4</td>
<td></td>
<td></td>
<td></td>
<td>0.67</td>
</tr>
<tr>
<td>Stage 5</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note. The ranking of mean scores of information source generally used is 3 < 2 < 4 < 5 < 1.

* indicates that the p-value is less than 0.01.

** indicates that the p-value is less than 0.001.

Koi hobbyists who are or formerly were koi club members (independent sample t-test, \( t = 5.463, p < 0.001 \)), who attend or formerly attended koi shows (independent sample t-test, \( t = 5.404, p < 0.001 \)), who received koi-related professional training (independent sample t-test, \( t = 4.410, p < 0.001 \)), who entered their koi into shows or contests, (independent sample t-test, \( t = 3.668.100, p < 0.001 \)), and who won at least one award in a contest (independent sample t-test, \( t = 2.759, p = 0.007 \)), tended to have significantly higher scores in their index of information sources used generally. The index of information sources used generally showed significant positive correlation to:
years of experience keeping koi (Pearson Correlation = 0.20, p = 0.001), years of koi club membership (Pearson Correlation = 0.13, p = 0.049), frequency of attending koi club activities (Pearson Correlation = 0.308, p < 0.001), years of koi show attendance (Pearson Correlation = 0.144, p = 0.037), number of shows attended per year in the past three years (Pearson Correlation = 0.186, p = 0.007), and the scores that participants gained in Part 3 of the questionnaire (Pearson Correlation = 0.173, p = 0.002).

Koi hobbyists who are or formerly were koi club members (independent sample t-test, t = 5.128, p < 0.001), who attend or formerly attended koi shows (independent sample t-test, t = 3.825, p < 0.001), and who entered their koi into contests at shows (independent sample t-test, t = 3.668.100, p < 0.001) tended to have a significantly higher index of information sources used regularly. The index of information sources used regularly was significantly positively correlated to years of experience keeping koi (Pearson Correlation = 0.135, p = 0.020), how often the participants attended koi club activities (Pearson Correlation = 0.201, p = 0.003) and the scores that participants gained in Part 3 of the questionnaire (Pearson Correlation = 0.128, p = 0.025). However, this index was not significantly correlated with years of experience belonging to koi clubs (Pearson Correlation = 0.065, p = 3.44), years of experience attending koi shows (Pearson Correlation = 0.058, p = 405) or the number of shows attended per year in the past three years (Pearson Correlation = 0.077, p = 0.267).

I also gathered information on whether or not the participants used the same sources of information for questions on different subjects. The indices of information sources indices used generally for a particular subject indicated that the participants in this study
used different sources for the five different subjects (one-way ANOVA, \( F = 6.750, n = 305, p < 0.001 \)). For each subject, the indices of information sources used generally were different from one another, except that there was no significant difference between the indices of information sources used generally for pond construction and water quality (Table 5).

Table 5

*Differences in Indices of Information Sources Used Generally for Different Subjects*

<table>
<thead>
<tr>
<th></th>
<th>Koi Variety</th>
<th>Water Quality</th>
<th>Pond Construction</th>
<th>Nutrition</th>
<th>Disease</th>
</tr>
</thead>
<tbody>
<tr>
<td>Koi variety</td>
<td>**</td>
<td>**</td>
<td>**</td>
<td>**</td>
<td>**</td>
</tr>
<tr>
<td>Water quality</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pond construction</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nutrition</td>
<td>**</td>
<td></td>
<td>**</td>
<td></td>
<td>**</td>
</tr>
<tr>
<td>Disease</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* * indicates that the p-value is less than 0.01.

** indicates that the p-value is less than 0.001.

According to the definition, Stage 3 and Stage 4 hobbyists are different in their personal background and socio-cultural interaction with other hobbyists. Among the 306 participants, there were 154 Stage 3 and 128 Stage 4 hobbyists. Significantly more Stage 4 hobbyists (85.9%) joined koi hobbyist clubs than did Stage 3 hobbyists (60.4%) (Pearson Chi-Square = 22.64, 1-sided p < 0.001). Also, more Stage 4 hobbyists (96.1%) attended koi shows than did Stage 3 hobbyists (56.5%) (Pearson Chi-Square = 57.65, 1-sided p < 0.001). Significantly more Stage 4 hobbyists (30.5%) received koi-related professional training than did Stage 3 hobbyists (15.6%) (Pearson Chi-Square = 8.93, 1-sided p = 0.0015). Also, Stage 4 participants had significantly more experience in koi
keeping than Stage 3 participants (independent t-test, mean difference = 5.43 ± 1.03 years, t = 5.29, p < 0.001), longer membership in koi clubs (independent t-test, mean difference = 2.63 ± 0.89 years, t = 2.94, p = 0.002), a longer history of attending koi shows (independent t-test, mean difference = 2.88 ± 0.83 years, t = 3.48, p = 0.002), more frequent attendance at koi club activities (independent t-test, mean difference = 3.33 ± 0.82 times/year, t = 4.04, p < 0.001) and more frequent attendance at koi shows in the past three years (independent t-test, mean difference = 0.92 ± 0.18 times/year, t = 5.10, p < 0.001).

Stage 3 and Stage 4 participants also differed in their attitudes toward the hobby of koi keeping (Table 6). Stage 4 participants indicated that their experiences in keeping koi (92.1%) and other animals (72.7%), as well as their formal education (76.4%), were important to their success in koi keeping, to a significantly greater degree than Stage 3 participants (90.8%, 51.7% and 46.0%, respectively). They also showed a higher level of agreement that the benefit of spiritual relaxation for themselves (72.4%), the financial return from keeping koi (84.3%) and enjoying the admiration of others regarding their koi and koi ponds (88.3%) were important to them, as opposed to Stage 3 participants (49.3%, 59.1% and 81.7%, respectively).
Table 6

Differences between Personal Perspectives of Koi Keeping for Stage 3 and Stage 4 Participants

<table>
<thead>
<tr>
<th></th>
<th>Mean difference in agreement</th>
<th>Standard deviation</th>
<th>t</th>
<th>P (one-sided)</th>
</tr>
</thead>
<tbody>
<tr>
<td>My experience in raising koi is important for me to be a successful koi hobbyist</td>
<td>0.31</td>
<td>0.09</td>
<td>3.32</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Having other pets has helped me be successful with my koi</td>
<td>0.40</td>
<td>0.11</td>
<td>3.61</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>What I learned in school (K-12, college) has helped me be successful with my koi</td>
<td>0.62</td>
<td>0.11</td>
<td>5.52</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>I keep koi as a way to achieve relaxation</td>
<td>0.34</td>
<td>0.10</td>
<td>3.46</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>I must experience financial return from keeping koi</td>
<td>0.47</td>
<td>0.10</td>
<td>4.74</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>I actively contribute to koi club(s)</td>
<td>0.22</td>
<td>0.07</td>
<td>3.05</td>
<td>0.002</td>
</tr>
<tr>
<td>I actively contribute to online koi discussion groups</td>
<td>0.22</td>
<td>0.09</td>
<td>2.58</td>
<td>0.005</td>
</tr>
<tr>
<td>I enjoy people’s admiration when showing my koi to them</td>
<td>0.21</td>
<td>0.08</td>
<td>2.64</td>
<td>0.005</td>
</tr>
</tbody>
</table>

Even though both Stage 3 and Stage 4 participants showed approximately the same level of agreement regarding the importance of participating in online discussion forums on koi (79.9% vs. 81.7%), and being koi club members (50.0% vs. 48.4%), Stage 4 participants showed greater agreement than Stage 3 participants to the statements that they actively contributed to koi clubs (86.7% vs. 77.6%) and online discussion forums (96.1% vs. 90.2%). However, both Stage 3 and Stage 4 participants showed similar levels of agreement that they had adequate incomes (62.0% vs. 60.2%) and time (53.0% vs.
57.5%) to spend on their koi-keeping hobby, and that the hobby provides the feeling of learning something (90.7% vs. 92.1%). Stage 3 and Stage 4 participants also indicated similar degrees of success (93.9% vs. 86.6%) while pursuing koi keeping. Moreover, both these two groups agreed that they helped/taught/mentored other hobbyists (74.2% vs. 67.2%), but they usually worked alone while doing their own koi-keeping projects (93.5% vs. 92.2%).

In regards to knowledge about their koi hobby, Stage 4 participants scored higher not only on all questions about their knowledge of koi keeping (independent t-test, mean difference = 4.24 ± 0.62, t = 7.10, p < 0.001), but also on questions about koi varieties (independent t-test, mean difference = 1.83 ± 0.30, t = 6.36, p < 0.001), water quality (independent t-test, mean difference = 0.21 ± 0.10, t = 2.01, p = 0.025), koi diseases (independent t-test, mean difference = 1.30 ± 0.29, t = 4.53, p < 0.001), and pond construction (independent t-test, mean difference = 1.11 ± 0.21, t = 5.25, p < 0.001), and higher with no statistical significance in the area of nutrition (independent t-test, mean difference = 0.02 ± 0.05, t = 0.42, p = 0.339). When encountering questions during their koi-keeping activities, Stage 4 participants searched for information from a wider range of sources than did Stage 3 participants (independent t-test, mean difference in the index of information sources used generally = 1.81 ± 0.31, t = 5.87, p < 0.001), and Stage 4 participants also checked these sources of information more regularly (independent t-test, mean difference in the index of information sources used regularly = 1.16 ± 0.28, t = 4.18, p < 0.001). Moreover, when encountering problems in different scenarios during their koi keeping, Stage 4 participants searched a significantly wider range of sources, and used
these sources of information with significantly greater frequency than Stage 3 participants (Table 7).

Table 7

Differences between Indices of Information Sources Used Generally and Regularly for Stage 3 and Stage 4 Participants

<table>
<thead>
<tr>
<th></th>
<th>Index of information sources used</th>
<th>Mean difference</th>
<th>Standard deviation</th>
<th>t</th>
<th>P (one-sided)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Koi variety</td>
<td>Generally</td>
<td>2.02</td>
<td>0.34</td>
<td>6.00</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td></td>
<td>Regularly</td>
<td>1.44</td>
<td>0.31</td>
<td>4.70</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Nutrition</td>
<td>Generally</td>
<td>1.75</td>
<td>0.36</td>
<td>4.84</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td></td>
<td>Regularly</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Water quality</td>
<td>Generally</td>
<td>1.81</td>
<td>0.35</td>
<td>5.12</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td></td>
<td>Regularly</td>
<td>1.23</td>
<td>0.31</td>
<td>3.98</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Pond construction</td>
<td>Generally</td>
<td>1.65</td>
<td>0.35</td>
<td>4.73</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td></td>
<td>Regularly</td>
<td>1.25</td>
<td>0.30</td>
<td>4.15</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Disease</td>
<td>Generally</td>
<td>2.17</td>
<td>0.36</td>
<td>6.04</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td></td>
<td>Regularly</td>
<td>1.24</td>
<td>0.33</td>
<td>3.81</td>
<td>&lt;0.001</td>
</tr>
</tbody>
</table>

Stage 3 and Stage 4 participants also consulted different information sources for different kinds of problems they encountered during their koi keeping (Table 8). For koi varieties, the majority of Stage 4 participants generally used books/magazines, friends in the koi business, friends who are considered koi experts, friends who are also koi hobbyists, koi-only retail shops, koi hobbyist clubs, koi shows/events, educational programs such as workshops/conferences, fish vets and fish biologists; the majority of Stage 3 participants used garden centers as their sources of information. For problems with water quality, the majority of Stage 4 participants generally used online discussion forums, books/magazines, friends in the koi business, friends who are considered koi experts, friends who are also koi hobbyists, koi-only retail shops, koi hobbyist clubs, koi shows/events, educational programs such as workshops/conferences, fish vets and fish biologists; the majority of Stage 3 participants used garden centers as their sources of information.
experts, friends who are also koi hobbyists, koi-only retail shops, koi hobbyist clubs, koi shows/events, educational programs such as workshops/conferences, fish vets and fish biologists; the majority of Stage 3 participants used chain pet stores, private pet stores, fish-only pet stores and garden centers as their sources of information. For problems with pond construction, the majority of Stage 4 participants generally used friends in the koi business, friends who are considered koi experts, friends who are also koi hobbyists, koi hobbyist clubs, koi shows/events, educational programs such as workshops/conferences, and fish biologists; the majority of Stage 3 participants used private pet stores, fish-only pet stores and garden centers as their sources of information. For problems with fish nutrition, the majority of Stage 4 participants generally used books/magazines, friends in the koi business, friends who are considered koi experts, friends who are also koi hobbyists, koi hobbyist clubs, koi shows/events, educational programs such as workshops/conferences, or fish vets and fish biologists; the majority of Stage 3 participants used chain pet stores, private pet stores, fish-only pet stores and garden centers as their sources of information. For problems with fish disease, the majority of Stage 4 participants generally used books/magazines, friends in the koi business, friends who are considered koi experts, friends who are also koi hobbyists, koi-only retail shops, koi hobbyist clubs, koi shows/events, educational programs such as workshops/conferences, or fish vets and fish biologists; the majority of Stage 3 participants used chain pet stores, private pet stores, fish-only pet stores and garden centers as their sources of information.
Table 8

*Information Sources Generally Used by Stage 3 and Stage 4 Participants in Different Scenarios*

*Note: Only information sources that showed significant differences in use between Stage 3 and Stage 4 are listed in the table.*

<table>
<thead>
<tr>
<th>Scenario</th>
<th>Source of information</th>
<th>Stage 3</th>
<th>Stage 4</th>
<th>Pearson Chi-Square</th>
<th>One-sided p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Koi variety</td>
<td>Books/magazines</td>
<td>77.1%</td>
<td>95.3%</td>
<td>18.50</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td></td>
<td>Friend in koi business</td>
<td>47.7%</td>
<td>64.1%</td>
<td>7.53</td>
<td>0.003</td>
</tr>
<tr>
<td></td>
<td>Friend as koi expert</td>
<td>52.9%</td>
<td>78.1%</td>
<td>19.28</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td></td>
<td>Friend as koi hobbyist</td>
<td>66.0%</td>
<td>82.8%</td>
<td>10.14</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td></td>
<td>Koi-only retail shop</td>
<td>54.2%</td>
<td>67.2%</td>
<td>4.87</td>
<td>0.014</td>
</tr>
<tr>
<td></td>
<td>Garden center</td>
<td>28.1%</td>
<td>15.6%</td>
<td>6.24</td>
<td>0.006</td>
</tr>
<tr>
<td></td>
<td>Koi clubs</td>
<td>62.1%</td>
<td>81.3%</td>
<td>12.38</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td></td>
<td>Koi shows/events</td>
<td>49.7%</td>
<td>88.3%</td>
<td>47.18</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td></td>
<td>Workshops/conference</td>
<td>40.5%</td>
<td>71.1%</td>
<td>26.26</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td></td>
<td>Fish vets</td>
<td>22.2%</td>
<td>35.2%</td>
<td>5.77</td>
<td>0.008</td>
</tr>
<tr>
<td></td>
<td>Fish biologist</td>
<td>15.0%</td>
<td>38.3%</td>
<td>19.77</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Water quality</td>
<td>Online discussion forum</td>
<td>58.8%</td>
<td>72.4%</td>
<td>5.66</td>
<td>0.009</td>
</tr>
<tr>
<td></td>
<td>Books/magazines</td>
<td>71.2%</td>
<td>89.0%</td>
<td>13.29</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td></td>
<td>Chain pet store</td>
<td>5.9%</td>
<td>0.8%</td>
<td>5.23</td>
<td>0.011</td>
</tr>
<tr>
<td></td>
<td>Private pet store</td>
<td>11.1%</td>
<td>2.4%</td>
<td>8.01</td>
<td>0.003</td>
</tr>
<tr>
<td></td>
<td>Fish-only pet store</td>
<td>22.9%</td>
<td>7.9%</td>
<td>11.58</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td></td>
<td>Friend in koi business</td>
<td>39.9%</td>
<td>66.1%</td>
<td>19.88</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td></td>
<td>Friend as koi expert</td>
<td>52.3%</td>
<td>78.7%</td>
<td>20.60</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td></td>
<td>Friend as koi hobbyist</td>
<td>60.1%</td>
<td>80.3%</td>
<td>12.79</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td></td>
<td>Koi-only retail shop</td>
<td>41.2%</td>
<td>54.3%</td>
<td>4.82</td>
<td>0.014</td>
</tr>
<tr>
<td></td>
<td>Garden center</td>
<td>20.3%</td>
<td>3.1%</td>
<td>18.58</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td></td>
<td>Koi clubs</td>
<td>51.0%</td>
<td>73.2%</td>
<td>14.45</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td></td>
<td>Koi shows/events</td>
<td>26.1%</td>
<td>59.8%</td>
<td>32.48</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td></td>
<td>Workshops/conference</td>
<td>26.8%</td>
<td>55.9%</td>
<td>24.50</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td></td>
<td>Fish vets</td>
<td>17.0%</td>
<td>29.9%</td>
<td>6.58</td>
<td>0.005</td>
</tr>
<tr>
<td>Scenario</td>
<td>Source of information</td>
<td>Stage 3</td>
<td>Stage 4</td>
<td>Pearson Chi-Square</td>
<td>One-sided p-value</td>
</tr>
<tr>
<td>-------------------</td>
<td>----------------------------</td>
<td>---------</td>
<td>---------</td>
<td>--------------------</td>
<td>-------------------</td>
</tr>
<tr>
<td>Water quality</td>
<td>Fish biologist</td>
<td>14.4%</td>
<td>26.8%</td>
<td>6.66</td>
<td>0.005</td>
</tr>
<tr>
<td>Pond construction</td>
<td>Private pet store</td>
<td>11.5%</td>
<td>2.3%</td>
<td>8.54</td>
<td>0.002</td>
</tr>
<tr>
<td></td>
<td>Fish-only pet store</td>
<td>16.2%</td>
<td>4.7%</td>
<td>9.42</td>
<td>0.001</td>
</tr>
<tr>
<td></td>
<td>Friend in koi business</td>
<td>45.3%</td>
<td>70.3%</td>
<td>17.55</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td></td>
<td>Friend as koi expert</td>
<td>50.7%</td>
<td>78.1%</td>
<td>22.29</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td></td>
<td>Friend as koi hobbyist</td>
<td>60.8%</td>
<td>76.6%</td>
<td>7.84</td>
<td>0.003</td>
</tr>
<tr>
<td></td>
<td>Garden center</td>
<td>23.6%</td>
<td>4.7%</td>
<td>19.51</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td></td>
<td>Koi clubs</td>
<td>54.1%</td>
<td>78.1%</td>
<td>17.53</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td></td>
<td>Koi shows/events</td>
<td>34.5%</td>
<td>71.1%</td>
<td>36.88</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td></td>
<td>Workshops/conference</td>
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<td>57.8%</td>
<td>24.41</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td></td>
<td>Fish biologist</td>
<td>9.5%</td>
<td>18.8%</td>
<td>4.99</td>
<td>0.013</td>
</tr>
<tr>
<td>Nutrition</td>
<td>Books/magazines</td>
<td>66.0%</td>
<td>82.0%</td>
<td>9.09</td>
<td>0.002</td>
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<tr>
<td></td>
<td>Chain pet store</td>
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<td>0.8%</td>
<td>6.30</td>
<td>0.006</td>
</tr>
<tr>
<td></td>
<td>Private pet store</td>
<td>13.3%</td>
<td>0.8%</td>
<td>15.45</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td></td>
<td>Fish-only pet store</td>
<td>19.3%</td>
<td>5.5%</td>
<td>12.93</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td></td>
<td>Friend in koi business</td>
<td>39.3%</td>
<td>66.4%</td>
<td>20.27</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td></td>
<td>Friend as koi expert</td>
<td>50.0%</td>
<td>78.1%</td>
<td>23.42</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td></td>
<td>Friend as koi hobbyist</td>
<td>56.0%</td>
<td>75.8%</td>
<td>11.90</td>
<td>&lt;0.001</td>
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<td>3.1%</td>
<td>19.31</td>
<td>&lt;0.001</td>
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<tr>
<td></td>
<td>Koi clubs</td>
<td>46.0%</td>
<td>68.8%</td>
<td>14.54</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td></td>
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<td>64.1%</td>
<td>23.90</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td></td>
<td>Workshops/conference</td>
<td>25.3%</td>
<td>59.4%</td>
<td>32.17</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td></td>
<td>Fish vets</td>
<td>15.3%</td>
<td>25.0%</td>
<td>4.07</td>
<td>0.022</td>
</tr>
<tr>
<td></td>
<td>Fish biologist</td>
<td>12.7%</td>
<td>26.6%</td>
<td>8.64</td>
<td>0.002</td>
</tr>
<tr>
<td>Koi disease</td>
<td>Books/magazines</td>
<td>70.7%</td>
<td>87.5%</td>
<td>11.56</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td></td>
<td>Chain pet store</td>
<td>7.3%</td>
<td>0.8%</td>
<td>7.18</td>
<td>0.004</td>
</tr>
<tr>
<td></td>
<td>Private pet store</td>
<td>14.0%</td>
<td>2.3%</td>
<td>11.78</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td></td>
<td>Fish-only pet store</td>
<td>19.3%</td>
<td>7.8%</td>
<td>7.60</td>
<td>0.003</td>
</tr>
<tr>
<td></td>
<td>Friend in koi business</td>
<td>43.3%</td>
<td>67.2%</td>
<td>15.84</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td></td>
<td>Friend as koi expert</td>
<td>52.7%</td>
<td>85.2%</td>
<td>33.30</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Scenario</td>
<td>Source of information</td>
<td>Stage 3</td>
<td>Stage 4</td>
<td>Pearson Chi-Square</td>
<td>One-sided p-value</td>
</tr>
<tr>
<td>------------------</td>
<td>-------------------------------</td>
<td>---------</td>
<td>---------</td>
<td>--------------------</td>
<td>-------------------</td>
</tr>
<tr>
<td>Koi disease</td>
<td>Friend as koi hobbyist</td>
<td>58.7%</td>
<td>78.1%</td>
<td>11.94</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td></td>
<td>Koi-only retail shop</td>
<td>42.7%</td>
<td>54.7%</td>
<td>4.00</td>
<td>0.023</td>
</tr>
<tr>
<td></td>
<td>Garden center</td>
<td>18.7%</td>
<td>2.3%</td>
<td>18.57</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td></td>
<td>Koi clubs</td>
<td>45.3%</td>
<td>68.8%</td>
<td>15.38</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td></td>
<td>Koi shows/events</td>
<td>24.0%</td>
<td>57.0%</td>
<td>31.61</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td></td>
<td>Workshops/conference</td>
<td>24.7%</td>
<td>61.7%</td>
<td>38.99</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td></td>
<td>Fish vets</td>
<td>24.7%</td>
<td>61.7%</td>
<td>19.16</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td></td>
<td>Fish biologist</td>
<td>16.0%</td>
<td>35.2%</td>
<td>13.58</td>
<td>&lt;0.001</td>
</tr>
</tbody>
</table>

For information on koi varieties, more Stage 4 participants regularly used books/magazines, friends in the koi business, friends who are considered koi experts, friends who are also koi hobbyists, koi-only retail shops, koi hobbyist clubs, koi shows/events, educational programs such as workshops/conferences, and fish biologists than did Stage 3 participants (Table 9). For problems with water quality, more Stage 4 participants generally used books/magazines, friends in the koi business, friends who are considered koi experts, friends who are also koi hobbyists, koi hobbyist clubs, koi shows/events, educational programs such as workshops/conferences, and fish biologists, while more Stage 3 participants used fish-only pet stores and garden centers as their sources of information. For problems with pond construction, more Stage 4 participants generally used books/magazines, friends in the koi business, friends who are considered koi experts, friends who are also koi hobbyists, koi hobbyist clubs, koi shows/events and educational programs such as workshops/conferences than did Stage 3 participants. For problems with fish nutrition, more Stage 4 participants generally used friends in the koi business, friends who are considered koi experts, friends who are also koi hobbyists, koi hobbyist clubs, koi shows/events and educational programs such as workshops/conferences than did Stage 3 participants.
business, friends who are considered koi experts, friends who are also koi hobbyists, koi shows/events, educational programs such as workshops/conferences, and fish biologists than Stage 3 participants. For problems with fish disease, more Stage 4 participants generally used books/magazines, friends in the koi business, friends who are considered koi experts, friends who are also koi hobbyists, koi hobbyist clubs, koi shows/events, and educational programs such as workshops/conferences than did Stage 3 participants. There were 7 Stage 3 participants using garden centers as their sources of information, though none of the Stage 4 participants indicated that they used this source for answers to their problems with koi disease.

Table 9

*Information Sources Regularly Used by Stage 3 and Stage 4 Participants in Different Scenarios*

*Note:* Only information sources that showed significant differences in use between Stage 3 and 4 are listed in the table.

<table>
<thead>
<tr>
<th>Scenario</th>
<th>Source of information</th>
<th>Stage 3</th>
<th>Stage 4</th>
<th>Pearson Chi-Square</th>
<th>One-sided p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Koi variety</td>
<td>Books/magazines</td>
<td>23.5%</td>
<td>55.5%</td>
<td>30.15</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td></td>
<td>Friend in koi business</td>
<td>15.7%</td>
<td>32.8%</td>
<td>11.38</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td></td>
<td>Friend as koi expert</td>
<td>20.9%</td>
<td>42.2%</td>
<td>14.85</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td></td>
<td>Friend as koi hobbyist</td>
<td>22.9%</td>
<td>37.5%</td>
<td>7.16</td>
<td>0.004</td>
</tr>
<tr>
<td>Koi variety</td>
<td>Koi clubs</td>
<td>22.2%</td>
<td>35.2%</td>
<td>5.77</td>
<td>0.008</td>
</tr>
<tr>
<td></td>
<td>Koi shows/events</td>
<td>14.4%</td>
<td>36.7%</td>
<td>18.78</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td></td>
<td>Workshops/conferences</td>
<td>7.8%</td>
<td>25.0%</td>
<td>15.53</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td></td>
<td>Fish biologist</td>
<td>1.3%</td>
<td>7.0%</td>
<td>6.07</td>
<td>0.007</td>
</tr>
<tr>
<td>Water quality</td>
<td>Books/magazines</td>
<td>22.9%</td>
<td>45.7%</td>
<td>16.25</td>
<td>&lt;0.001</td>
</tr>
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<td></td>
<td>Fish-only pet store</td>
<td>5.2%</td>
<td>0.8%</td>
<td>4.4</td>
<td>0.018</td>
</tr>
<tr>
<td></td>
<td>Friend in koi business</td>
<td>12.4%</td>
<td>29.9%</td>
<td>13.38</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td></td>
<td>Friend as koi expert</td>
<td>17.6%</td>
<td>44.9%</td>
<td>24.18</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td></td>
<td>Friend as koi hobbyist</td>
<td>15.7%</td>
<td>37.0%</td>
<td>16.42</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td></td>
<td>Garden center</td>
<td>3.3%</td>
<td>0.0%</td>
<td>4.23</td>
<td>0.02</td>
</tr>
<tr>
<td>Scenario</td>
<td>Source of information</td>
<td>Stage 3</td>
<td>Stage 4</td>
<td>Pearson Chi-Square</td>
<td>One-sided p-value</td>
</tr>
<tr>
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Qualitative analysis

Among the 12 hobbyists I interviewed for this study, there was one (Ada, not a real name, as with all the participants interviewed in this study) in Stage 1 of engagement, 2 (Bob and Carl) in Stage 2, 3 in Stage 3 (Doug, Emily and Frank), 4 in Stage 4 (Gary, Henry, Ivan and Jeff) and 2 in Stage 5 (Ken and Lora). I encountered Gary at the PNKCA Annual Conference in Portland, Oregon, USA (June, 2011); Emily and Henry at the Northwest Koi and Goldfish Show in Portland, Oregon, USA (July, 2011); and Bob, Frank, Ivan, and Ken at the Washington Koi & Water Garden Show in Bellevue, Washington, USA (September, 2011). I met Ada at a monthly meeting of the Oregon Koi and Watergarden Society in Roseburg, Oregon, USA (July, 2011), and I met Jeff in a water garden store recommended by Emily in Eugene, Oregon, USA (August, 2011). Lora was a volunteer in the Visitor Center at HMSC. I have known her for six years, and she introduced Doug to me for the interview. I met Carl on a koi hobbyist discussion forum (the Pond Forum, http://www.thepondforum.com/forum.php, traced on 01/16/2012). I conducted my interviews with Bob, Frank, Ivan and Ken on site (the Washington Koi & Water Garden Show), and with Ada, Doug, Emily, Gary, Henry, Jeff and Lora at their houses. I interviewed Carl over the phone.

Koi hobbyists in different stages of engagement

Stage 1:
People consider keeping koi for various reasons. Among the 12 hobbyists I interviewed for this study, 2 of them started this hobby without even considering it in the very beginning. One of my interviewees, Ada, likes gardening and thought she would like to have a water garden at home, so she just dug a pond, and then bought a koi and added it to the pond. A blue heron came and ate her koi, and then she started to seriously consider gathering more information to at least keep her fish alive. She started gathering information from the internet, as well as from books, magazines and any other sources she could find, but she verifies the reliability of information before she applies it. “I am a medical doctor; I do not take any new technology or new medicine and just use it without verifying it.” The way she verified the information was to find more sources, “at least three,” which offered the same information or opinion, and then she would deem the information reliable. By chance, she found the annual show of the Oregon Koi and Watergarden Society in Roseburg, and joined the club. She regularly attended monthly club meetings and had met a number of other koi hobbyists in the club. She visited some club members’ houses and koi ponds, and gained some ideas of how a koi pond should be constructed before designing her own pond. She received some ideas about setting up a pond from a club member who owned a water garden/koi store, and bought some equipment from him. She obtained her filtration system from a vendor’s web page because she was impressed by the “more natural, lower maintenance type of filter.” She had her husband working with her to build the pond, and her family was looking forward to enjoying the pond and fish at the house. Her goal for koi keeping was to just enjoy the animals and aquatic plants. “I will never exhibit my koi in a show,” she says, “because of
the stress and potential diseases my fish will get.” She also stated, “I will keep those fish just for the joy of my family and myself, not for showing them.” However, she enjoys visitors’ admiration when they see her garden, and she would expect the same with her koi pond.

Stage 2:

After making up their minds to have koi, hobbyists construct their ponds or set up their fish tanks, and purchase koi. At this stage, because they are new to this hobby, problem situations inevitably arise, and they seek ways to find out what was causing their problems and how to solve them.

Bob came to the Washington Koi & Water Garden Show for a specific purpose: to search for information about how to treat his koi for a disease that was affecting them. He has had ornamental saltwater fish for seven years, and decided to switch to koi seven months ago. He “…had everything the same but salinity, but the koi just got sick one after another.” First he searched online for the problem (“cotton mouth and they’re bouncing off the walls”), but he could not find information that had been verified by any authority, and most of the information was very old (“some 2006, 2007”). He still tried the recommendations he found but they did not help the situation. He did most of his information seeking online, as well as at the big chain pet store that he bought his koi from. “But they did not work,” he said. His search for information included navigating an online koi hobby discussion forum, but he did not post any questions on the forum, just looked for others who had the same problem to see if they got the answer. One of his friends told him about the Washington Koi & Water Garden Show, so he went to see if a
solution could be found. He brought pictures of his sick koi to a vendor at the show. “He told me what caused the sickness and why the consequences in my tank were so serious, and he recommended this [product] to me. I will try this and also increase the tank temperature a little bit and see if it will work.” He also learned from another vendor that adding salt to the water could ease the koi’s stress. “I never thought about adding salt into a koi tank because they are freshwater, right? The guy explained this with osmotic pressure, which I can recall from my college class. So I believe adding salt into the tank might be a good idea.” Bob also thought attending the koi show was a good idea, because he could ask questions in person and get instant responses. He would also like to join the koi club to meet other koi hobbyists and learn from them.

Some koi hobbyists spend quite a long time gathering information and preparing themselves before they construct their ponds and purchase their first koi. My interviewee Carl started his koi keeping in a unique way. He had thought about having koi for many years, because he thought a koi pond would be a good addition to his house. He had owned a saltwater ornamental fish store for 13 years, so he had a basic idea of how to keep fish alive and surviving well. He mostly relied on books to search for information about koi and koi ponds. “Even 10–15 years before I had koi, I had books on koi,” he said. “I got most of my knowledge (about filtration and koi) from books. I have a very expensive library. Most of them are reference types of books. Not the kind of “check-out-the-picture kind of books.” When he started seriously considering constructing a koi pond, Carl also sought for information online. “I’ve looked at hundreds of ponds on YouTube, and every time I went on that I chose what I like and what I don’t about ponds.” He got
ideas about what a koi pond should be and what components he needs for his pond from those YouTube clips. He originally wanted to have a water garden with some koi (more like a Stage 3 hobbyist in my Stage of Engagement Model), but after reading a great deal of information and discussing it on koi hobbyist discussion forums, he decided to focus more on koi than on the water feature. “For some time I thought I wanted a water garden with rocks and plants in the pond, [but] after studying enough and looking at the fish itself, I fell in love with the fish.” Therefore, one of his goals in koi keeping was to enter his fish into a show (at which point he would become a Stage 4 hobbyist). To gather more accurate information and specific ideas about how to set up his koi pond, he took a 12-minute video clip of his house, front yard and back yard, pointing out some potential locations for his pond and the filtration systems, the characteristics of substrates in the yard, and even companion plants in his garden. He then uploaded these clips onto YouTube (http://www.youtube.com/watch?v=e6_3hJ_JiHM, traced on 01/15/2012) and posted on a koi hobby discussion forum, inviting people to give suggestions (http://www.thepondforum.com/showthread.php?1135-Building-Pond-Feedback-Comments-Please, traced on 01/15/2012). In 4 days, he got 32 replies with suggestions about the location, size, and even companion plants for the pond, to start with. He also learned a lot of details about filtration, pond substrates, and the water chemistry of koi ponds. Encouraged by the members on the forum, he has started posting threads asking and answering questions, and he has started 94 threads and received 1887 replies in six months. For him, the most important thing he has learned about koi keeping, after he built a koi pond, was that there are so many varieties of koi.
When I got into the pond, I did not know there are different varieties of koi. I always assumed koi are one kind of animal and some of them are better-looking than others. But they are still the same fish. I had no idea that there are a variety of koi. I’ve set a pond up without even knowing that koi come in different varieties. And they all have names to them. (Carl, interview)

He learned extensively about koi varieties from online discussion forums. He also learned about the characteristics of each variety and the criteria for good show koi. As mentioned above, he was considering showing his koi eventually, so, “I am still interested in knowing how the fish of each variety tends to be. I still do not have much idea about the history of the varieties yet. I do not have a clear picture of that.” However, there are no koi hobbyist clubs in his area, and no koi-only retail shops nearby. So he still had to seek information through the internet because “it is spatially limitless.” He participates in several online discussion forums, but focuses mainly on one particular one because “people there are friendlier and I like the atmosphere in that forum.” He has posted an average of 9 posts per day since he joined the forum, and his discussion covers koi varieties, koi showing, pond construction, koi diet, koi disease and aquatic plants for koi ponds.

Stage 3:

The different views on koi between Stage 3 and Stage 4 hobbyists distinguish them into two categories.

There are water garden people and koi people and these two groups focus on different things….And then, you have another whole set of people who are so laid
back, they never do anything anyone else does it [sic]. Then there are people like me that are taking information from the koi side, unlike those koi purists who take information from the judges’ side. (Ada, who was at Stage 2 currently but her goal was to be a Stage 3 hobbyist, interviewed at her house.)

Koi hobbyists in this stage usually enjoy the water feature of their pond more than the koi in the pond. Doug, one of the Stage 3 hobbyists I interviewed, said, “half of my garden is British style and half is Japanese style, and the koi pond in the middle blends the two different styles together well.” Stage 3 hobbyists enjoy their koi as part of the attraction of the water feature, but Stage 4 hobbyists focus more on the koi and tend to show them off (e.g., enter their koi into shows) or intentionally breed koi with the ideal parent fish of their choice. (I would discuss more about Stage 4 hobbyists later.) Stage 3 koi keepers might periodically add new fish or change their pond feature, but overall, they are satisfied with the koi pond they have as an attraction in their garden or their home. Some of them treat their koi as they treat other “regular” pets, like cats and dogs, and they name every koi in the pond. By my definition, hobbyists in this stage do not enter their koi into shows because they are not interested in doing so, or “it’s too stressful for the koi during the transportation and being in the tank under the hot sun” (Ada), or “they might pick up some pathogen while being with others’ fish” (Doug). They also might have strong emotional connections with their fish: “This is Dusty, my favorite fish in the whole pond. I love to pet him every time I can by the pond. And this is Lawn Mower; you can tell why when you see him eat.” (Emily, interviewed at her house)
The hobbyists’ learning curve about their koi becomes slower at this stage because they have been through the early development period of koi keeping and have learned most of the basic knowledge they need to keep their koi alive, as well as healthy, happy and pretty. Emily, another Stage 3 hobbyist, shops for fish food at garden centers and pet stores, but she does not seek specific information from these two sources. She does not feel the need, since she “does not want to add in new koi and my koi pond is pretty stable.” She does add a chemical to the water to prevent fish parasites from invading her pond, as recommended by a friend who has been in the koi business for several years. She occasionally reads articles and looks at pictures of ponds in magazines, to get ideas for other water features she might add.

Doug said of his koi pond, “There were a lot of things to do in the first couple years.” In the consideration stage, he had to design “a pond to blend into the landscape, and design a filtration system which will function perfectly and with minimum maintenance, and choose several koi of high quality.” He was a member of a local garden club, where many of the members gave him advice about water garden design and ornamental aquatic plants. He modified a filtration system originally designed for catfish farming, from class notes he took in college 20 years ago, remembering every detail of the design. After the pond was built and was running smoothly with a stable environment, he went to the Northwest Koi and Goldfish Show with friends who were in the koi business and had them pick out four champion koi for him. “I knew the basic koi varieties and I knew which color and varieties I wanted for my pond, but I didn’t know which fish were best in that variety. So I had my friends to pick them up for me. I only
wanted the high quality fish; money was not the issue.” After the koi were introduced to his pond, koi keeping was very low maintenance for him. He spent time looking for suitable aquatic plants which are “beautiful, unique and grow fast enough to fix the nitrogen waste in the koi pond,” so that he can remove the nitrogen waste by harvesting the plants. With advice from friends in the garden club and several nurseries, he changed his aquatic plants several times, and finally settled on one plant that works perfectly. He has only cleaned his filter once in the past five years. Because his pond was so heavily covered by aquatic plants, he can only see his koi when he feeds them. “I enjoy seeing them when they come up and eat. My family and friends who visit my garden like them as well.”

Some Stage 3 hobbyists regularly attend koi hobby related events, and even if they are not showing or planning to show their fish, they are still looking for detailed information about show quality fish. Frank was a member of the Washington Koi & Water Garden Society, and I met him at the club’s annual koi show. I noticed he was following the judges closely when they were explaining the details about koi varieties, and he had quite a long conversation with one of the judges afterwards. He does not want to show his fish because “You know it takes a lot of money to buy the fish [with show potential],” but he still wants to know what makes a koi a great koi. For him, there was a very fine line between “an exceptional fish and one that is just above average.” He used stereo systems as an example. “If you’re a real connoisseur [and] like that kind of stuff and they say if you buy this kind of stereo system, then you can hear this level. If you listen and I listen, and we’re not connoisseurs, we look at it, or listen to it, and we won’t
be able to pick it out.” Even though he has had koi for over five years and he had the knowledge to keep the koi well, he still continues to learn from koi club meetings and koi shows about high quality koi, so that “when I purchase fish, I know what I’m getting. I’m getting the best.” Frank also regularly visits a koi-only retail shop in his area and participates in an online koi hobbyist discussion forum.

Stage 4:

Koi hobbyists in Stage 4 are most interested in showing and breeding koi. For showing, they have to understand the differences between koi varieties, the characteristics of and standards for each variety, how to maintain good water quality, what kind of diet produces fast-growing and beautiful fish, and how to prevent and cure diseases. Koi keeping at this stage usually involves very intensive learning.

Henry traced his history with koi back to his early childhood. He had a very good friend who was originally from Japan. Henry liked his friend’s Japanese garden, which included a koi pond. When he started his koi hobby during the 1960s, there was not much information available about koi, “but…keeping koi was kind of easy at that time; those koi were just tough. However, recently they (koi breeders) inbreed koi so much that they are genetically weaker so it takes more to take good care of them” He then turned his hobby into a business, and he joined the oldest koi club in the western United States. During that time, he was encouraged by his friends to become a koi judge. To do so, he had to attend many classes and workshops. He also visited a number of koi-only retail shops, koi farms and koi shows in the U.S., Japan and many other countries. “I still have a lot to learn; new bloodlines come out every once [in] a while and the standards of good
koi have to be refined.” He gets together with other koi judges from all over the world once a year, so that they can teach each other and prepare themselves with better and updated information about koi judging and koi care. “Because of domestic and international koi trade, there are also new diseases coming up and spreading around. There are also new products and medicine for koi coming up. I gather this information by talking with other koi experts, koi breeders, and people in [the] koi business during the koi shows, workshops and conferences.” He also subscribes to several koi magazines and gains some updated information from them. He does not trust information from the internet, because “most of them [web sites] are not verified by authority.” He participates frequently in the activities of a local koi club, and provides help to other koi hobbyists. He has closed his koi business, but still serves as a koi judge. He enjoys his interactions with his koi every afternoon in his backyard pond.

Dan participated in the Washington Koi & Water Garden Show. He did not enter any of his fish in competition in 2011, but he followed the judges as they walked around and explained why they made their decisions for each koi. One of his goals for being at the show was to learn how to select a good koi for showing purposes. Although that information was available in books, magazines, and on the internet, at a show he can see real fish so that he can better understand the key points of champion fish, and can apply that information when he was buying fish. He can also talk to the owners of the award-winning fish and ask them questions about water quality, filtration system set-up, diet and daily maintenance, and get instant answers. Dan goes to at least two koi shows per year, and he also attends conferences and workshops on koi keeping. He regularly participates
in activities with the local koi hobbyist club, and regularly talks to koi suppliers and a few breeders.

Stage 5:

Koi hobbyists may give up their koi keeping hobby for various reasons. Among the participants in this study, some stopped because of health (1) or financial or family issues (1), some because they had to relocate and could not take their koi with them, and some (2) gave up keeping koi because of the frustrations they experienced. For my two Stage 5 interviewees, Lora had been through Stages 1, 2, 3, 4 and 5, and Ken had been through Stages 1 and 2 before he quit keeping koi.

Lora had koi for more than 40 years, starting from the time of her marriage; her husband had kept koi for over 55 years. They had worked together, keeping koi as a hobby, turned it into a business and operated a koi farm for 15 years, after her husband retired from his regular job. Then they closed the koi farm for their second retirement, but still kept koi as their hobby. Her husband sold all their koi and equipment after he was diagnosed with cancer in 2010, and she has not had koi since then (though she kept two goldfish at home). She started the hobby when there was not much information about koi keeping and husbandry available. Her method of learning was “do it, fail and do it again.” She and her husband actively attended local koi club events such as monthly/annual meetings and koi shows. They also visited other koi farms in the U.S. and Japan. Both of my interviewees in the Eugene area had obtained some of their fish from this couple and mentioned that they also received help and information from them about building a koi
pond, choosing good koi, and treatment of disease. Lora decided to stop keeping koi because of losing of her partner, and her own health issues.

Ken has been keeping tropical ornamental fish, as well as koi, since his early childhood in the Philippines and Malaysia. He still keeps tropical fish in his house in the U.S. About 3 years ago, he was at a koi show and started seriously considering keeping koi. With almost 20 years of experience keeping other ornamental fish, Ken set up a 400 gallon indoor pond and bought his first koi at a koi show auction. He started with inexpensive koi, and “of course I wanted to appreciate something nicer so I started buying something more expensive.” He applied the knowledge and experience he gained from his history with ornamental fish to his koi pond, except, “the only thing I was really worried [about] was more the temperature, because we don’t have that problem in the Philippines; it’s always tropical.” However, his koi started to get sick, and he searched for information online, sought help from the local koi club, and hired a specialist recommended by the club, but none of these helped his situation. Panicked over his financial loss and emotional stress, he gave the remaining koi away. He said that he would not have koi again, at least for several years, because of the frustration involved with keeping them healthy.

Comparing the learning of koi hobbyists with different goals for koi keeping

Introduction: Two cases, Ada and Gary

Ada was categorized as a Stage 1 hobbyist when I met and interviewed her in the summer of 2011. Ada appreciated the beauty of her home garden and wanted to add a water feature to it. She started her first pond with “just common sense,” dug a small and
shallow pond with an artificial waterfall, and added a koi and some aquatic plants. The koi was attacked and eaten by a blue heron because the water was shallow and without protection for the fish. Ada gave up her water garden for a while because of frustration over her koi being killed. She started rebuilding the pond in late summer of 2011 and obtained three koi from a local koi hobbyist club member. Ada enjoyed the pond with its new aquatic plants and fish, and she did not plan to show or breed her fish in the future.

Gary had been a koi hobbyist for three years. He regularly entered his koi into competitions in koi shows, and had won several awards. Gary was categorized as a Stage 4 hobbyist. Gary began keeping koi because of his girlfriend, who wanted to have a water garden. After they set up their pond, they had a problem with mosquitoes, so they bought some goldfish to eat the mosquito larvae. They joined a goldfish and koi hobbyist club to learn more about goldfish, but then Gary fell in love with koi. Gary attended the club meetings regularly and visited many other members’ ponds during club activities. He appreciated the beauty of koi and started collecting different varieties of koi and entering his koi into competitions. He won several awards and sold some of his award-winning koi in order to buy more koi.

**Motivations and goals:**

Both Ada and Gary valued the time spent with their families while working and enjoying their koi. Their families enjoyed the beauty and the peace of their ponds and koi, and liked to work with them in their koi-keeping activities. Gary’s girlfriend, who frequently worked with Gary in koi keeping, was more interested in aquatic plants and the way the koi pond enhanced the landscape of their yard. Gary appreciated her work
because their different focuses resulted in a well-balanced pond, since Gary was mainly interested in the koi.

Both Ada and Gary enjoyed the admiration of their friends when they saw the fish and ponds. They also felt that it was relaxing to watch and engage with their koi and ponds after a busy day at work. Their ponds and fish provided them with a “sit back and relax” opportunity, so they became renewed and refreshed while watching their fish and enjoying the peaceful atmosphere in their gardens.

During their koi keeping, though they encountered different problems relating to koi, water quality, pond construction/modification, and disease, they enjoyed solving the problems. They enjoy “exploring new ways [of] doing things, and being creative” (Ada) during their koi keeping and “building things and solving problems, and thus [I] enjoy doing the work for my koi” (Gary). They have also enjoyed the process of pond building and koi keeping. “The whole process is also a relaxation for me,” said Ada. The products of their hard-earned learning processes and participation in the koi community—Ada’s koi pond and aquatic plants and Gary’s well-designed, well-balanced and limited-maintenance pond—have become a source of joy and relaxation for them and their families, and a source of admiration from friends who visit their ponds. As Gary said:

Even [though] doing this [koi keeping] takes a lot of time and effort, it’s a joy seeing how they change and evolve and the events that happen through time in the precious life. They are wonderful pets in a lot of ways, because they are so beautiful and having a place to sit and watch them will be wonderful too.
With regards to showing koi, Ada did not want to do that because of her concerns about stress during transportation to the show and cross-contamination while with fish from other owners, and “the most important of all, I just do not care [about showing my koi].” On the other hand, Gary’s enjoyment and appreciation of the beauty of different varieties of koi were what motivated him toward koi showing. He started his water garden with goldfish, but switched to koi because the weather in his area was just too cold for goldfish to thrive outdoors. After joining a koi hobbyist club, he met several club members who were interested in showing their koi and provided Gary with a lot of help in his koi keeping experience. “They helped me to see the different varieties of the fish, the size and things like that. They gave me exposure to other varieties of koi.” From them, Gary learned the vocabulary to discuss different varieties of koi, and the characteristics of each variety. He became more and more familiar with koi showing and decided to “…be a part of that [koi showing], and see if my fish can do the same, and getting encouragement from other club members that they wanted to see my fish shown.”

Showing koi was primarily about choosing fish with potential and providing them with good diet and water quality so they can grow larger and prettier. Gary said that “some people just have the talent for doing something and for some reasons; I am just able to look into a tank of fish and pick up one that will win, sometimes.” Encouraged by winning his first awards, Gary started to learn more from books and magazines, other club members, vendors, and experts such as judges at koi shows, and he decided to collect different koi varieties for showing. He also had to expand his pond and modify his filtration system to hold more fish.
Sources of information used in learning:

Both Ada and Gary used multiple sources to seek the information they needed for their koi keeping, since they are relatively new to this hobby and wanted to learn as much as they could to keep their koi healthy and happy. They read books and magazines, and they both joined local koi hobbyist clubs soon after embarking on their koi hobby. They attended the club activities regularly and consulted other club members who had expertise in koi keeping. Some of the clubs’ activities involved visiting other club members’ gardens and ponds, and both Ada and Gary gained ideas for pond building by studying other club members’ ponds.

…[when I see their fish], I want to have those experience in their ponds, I want to have the peaceful place to sit and enjoy my pond, I want to have the fish in my pond that I can enjoy looking at, I want that in my yard. And when I go to a meeting and I can see their set-up in their yard. So the more I saw those things, the more I think that’s something I will enjoy having in my house. So that’s why I want to have more exposure to different kinds so I can see what kind of these things can work and I can simulate that in my own pond. (Gary, interview)

Both Ada and Gary utilized information online and agreed that most of the information available online should be verified before use, based on their previous job-related experience. Ada would try to find information from other sources to support the recommendations before she adapted them and used them in her pond. Gary would consult with experts he knew (usually koi hobbyist club members) and gain various opinions before he used the information.
Even though Ada and Gary have both searched multiple sources of information for their koi keeping and both verify the information before using it, the focus of information-seeking was different for each of them, due to their different goals and motivations for koi keeping. Ada’s information searches were mainly related to aquatic plants, biological filtration and landscaping. She did not pay much attention to koi varieties, and was not familiar with them. The three koi Ada owned were obtained from one of the members of her koi club, who gave them to Ada for free. Ada did not care which variety they were. Gary, on the other hand, asked questions of other club members about koi varieties and koi showing during club activities. He attended koi shows and conferences and listened to the experts such as vendors, koi breeders and koi show judges, and workshop instructors. He also regularly read professional magazines, such as KOI USA. Gary’s information seeking focused more on koi varieties, koi showing, and pond and filtration system construction that would allow his ponds to hold more koi.

**Knowledge about water filtration and the nitrogen cycle**

Ada and Gary both had enough knowledge about water filtration and the nitrogen cycle to keep their fish and ponds at an enjoyable standard. They both clearly understood that nitrogen waste is generated by fish after food consumption and is toxic to fish, so it needs to be removed or converted into a non-toxic form. For Ada, with fewer fish in a big pond that held a large number of aquatic plants, the capacity of her filtration system and the nitrification of her filter were not her first concerns. She designed her filter as a biological, plant-mediated system, and nitrogen waste removal relied mainly on the
plants in the pond. Thus, she described the nitrogen cycle this way: “The fish produces nitrogen, and then the plants eat the nitrogen and clean the water.”

To Gary, the filtration and nitrogen cycle was more complex:

During the daytime, you are going to have photosynthesis going on with your plants and you are going to check your nitrogen and ammonia and the pond. If you do not have enough aeration in the filter, you are going to have a crash at night. In your filter, you want to have enough oxygen supply so that you are going to have beneficial bacteria…. Then you have to mechanically every once a while remove the compost and when you remove it, it’s gonna help the filter to work better but you cannot remove all of it, if you do, you don’t have the start of those beneficial bacteria later on. So you need to have more aeration in the filter or you have to have more plants in it to help with that cycle.

Because one of Gary’s goals for koi keeping was to show his koi, his pond held more koi and he fed his koi more in order for his koi to grow more quickly and to greater size. With this situation, the capacity of filtration and the nitrification of his filter was a major concern, so he emphasized that nitrification needs oxygen and he had to add aeration into the filter because his filter had to deal with a heavier load of nitrogen waste. He also talked about keeping enough beneficial bacteria in the filter when removing the compost from the system, which Ada did not emphasize because her filtration system deals with very little nitrogen, and aeration would not be a concern.

Neither Ada nor Gary recalled the nitrogen cycle being taught in school. Ada emphasized that she learned all her information about the about the nitrogen cycle and
filtration systems from her internet searches. As Gary put it, these two hobbyists incorporated the general ideas they learned in school with specific and more detailed content for koi from books, magazines, the internet, and other people’s ponds, and constructed systems suitable for their needs.

It’s not something that was formally taught to me, but it’s just regular logic, like you [’re] working with your computer system or whatever. If you have that many fish, that much water, than you need that much filtration. In one way, it’s what was taught in school, but in another way it was never brought out specifically for koi. [I get] ideas from books, magazines and other people’s ponds. Then make it my own judgment about what I want and what kind of filtration I need. (Gary, interview)
Chapter Five: Discussion

When studying learning in a free-choice environment, it is critical to understand which factors will most affect the learning experiences, what the relationships are between these factors, and how these factors interact. Moreover, learning is such a complicated process that only studying a single or a small number of factors might not be sufficient to realistically and precisely describe this type of learning. Thus, in this study, I used Falk and Dierking’s (2000) Contextual Model of Learning as my theoretical framework to organize the complexities of the process that koi hobbyists engage in during free-choice learning.

In order to explore koi hobbyists’ personal context, I developed a Stage of Engagement Model (modified from Prochaska & DiClemente, 1986), to illustrate koi hobbyists’ engagement with their hobby according to the hobbyists’ years of experience keeping koi, and their goals associated with keeping koi. Among the 306 participants in this study, there were 8 categorized as Stage 1 hobbyists, 13 as Stage 2, 154 as Stage 3, 128 as Stage 4, and 3 as Stage 5 koi hobbyists. The composition of participants in this study seemed to skew toward to Stage 3 and 4 due to my data collection methods. I distributed my questionnaire mainly in koi shows, koi club meetings and through koi clubs and online koi discussion forums. The potential participants that this survey could reach then were hobbyists who participated in koi club activities, who participate in online discussion forum and who attend koi shows. So koi hobbyists who have koi currently or people who consider having koi so seriously that they actively attend koi hobbyists group activities and gather information even before they have koi became the
majority of participants in this survey. This is why the numbers of Stage 3 and Stage 4 participants were much higher than other groups. Stage 5 hobbyists are those who quitted koi hobby already so they are also difficult to be found by researchers. These three Stage 5 participants were either still have some kind of connection with their koi clubs or had some koi friends who were still active in the koi hobbyists groups so that they could be aware of this study and contributed to this research. Stage 1 hobbyists by definition were those who have not had koi yet so theoretically it is difficult to locate them. However, some Stage 1 hobbyists also considered seriously having koi, so they participated in koi related events and activities such as koi related workshops, koi club meeting and online discussion forum, and then could be reached by this study. So, with this sampling method, I had high probability to collect data from Stage 2, 3 and 4 and had difficulty to reach enough numbers of Stage 1 and 5. Since hobbyists in Stage 1 and 2 are more in a transitional status and could be benefit to this study in revealing how hobbyists decide to move toward to maintenance stage (Stage 3) or becoming an expert stage (Stage 4), I believe it is worthwhile to collect more data about hobbyists in these two stages and gather more participant to this survey. In the future, I think the target group of data collection could be extended in order to gather more information about Stage 1 and Stage 2 hobbyists. For example, data collection could be done in private pet stores, “big chain” pet stores or garden centers, where more new comers in this hobby would usually go to. This approach will also be able to reach some non-koi hobbyists (Stage 0) who have other ornamental fish or other kinds of pet.
Other than the numbers of participants in each stage, the results of this study showed that this Stage of Engagement Model describes the various stages well. From the viewpoint of a researcher studying koi hobbyists’ learning about their hobby, I divided those subjects who had never owned koi into two groups: those who had no intention of owning koi or who may think about it occasionally but were not seriously considering it, and those who were seriously considering koi ownership. Although this study does not emphasize the first group, referred to as Stage 0 hobbyists in some of my comparisons with other stages, the attitude of the Stage 0 group toward koi keeping as a hobby is similar to people in the Stage of Precontemplation in Prochaska’s Stage of Change Model (Prochaska & Velicer, 1997). They do not intend to start this hobby in the near future, and may not even have any idea what koi are. However, if they should happen to see a koi pond at a friend’s house or some attractive pictures of koi or koi ponds in a magazine, and start to think, “maybe it would be a good idea to have a pond and some koi in my garden,” then they are transitioning into the next stage. If they are encouraged by other people or the conditions are right, and they start thinking seriously about the possibility of keeping koi, and they become Stage 1 hobbyists.

Hobbyists’ learning about their hobby can start before they physically engage with the hobby. In Brossard, Lewenstein and Bonney’s (2005) article on the impacts of a citizen science project on participants, they claimed that since the participants were so motivated to work on the project (The Birdhouse Network), they would spend a good amount of time and painstaking effort in learning about the subjects. In fact, a substantial amount of learning takes place when individuals are beginning to consider engaging with
a hobby. In this research, individuals search for information about what koi are, the costs and benefits of keeping them, how to take care of them, how to design a pond or tank that blends harmoniously with their house or yard, where to buy koi, what kind of koi to buy, and other similar considerations. Ada, one of my interviewees, was an example of a Stage 1 koi hobbyist. When I met her at one of the monthly meetings of the Oregon Koi & Watergarden Club in July 2011, she was just thinking about getting some koi, and when I visited her at her house the next month, she was building her koi pond with her family. In theory, there should be many more Stage 1 hobbyists than those I was able to locate. So in future studies I might have to expand and improve my data collection strategies as I mentioned in the previous discussion. It would also be worthwhile to follow several Stage 1 hobbyists over time to observe how they transition from one stage to another and to study how their information seeking strategies change as a function of the experiences and knowledge they accumulate through engagement with their hobby.

After Stage 1 hobbyists build their pond (or set up their tank) and buy some koi, they become Stage 2 hobbyists. This group of hobbyists may have some basic knowledge about koi, but they will encounter more while they are engaging in the hobby. At this stage they might have to learn about how to design a pond and filtration system to maintain good water quality, which type of koi they would like to have in their ponds, what to feed the koi, and what to do if they get sick. There is considerable need for learning to develop during this stage, and most hobbyists learn a lot about koi through doing. In the first six months after he built his pond and bought his koi, Carl, one of my Stage 2 interviewees, visited koi farms, participated frequently in online koi hobby
discussion forums, and learned about water chemistry, koi food, feeding strategies, companion plants for koi ponds, koi varieties, filtration systems, koi history, koi diseases, and daily koi husbandry and maintenance. In this study I used three years as boundary of Stage 2; if the hobbyists are still interested in keeping koi after this time period they will move to the next stages: Stage 3 or Stage 4, depending on their expectations for their koi hobby. I defined Stage 1, 3, 4 and 5 koi hobbyists according to whether they currently have koi, used to have koi or do not have koi and their goals in koi keeping, and there were clear boundaries between these four groups. However, it’s difficult to define Stage 2 because it is a transitional stage between Stage 1 and Stage 3 and 4. In the hobbyist world, people usually call a hobbyist at this stage a “newbie” or a “newcomer”, but there is no clear definition about this stage even though almost everyone knows what a newbie or a newcomer is referring to. I assumed that a new koi hobbyist would encounter most of the possible problems of koi keeping in the first three years and would exhibit a dramatic change in knowledge level in order to solve those problems. I discussed this assumption with Dr. Tim Miller-Morgan, who is an aquatic animal outreach specialist, and he agreed with my assumption about the time line. The result of this study showed this definition of Stage 2 basically worked, however, this does not necessarily mean that this is a good operational definition. In this study, one of the interviewees, Gary, was categorized as a Stage 4 hobbyist because he has had koi for 3 years and so turned his koi unto shows and won awards. However, he started to show his koi in his first year of koi keeping and won his first award in his second year. In this case, the “three year” boundary did not seem to be a good delineation point between stages. In future studies, I am going to explore this
issue more deeply and try to develop a more reasonable and reliable indicator for this important boundary condition.

People take their hobby with different levels of seriousness (Craike, 1999). One, for example, might take the differences between koi varieties very seriously, while another might just enjoy the beauty of the fish, no matter what variety it is. Stage 3 hobbyists are usually more “laid back” and relaxed than Stage 4 hobbyists. They appreciate the beauty of koi, but also enjoy the entire water feature surrounding the koi. By my definition, Stage 3 hobbyists do not enter their koi in shows and do not intentionally breed them. They treat their koi as they do other pets, and sometimes they have a very strong connection with their fish. They sometimes may expand their ponds or add in new fish, but they are generally satisfied with what they have. They still search for knowledge about fish, but not as regularly as Stage 4 hobbyists because they’ve experienced those conditions and problems that newer hobbyists might not have encountered, and already know how to solve most problems they encounter.

Stage 4 hobbyists take another step forward. They intend to show their fish and win awards, or to breed their koi. To do so, they have to know the varieties of koi and the standards of each koi variety, as well as judges’ preferences. They have to know how to feed their koi appropriately and maintain better water quality so that the koi can achieve maximum size and beauty in order to be competitive with other hobbyists’ koi. They have to be prepared to deal with disease, because entering fish into shows and buying new fish increases the risk of introducing new pathogens and parasites into their koi environment. At this stage, learning is also intensive, similar to Stage 2. From this stage,
a hobbyist may even turn his/her hobby into a business and become a professional koi keeper, as Lora, my Stage 5 interviewee, did.

People from any stage may give up keeping koi for various reasons, thus moving to Stage 5. People who gave up the idea of keeping koi after serious consideration were also deemed to be in Stage 5. Ken stopped keeping koi while he was at Stage 2, due to the frustration of losing koi because he was unable to solve the problems affecting their health. Lora went through Stages 1, 2, 3, and 4, and even became a koi professional, before giving up her koi because of losing her husband. People may also stop keeping koi for a time, and then come back to it. Ada had her first koi for six months in 2010, but the koi was eaten by a heron. About eight months afterward, she began seriously considering rebuilding her water garden with a better design. When I visited her in the summer of 2011, she was building her pond (Stage 1), and I hoped she would have her koi prior to completion of this study (Stage 2). (Ada did finish her pond building and had her koi before the winter of 2011.)

When we look at the Part 3 questionnaire scores from all participants, the mean knowledge scores of Stage 1 participants showed no significant difference from Stages 2, 3, and 5, but were significantly higher than those who did not have koi and have never considered keeping koi (Stage 0). This indicated that when seriously considering keeping koi, these participants learned about koi before they acquired any fish. Traditionally, when people have thought about hobbyists, they thought of them in a dichotomous way: you are a hobbyist or you are not a hobbyist. With this view, all the people in the Precontemplation (Stage 0) and Contemplation (Stage 1) stages fell together on the not-
hobbyists’ side of the fence. However, as suggested in my preliminary research, there can be significant hobbyist activity going on between these two stages, which my study revealed. It should be noted that when using the Part 3 questionnaire scores from all participants as an indicator of koi hobbyists’ knowledge levels, the difference of mean scores between Stage 0 and Stage 1 was even larger than the difference of mean scores between Stage 1 and Stage 4. This showed that the learning process in Stage 1 shows substantial progress and the amount of knowledge gained is very dramatic; possibly more dramatic than we thought. From a learning point of view, much of the learning was occurring even before the person was technically a hobbyist. Moreover, the knowledge a learner gained between considering engaging with this hobby and physically engaging with the hobby was much more than s/he gained after physically engaging with the hobby and moving toward becoming an expert in the field.

In order to search for the information they need to make the decision whether or not to begin keeping koi, or to prepare themselves for their future acquisition of koi, Stage 1 koi hobbyists might go online to a koi hobby discussion forum, join koi clubs, or attend koi shows or koi-related education programs such as workshops or conferences, and these sources were also where I posted my questionnaire survey. Obtaining the information about this study and being willing to participate could then serve as evidence of learning by Stage 1 participants.

Also, among the three Stage 5 participants, one had not had any koi for 3 years, one for 7, and another for 15 years. However, the mean scores this group received for the koi quiz showed no significant difference from Stage 2 and Stage 3 participants, and a
significant difference from Stage 0 participants. Even thought the sample size was only three, and potentially biased, these results suggest that the knowledge an individual gains through the intensive, self-motivated, self-guided and hands-on learning experience typical of a FCL hobbyist persists long after s/he has given up the hobby.

The results of the “koi quiz” section of the questionnaire showed a significant positive correlation between knowledge and years of experience keeping koi. Therefore, we expected that Stage 3 participants would score higher than Stage 2 participants, since Stage 2 participants have less than three years experience of koi keeping and Stage 3 participants have more than three. However, there was no significant difference between the scores gained by Stage 2 and 3 participants. One of the reasons could be that the 23 Stage 2 participants in this study might have different goals for koi keeping: some of them might aspire to be Stage 3 (laid back, no showing or breeding koi) and some might aspire to be Stage 4 (showing, breeding). With different goals, these participants might acquire different kinds of information, learn from different sources and apply different amounts of time and effort to learning, and thus have different knowledge levels about koi and their koi hobby. In fact, among the three pre-Stage 3 interviewees, one’s goal was to be Stage 4 (Carl) and the other two (Ada and Bob) preferred to be Stage 3, and Carl did score higher than Ada and Bob (35 vs. 30 and 29). In the result of the quantitative study, the mean score of Stage 2 (30.0±5.1) participants fell below the mean scores of Stage 3 (30.3±6.2) and 4 (34.8±4.4) participants, and was significantly lower than the Score of Stage 4, but not significantly lower than Stage 3. This difference between the scores of Stage 2 and Stage 4 hobbyists also indicated that there was some knowledge
required for a new koi hobbyist to become a masterful koi expert. I expect that, through time, those Stage 2 hobbyists whose goals were to be Stage 4 hobbyists would have more intensive learning while engaging with their hobby and would end up knowing more about their hobby and their fish. This explanation would also help to explain the finding that koi hobbyists’ learning goals typically outweighed years of experience as a determinant of knowledge level regarding koi and koi keeping.

The results of this study showed that participants who are members of koi hobbyist clubs and who attend koi shows scored higher on the “koi quiz.” The study also showed that the knowledge level of participants was positively correlated with how often the participants attended koi shows and koi club activities, but there was no significant correlation between knowledge level and years of membership in koi clubs or of attending koi shows. In other words, for the knowledge level about koi and koi keeping, frequency of participation in koi hobbyist clubs emerged as more important than length of involvement. Those participants spending the most time in the koi hobbyist community get more chances to see, talk to, and learn from people in the community and thus know more about koi and koi keeping. A good example is Gary, at Stage 4. He actively participated in his koi club activities and attended almost every monthly meeting and every annual show, and thus he had opportunities to learn from experienced club members, a club member who was in the koi business, and vendors in the show. Therefore, even though he has been keeping koi less than 3 years, he has been able to enter his koi into competitions in the show and has won multiple awards. Frank (Stage 3) and Ivan (Stage 4) were other examples that showed that attending koi shows was one of
the primary learning opportunities for hobbyists. I interviewed both subjects at the koi show in Bellevue, WA, USA, and they both stated that they had gained information from the judges in the show, particularly about koi varieties. Koi hobby-related professional training and competitions in koi shows were also learning opportunities for koi hobbyists. The study results showed that participants who received koi-related professional training and attended koi show competitions scored significantly higher on the “koi quiz” than those who did not.

The degree to which people actively engage in learning in support of their hobby is not constant across stages. Typically, we think of a stage model like this as a progression, in which hobbyists move though one stage after another in a linear mode. The results of this study showed that perhaps it is progressive in terms of degree of engagement with the hobby, but it is not linear in terms of knowledge or utilization of resources. This research allows us to see that there are critical time periods and thresholds. For example, there is clearly a critical time period between Precontemplation and Action, and much of the learning that supports an individual’s ability to be a successful hobbyist actually occurs before s/he would technically be considered a hobbyist. That is one of the major findings of this research.

It is also important to understand which information sources koi hobbyists used in order to acquire knowledge related to their hobby. To do so, I generated a list of information sources and asked the participants to choose which sources they used occasionally or regularly, when they have questions about their koi. The idea was that those sources of information they used occasionally were sources available for them to
use when they needed to, while those sources they used regularly were not only available for them to use, but also were the sources they had verified and trusted. Thus, I used the index of information sources used generally and regularly to estimate the information-seeking strategies of koi hobbyists with different personal backgrounds and socio-cultural interactions when they encounter different types of situations or problems while they were engaging their koi hobby.

The results showed that participants’ years of experience keeping koi, attendance at koi club activities, koi shows and koi competitions, and receipt of koi-related professional training all positively correlated with their index of information sources used generally and regularly. The results also showed that participants who scored high on the “koi quiz” had a higher index of information sources used generally and regularly. These results indicated that a participants’ personal history of koi keeping, such as years of experience, attending shows and competitions, receipt of professional training, knowledge level about koi keeping, and socio-cultural interactions with other hobbyists, such as being a member of a koi hobbyists’ club and actively attending club activities, directly influenced their information-seeking strategies.

Koi hobbyists at different stages of engagement had different indices of information sources used generally and regularly as well. The rankings of the index of information sources used generally of participants in the 5 stages are Stage 1 > Stage 4 > Stage 5 > Stage 3 > Stage 2, and the rankings of the index of information sources used regularly of participants in the 5 stages are Stage 1 > Stage 5 > Stage 4 > Stage 2 > Stage 3. Stage 1 participants used more kinds of information sources and used them more regularly than
all of the other 4 groups. Because they were just considering having koi, anything about koi was new to them. They had to gather information about the pros and cons to decide whether they really wanted to have koi or not. Carl, one of my Stage 2 interviewees, mentioned that before he started keeping koi (so he was in Stage 1 at that time), he had gathered information from multiple sources such as books, magazines, chain pet stores, garden centers and the internet. He had viewed hundreds of YouTube clips of koi ponds and water gardens to get an idea of what a koi pond should be. So as Stage 1 hobbyists, they act like a sponge, absorbing all the information they can get. These are self-supporting and self-reinforcing systems influenced not only by hobbyists’ personal contexts, but also their socio-cultural contexts. However, the hobbyists do not treat all information sources equally; they have ways to verify the reliability of those sources of information. Carl used his experience operating a saltwater fish store for 13 years to see if the information “makes sense or not, and see if there is an ‘aha’ moment.” On the online discussion forum, Carl even tried to find the “key players” and just follow what the key players said. He went through almost every post on the forum and, according to what people posted and how they interacted with other forum members, and then he could tell who is “trustable.” Some of these key players were other koi hobbyists, while some of them were koi breeders and koi and pond-related product vendors. He found the reliable sources and followed their suggestions. To verify the reliability of information, Ada would check at least three other sources, based on her experience as a medical doctor, and see if others agreed. After the verification, she regularly visited those sources, seeking useful information (“I live on that website [skippyfilter.com],” she said).
Participants at Stage 4 used more sources of information and used them more regularly than participants at Stage 2 and Stage 3. Stage 4 participants were more interested in showing and breeding their koi than participants at the other stages. They usually bought more new koi and bought koi of higher show quality, and had to maintain good water quality and provide appropriate food and husbandry to ensure their koi grew well to reach and maintain that show quality. Thus, they encountered more problems while engaging in their koi hobby. In addition, their motivation to show and breed their fish also forced them to solve these problems satisfactorily, so they tended to search through more sources of information and search them more frequently. As Jeff (one of the Stage 4 interviewees) said, “Keep up and maintain what they need, which is not easy. That’s kind of part of the fun of it. Trying to give them the best environment you can with the time and money you have available.”

Besides personal background, expectations regarding koi-keeping and socio-cultural interactions with others, another factor that appeared to affect hobbyists’ ways of learning were physical context issues such as the kinds of problems encountered in the particular environment surrounding their pond. In this study, I asked what kinds of information sources the participants would use when they encountered each of five different problems (koi variety, pond construction, water quality, koi diet and koi disease) during their koi keeping. The result showed that indices of information sources used generally for the five different subjects were different. This indicated that hobbyists would apply different information-seeking strategies and search different information sources when they had different questions. A good example of this was Doug. In answer
to the question about his information-seeking strategies, he said that for pond construction he had referred to his notes from a long-ago college course in aquaculture. However, in feeding his fish, he followed the advice of fellow garden club members, who recommended organic, home-grown fruits and vegetables. For the decision of what variety of koi to choose, he relied on the advice of friends who suggested he go to a koi show. While for treatment of diseases in his koi, he relied on his own professional knowledge (he is a veterinarian), as well as suggestions from friends.

Stage 3 and Stage 4 hobbyists are different, by definition of the Stage Model of Engagement. Stage 3 hobbyists enjoyed a more “laid-back” style when taking care of their koi and ponds. They enjoyed their interactions with their koi, as well as their ponds and gardens. They felt that it was important that family and friends also enjoy their fish. Stage 4 hobbyists appreciated the beauty of the koi themselves. They worked hard to learn the different koi varieties, and how to take good care of their koi so that the beauty of the fish can be displayed in competition, and be passed to the offspring with deliberate breeding. Ada described Stage 4 koi hobbyists as “koi purists,” and Stage 3 hobbyists as the “water garden guys.” Even though she did not cover all the characteristics of these two groups, her statements seemed to capture the essence of each.

As the results of this study showed, Stage 4 participants attended koi club activities, shows and koi-related professional training sessions. They do so to gather more information about koi keeping, so that they can better achieve their goals. Stage 4 participants also credited their experience with keeping koi, experience with keeping other pets, and even the knowledge they had gained in their formal education for their
success in koi keeping. Gary stated in the interview that, through his two years of success and failure at koi keeping, he developed a clear idea of which kinds of koi would turn into great koi, and which kind would be mediocre. This helped him to select the right koi for future competitions. Jeff applied his experience with breeding Chihuahua dogs (he is an amateur Chihuahua breeder) when selecting the spawning pairs for breeding koi, and he recalled the nitrogen cycle (which is important in filtration system design) from his high school years.

More Stage 4 participants than Stage 3 participants agreed that the benefit of spiritual relaxation, the financial return from keeping koi, and the admiration of their koi by others were parts of their motivation for keeping koi. Even though some of the Stage 3 hobbyists thought that having to spend too much time taking care of the fish, dealing with diseases brought on by constantly introducing new koi to the environment, and the difficulty of transporting the koi safely from home to shows and back were stressful, and that those issues were part of the reason why they did not show and breed their koi, most (72.4%) of the Stage 4 participants in this study, who did show and breed koi, still agreed that koi-keeping was a spiritual relaxation for them. As Jeff stated in the interview, “It’s relaxing to me. I like to come back here to forget about some of my [problems], forget about the rat race for awhile, check out my koi, and you hear the running water.” And Henry enjoys his time every afternoon sitting by his koi pond with a glass of wine and just watching his award-winning koi.

As for financial returns, Stage 4 participants thought they were important because keeping koi, especially high-quality koi, is not cheap. One of the award-winning koi
hobbyists I encountered at the Northwest Koi and Goldfish Show in 2010 (during the pilot study) said, “I know it is unfair, but it’s not a poor man’s game.” Two of my Stage 4 interviewees said that they do not want to make money from their koi hobby, but they do want to earn enough money to keep the hobby going. Gary usually bought smaller koi with award-winning potential, and he raised them and entered them into competitions. If the fish won an award, he did not hesitate to sell it for a higher price because, “then I can buy more koi.” Both Stage 3 and Stage 4 hobbyists appeared to enjoy the admiration they received from others when displaying their fish. Moreover, Stage 4 hobbyists not only showed their koi to visitors at their homes, but also exhibited their fish in shows and competitions. And keeping award-winning koi usually engenders admiration. Gary specifically showed me his award-winning koi when I visited him, and was very happy when I also enjoyed the beauty of his koi.

While both Stage 3 and 4 participants “agreed” or “somewhat agreed,” at the same level, that participating in online koi discussion forums and membership in koi clubs were important to their koi-keeping success, Stage 4 participants more often agreed with the statements that they actively contributed to koi club activities and online discussion forums. Henry was one of the founders of a koi club in Oregon, USA. He gives talks, seminars, and workshops at koi shows and conferences, and he helps his club members to build their ponds, select good koi and deal with disease. “I have been through a rough route in koi keeping,” he said, “and I hope with my help they do not have to suffer those things.” Gary said that he liked to help other koi keepers because being appreciated is also a kind of reward for koi keeping.
Another personal characteristic of koi hobbyists is their knowledge about their koi and koi hobby. As stated above, koi hobbyists in Stage 4 were most interested in showing and breeding koi. In order to successfully show koi, they have to understand the differences between koi varieties, the characteristics and standards of each variety, how to maintain good water quality, what diet to provide for fast-growing and beautiful fish, and how to prevent and treat disease. To breed koi, they have to know everything needed for showing, as well as how to select the spawning pairs so that they can get the offspring desired. Unlike Stage 3 hobbyists, who basically only worry about keeping their koi healthy and “happy,” Stage 4 hobbyists need more knowledge to achieve their objectives.

The results of the study showed a significant difference in the total “koi quiz” scores between Stage 3 and Stage 4 participants. Stage 4 participants scored significantly higher than Stage 3 participants in knowledge about koi varieties, pond construction, water quality and koi disease. The results of the study also showed that Stage 4 participants had a significantly higher index of information sources used generally and regularly than Stage 3 participants, which implied that Stage 4 participants used a wide variety of information sources, and consulted those information sources more frequently and regularly. One example of the intensive learning of Stage 4 hobbyists was Carl (who was actually a Stage 2, but his goal was to show his fish in the very near future). Carl has collected a large number of reference books (‘‘…case after case of books, and I got most of my knowledge [about filtration and koi] from books. I have a very expensive library. Most of them are reference types of books. Not the kind of “check-out-the-picture kind of books.’’). He also watched hundreds of YouTube clips about water gardens and koi ponds.
before he started to design his own pond. In addition, Carl visited pet stores, koi farms and friends he knew from the koi hobbyist discussion forum to buy his fish. He got some of his pond supplies from vendors online as well. After setting up his koi pond and introducing his koi, he still participated intensively in online discussions about koi varieties, koi shows, pond construction, filtration, koi diet, koi disease, and aquatic plants for koi ponds. He averages approximately nine posts per day, every day, on the discussion forum.

Stage 3 and Stage 4 participants also used different information sources for different kinds of problems they encountered during their koi keeping. In general, Stage 4 participants would consult books/magazines, friends, koi-only retail shops, koi hobbyist clubs, koi shows/events, educational programs such as workshops/conferences, and specialists, while the majority of Stage 3 participants would use chain pet stores, private pet stores, fish-only pet stores and garden centers as their sources of information. Because Stage 4 hobbyists have higher expectations about the quality of their koi and have more specific questions about koi varieties, they tend to seek out more “expert” type of information sources, and information from books/ magazines, friends, koi-only retail shops, koi hobbyist clubs, koi shows/events, educational programs such as workshops/conferences, and specialists are considered more authoritative. Stage 3 participants tended to use chain pet stores, private pet stores, fish-only pet stores and garden centers as their sources of information because those sources were easier to find and/or more financially friendly.
According to situated cognition theory, knowing cannot be separated from doing (Dewey, 1981, originally published in 1902; Brown, Collins, & Duguid, 1989; Greeno, 1989; Clancey, 1995), and all knowledge is situated in activity bound to social, cultural and physical contexts (Greeno & Moore, 1993). In this study, I documented hobbyists’ learning about koi and koi keeping and compared the different learning processes of hobbyists in different stages of engagement. In Ada and Gary’s cases, since they had different goals for their koi keeping, they encountered different kinds of situations and problems and utilized different sources of information to solve the problems. This kind of learning cannot be separated from the context, which includes the learner himself/herself, physical settings, and the interaction between members in the community. For example, Gary liked to select koi with award-winning potential on-site (including koi shows, koi-specific retail shops or koi breeders) instead of buying koi from mail order catalogs or the internet because “when seeing the fish in person, you get a different perspective.” He could look at a group of fish and see the sizes, colors, patterns, and the skin tones of all the fish together, and he could tell whether he liked the breeders’ way of breeding this specific variety. He could also talk directly to the owners or breeders of those fish and ask particular questions about exactly the fish he wanted to buy. These conditions were difficult to replicate online or through the colorful pictures of mail-order catalogs. Another example was Ada visiting other club members’ ponds during club activities. When she was standing by a pond listening to the pond owner talking about that particular pond, she could pick up ideas right away. She then brought the ideas home,
but she had to modify the ideas before she applied them to her own situation due to her particular circumstances and pond setup.

Both Gary and Ada were members of koi hobbyist clubs. While learning about koi and koi keeping, their process of engagement and interaction with other club members matched Lave and Wenger’s (1991) description of participation in a community of practice. In a community of learners, people share interest and expertise with each other, learn how to learn, learn how to connect various concepts of interest, and learn how to help and collaborate with others to pursue the area of inquiry (Matusov & Rogoff, 1995). Learners’ development includes not only increasing skill levels, but also the ways they conform to the norms of the community by adopting its terminology, styles, and values. Before Gary joined the club, he had no idea of koi varieties. He just thought koi were all one kind of animal, and some of them were better looking than others. There were quite a few club members who were very interested koi varieties and in showing their koi. After he joined the club and began talking and interacting with other club members, Gary gradually learned about the different varieties of koi, and how to say their names with the proper Japanese pronunciation. He also observed other club members’ koi, asking specific questions about why one fish was better than others, and thus developed the interest in koi showing and gained ideas of how to select and take good care of award-winning koi. The processes by which Gary gained knowledge of and interest in koi showing through his interaction with koi club members clearly reflected Lave and Wenger’s (1991) notions of legitimate peripheral participation. In Gary’s club, he, as a novice, entered at the edge of a community in which there were members sharing the
same subjects of interest—koi keeping and koi showing. His participation was on the periphery. Gradually, Gary’s involvement deepened and became more complex; he picked up the vocabulary that other club members used regularly and participated in more club activities. He became a full participant, and gained knowledge and skills during his participation.

We usually think about hobbyist learning as a trajectory towards mastery. At one level, this is true; every hobbyist is on his or her own trajectory toward mastery. However, this is too simplistic a model because there are different levels and types of mastery, and different people aspire to achieve different ones. Koi hobbyists’ learning was affected by various factors: learners’ personal motivation and background; learners’ socio-cultural interactions with others; and the physical situations where the learning took place. In this study, I categorized koi hobbyists into different stages of engagement according to their personal backgrounds, such as experience, motivations and goals for koi keeping. Based on the results, I showed that koi hobbyists in different stages of engagement and with different socio-cultural interactions (such as with family members or other koi hobbyists) learned differently. When facing different situations or problems during their koi keeping, koi hobbyists would choose multiple sources of information, depending on its availability and reliability, to solve those problems. Defined by their interest and motivation, and their needs, people pursued their hobby in different ways, as described in my Stage of Engagement Model, Prochaska’s Stage of Change Model, and Falk’s and Dierking’s Contextual Model of Learning. What we see from the data is a group of koi hobbyists who were setting out to fulfill their own needs; although each need was personal and
unique, there were parallels amongst these different needs based upon context and stage. Hobbyists utilized the various learning resources in their environments in different ways, as a function of their different needs. There were various resources available and hobbyists were able to select those they needed and which were appropriate for them based on their needs. The results of my study of hobbyists’ learning supported Prochaska’s Stage of Change Model and Falk and Dierking’s Contextual Model of Learning (2000), as well as my Stage of Engagement Model in this special kind of free-choice situation.

In future studies, other than looking into more detail of how personal, socio-cultural and physical contextual factors affect how hobbyists learn, I would like to explore more how koi hobbyists interact with each other in the koi clubs and how these interactions would shape the way koi hobbyists learn. Using a lens of situated learning and viewing how hobbyists learning changes in the process of becoming established members of the hobbyist community through participation would also benefit our understanding of this type of everyday, free-choice learning. Because of the popularization of the internet, searching for information online and joining in online hobbyists groups has become one of the most common and important ways that hobbyists learn about their hobby and interact with others sharing the same interest from all over the world. How these kinds of online communities differ from actual koi clubs as sources of information and communities of practice for koi hobbyist represents an important future line of investigation.
Chapter Six: Conclusion

In this study, I approached koi hobbyists’ learning about koi and their koi hobby in both a quantitative and qualitative way. I designed a Stage of Engagement Model to illustrate koi hobbyists’ engagement with their hobby. I adapted Falk and Dierking’s Contextual Model of Learning to explain how personal, socio-cultural and physical contextual factors affected koi hobbyists’ learning.

Hobbyists’ learning about their hobby starts early, sometimes even before they physically engage with the hobby. Actually, a significant amount of learning takes place when individuals are in the Contemplation stage, technically only considering engaging with the hobby. Before they start, they search for information about the hobby, and the benefits and costs of engaging in the hobby. They also learn while engaging in the hobby. They encounter problems while pursuing their hobby, applying multiple learning techniques for acquiring needed information, verifying the reliability of information gathered, and making sense out of it to solve their problem. Hobbyists with different personal backgrounds, such as different amounts of knowledge about the subject, different motivations and commitment to the hobby, different types of socio-cultural interactions with friends, family and other hobbyists, and with different physical situations such as availability of information sources and problems encountered, learn differently. Using this as a learning lens and framing engagement through a Stage of Engagement model suggests a very different view of how to classify and understand the behavior hobbyists. Traditionally, individuals in the Contemplation stage would not be considered hobbyists, but this study would suggest that they most definitely are.
Similarly, years of engagement with a hobby are typically used as a tool for classifying levels of engagement with a hobby, but this study suggests that hobby goals/motivations and learning resource use might be better classification tools.

Key qualities of the learning that hobbyists engage in are self-motivation and self-direction, with clear learning goals, requiring persistent effort and time while engaging, and application of multiple learning skills under different circumstances. This type of learning has also been described as characteristic of learners participating in school-based project-based and hands-on activities (e.g., Krajcik, Blumenfeld, Marx, Bass, Fredricks, & Soloway, 1998; Moylan, 2008). The knowledge hobbyists gained while they were engaged with their hobby was shown to be constantly in need of updating and was reconstructed as individuals encountered new challenges and acquired new information. This represents a very dynamic form of learning, the kind of learning that most educators say they strive for (e.g., Bransford, Brown & Cocking, 2000). Further evidence for this was the persistence of knowledge gains individuals acquired while pursuing their hobby which remained with them years after they stopped participating in the hobby.

Is this kind of complex self-reinforcing system of learning unique to koi hobbyists? It should not be. At least we can hypothesize that virtually any hobby domain would have similar kinds of processes at work. There will be individuals at different stages, and people are in these stages in large part because of their motivations and needs. In this study, knowing how hobbyists learn provides an opportunity to examine the applicability of the Stage of Behavior Change Model, situated learning and the Contextual Model of Learning in understanding this particular type of learning. It should also offer insights
into how learners construct their knowledge by applying different learning strategies under certain circumstances when their personal, socio-cultural and physical contents interact.

We live in a world that demands continuous learning; we also live surrounded by a multiplicity of information-rich resources. People are actively engaged with learning within these systems, using their personal, socio-cultural and physical contexts to support their learning. Through Prochaska’ model, we can actually see that people behave and learn differently in different stages of engagement. Although all of the koi hobbyists in this study had roughly comparable socio-economic and educational backgrounds, all had koi ponds, and all maintained koi, their learning behaviors significantly differed based on their personal (motivations and needs), socio-cultural (interactions with other hobbyists) and physical (sources of information available and utilized) contextual factors. These findings are likely to be true for other koi hobbyists in particular and other hobbyists in general. In the short term, the value of these findings can be applied to facilitating improved outreach programs, and to benefiting hobbyist-related businesses. With the ability to predict learners’ behaviors and factors that will contribute to achievement of their overall learning goals, educators can make decisions about what educational interventions should be designed or if additional facilitation/scaffolding is needed, and in what ways, types, and formats the information should be delivered in order to maximize the learning outcomes of hobbyists. This dissertation study has also laid the groundwork for future studies of other kinds of hobbies and hobbyists.
For the purpose of generalizing findings of this study to understand free-choice science learning in general, the results of my study showed that the Contextual Model of Learning is a useful framework, and that the general assumptions underlying Prochaska’s Stage model could be usefully applied to studying koi hobbyist learning. And therefore, if we look at other kinds of FCL activities, one could ask whether these models would apply equally in those contexts. Research (e.g., Falk & Storksdieck, 2005) has shown that the Contextual Model of Learning adequately described and predicted people’s learning behavior in a museum-like setting. However, adding the lens of Prochaska’s model might help further elaborate the model, allowing more detailed categorization of visitors possessing different experiences, prior knowledge and learning goals, and result in a better understanding of individuals’ learning processes.

For the purpose of linking the findings of this study with formal science education, in the future I could envision applying other learning theories, methodology and research tools developed in the formal education context to investigations of free-choice learning. The results of this investigation suggested that at least the general framework of situated learning is a useful framework for this kind of unique, free-choice type of learning. I would like to apply other lenses such as constructivism and socio-cultural theory in studying the learning of hobbyists. Quantitative and qualitative analytic tools such as advanced statistic models and computer software originally developed for in-classroom learning might also be applied to the study of hobbyists’ learning as well.

I would suggest that the findings from my study could also be applied to formal education situations. For example, in formal education settings, there have been efforts to
train students to be self-directed learners and to prepare students for success in the modern world. How to encourage learners to find questions, design and conduct investigations, observations and experiments, collect and analyze data, draw conclusions and show their findings has been recently proposed as the optimal outcome of science education (National Research Council, 2012). With its characteristics of self-directed investigation and learning, collaborative work with other hobbyists, real-world problems and questions, and koi ponds and show-quality koi as the final artifacts of their learning processes, hobbyists’ learning shares many similarities with Project-based Learning (PBL), even though the latter was designed and defined as a teaching strategy (Krajcik, et. al, 1998; Moylan, 2008). Understanding how learners (hobbyists) learn in free-choice learning settings, how they define questions and start authentic investigation, how they use cognitive tools to support the inquiry process, how they collaborate and communicate with others in order to search for information, answer questions and solve problems, and how they show their koi and build ponds (in the case of koi hobbyists) as a product of their learning/inquiry process, might help us to generate some thoughts about formal, in-classroom teaching strategies.

In formal education, unlike informal education, elaborate systems have been set up to try to get children to learn. My study showed that a system exists where people are learning all the time, driven by their own intrinsic interests and needs. So a potential use of this study would be to create a model system within formal educational settings that was built on the intrinsic interests and needs of students. In the past there have been a number of reform efforts, such as PBL, trying to create curricula, teaching strategies and
learning environments to help students to become interested in learning, and some of those efforts have been shown to successfully move in that direction. However, there is still a shortage of teaching strategies for accomplishing this. In the case of PBL or science fair activities, for example, motivation to learn only works when students get to choose their own projects. So, how would we re-envision PBL and science fairs to encompass what we just learned from this study? If the environment is properly structured, children will spend a great deal of time and energy in learning before they become invested in actually doing a project. Traditionally, we have tried to help children quickly launch into a project because we believed that learning only happens while they are working on the project. This study suggests that a significant amount of learning happens during the transition between Precontemplation and Contemplation stages and during the Contemplation stage, which, in the case of PBL, is when children are exploring possible project topics and investigating which topics match their interests and are worth the investment of tremendous time and effort. So we should not reduce that phase of the project. If the goal is learning, the process of choosing a good project based on students’ interests and needs may be as important as, or even more important than, actually doing the project. However, this is usually not the way PBL learning is handled in schools.

Overall, in this study, I approach koi hobbyists’ learning about koi and their koi hobby in both a quantitative and qualitative way. I designed a Stage of Engagement Model to illustrate koi hobbyists’ engagement with their hobby. I adapted Falk and Dierking’s Contextual Model of Learning to explain how personal, socio-cultural and physical contextual factors affected koi hobbyists’ learning. Findings of this study
documented that koi hobbyists’ personal, socio-cultural and physical contextual factors would all affect koi hobbyists’ learning about their hobby. This study could provide a framework for future studies on leisure hobbyists’ learning. Moreover, I hope the results of my study can mutually benefit formal and informal educational research by refining those learning theories or even generating new viewpoints which will help to promote public scientific literacy.
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Appendices

Appendix A: Paper-based Questionnaire for Quantitative Approach of this Study

I am at least 18 years old.

___ Yes (continue the survey)   ___ No (leave the survey)

This confidential survey will take approx 15 minutes to complete.

You are being asked to do this survey because you are a Koi hobbyist, you are in a Koi show, you are a Koi hobbyist club member or you are viewing a Koi hobbyist related webpage. This study is designed and carried out by Oregon State University researchers to learn more about the motivation, interests and information seeking strategies of Koi hobbyists when engaging with their Koi hobby. This study is also part of Chi-Chang Liu’s dissertation while purchasing his PhD degree in the Department of Science and Mathematics Education at Oregon State University. The result of this survey is also to help the development of an outreach program to facilitate ornamental fish hobby and business funded by Oregon Sea Grant. The survey is not for the purposes of assessing your science knowledge, performance, or personal abilities.

There are no foreseeable risks or benefits to taking part in this study. Your participation is voluntary and you may refuse to answer any question. Your responses will be combined with others in a statistical database. The information collected on this survey will remain anonymous/confidential. Only project researchers at Oregon State University will see the results.

If you have any questions about this research project, please contact: Dr. John Falk by phone at (541) 737-3664 or by email at Falkj@science.oregonstate.edu. If you have questions about your rights as a participant, please contact the Oregon State University Institutional Review Board (IRB) Human Protections Administrator, at (541) 737-8008 or by email at IRB@oregonstate.edu. This contact information will be provided again at the end of this survey.

By continuing with this survey you agree to take part in this study.
Part 1:

Please answer the following questions related to your involvement with raising Koi as a hobby:

1. Are you presently involved with keeping Koi as a hobby?  _____Yes  _____No

   If yes,
   a. how many years have you had Koi?  _____# of Years
   b. did you ever quit, then start again with Koi?  _____Yes  _____No

      If so, please briefly explain why:

   If not,
   c. have you raised Koi before?  _____Yes  _____No

      If yes, please explain why you quit raising Koi:

      If not, would you consider being involved in the Koi hobby in the near future?

      _____Yes  _____No

2. Location of your pond(s)
   a. Do you have outdoor ponds?  _____Yes  _____No
   b. Do you have indoor ponds?  _____Yes  _____No
   c. Description of your pond and Koi:
      1. Volume/Size of the pond(s)
      2. Number and approximate size of your Koi

3. Are you presently a member of a Koi club?  _____Yes  _____No

   If yes,
   a. how long have you been a member?  _____# of Years
b. how often do you attend club events? ____# of times/year
c. what type of events do you generally attend? 

4. Do you attend Koi shows? ____Yes
   ____No
   a. How long have you been attending Koi shows? ____# of Years
   b. How many shows have you attended? ____# of shows attended

5. Have you ever entered your Koi in a show? ____Yes
   ____No
   and have your Koi ever won awards or honors? ____Yes
   ____No
   if so, please briefly describe those awards and honors:

6. Have you received professional aquaculture or Koi related training? ____Yes
   ____No

7. Have you ever intentionally bred your Koi? ____Yes
   ____No
   a. If yes, what did you do with the offspring?

8. Have you ever sold Koi that you spawned? ____Yes
   ____No

9. Where do you typically shop for Koi supplies?
   a. ____Pet Shop
   b. ____Online
   c. ____Mail order
   d. ____Koi specific dealer
   e. ____Garden center
   f. ____Fish retail shop (sells many species of ornamental fish)
   g. ____Other (Please specify)
10. When you are going to buy Koi or you have questions about Koi varieties, which sources do you seek for help or learn about your Koi hobby?
   – Please label the following sources as either:
     (R) - I use this source on a regular basis
     (O) - I occasionally use this source
     (N) - I never use this source

   1. _____Internet:
      1. _____ Documentary WEB Sources
      2. _____ Interactive Discussion Boards
   2. _____Books/magazines
   3. Friends and/or family, who is
      1. _____ someone in the Koi business
      2. _____ considered a “Koi” experts
      3. _____ a Koi hobbyist
   4. _____Pet Stores
      1. _____ A chain, or “big box” store
      2. _____ Private pet store
      3. _____ Fish only store
   5. _____Koi only retail shop
   6. _____Garden Center
   7. _____ Other Koi hobbyists acquaintances
   8. _____Koi Clubs
   9. _____Koi Shows/Events
   10. _____Educational Programs – workshops/conferences
   11. _____Fish Vets
   12. _____Fish Biologists
   13. _____Others (Please specify)___________________________________

11. When considering whether to build a Koi pond, or improving an existing pond, which of the following sources did you or will you utilize? Please label the following sources as either:
    (R) - I use this source on a regular basis
    (O) - I occasionally use this source
    (N) - I never use this source
12. When considering Koi pond water quality problems and challenges, which of the following sources did you or will you utilize? Please label the following sources as either:
(R) - I use this source on a regular basis
(O) - I occasionally use this source
(N) - I never use this source

1. _____ Internet:
   1. ____ Documentary WEB Sources
   2. ____ Interactive Discussion Boards
2. _____ Books/magazines
3. _____ Friends and/or family, who is
   1. ____ someone in the Koi business
   2. ____ considered a “Koi” expert
   3. ____ a Koi hobbyist
4. _____ Pet Stores
   1. ____ A chain, or “big box” store
   2. ____ Private pet store
   3. ____ Fish only store
5. _____ Koi only retail shop
6. _____ Garden Center
7. _____ Other Koi hobbyists acquaintances
8. _____ Koi Clubs
9. _____ Koi Shows/Events
10. ____ Educational Programs – workshops/conferences
11. ____ Fish Vets
12. ____ Fish Biologists
13. ____ Others (Please specify)______________________________
4. _____Pet Stores
   1. _____ A chain, or “big box” store
   2. _____ Private pet store
   3. _____ Fish only store
5. _____Koi only retail shop
6. _____Garden Center
7. _____Other Koi hobbyists acquaintances
8. _____Koi Clubs
9. _____Koi Shows/Events
10. _____Educational Programs – workshops/conferences
11. _____Fish Vets
12. _____Fish Biologists
13. _____Others (Please specify)___________________________________

13. When considering Koi nutrition and diet challenges, which of the following sources did you or will you utilize? Please label the following sources as either:
   (R) - I use this source on a regular basis
   (O) - I occasionally use this source
   (N) - I never use this source

1. _____Internet:
   1. _____ Documentary WEB Sources
   2. _____ Interactive Discussion Boards
2. _____Books/magazines
3. _____Friends and/or family, who is
   1. _____ someone in the Koi business
   2. _____ considered a “Koi” expert
   3. _____ a Koi hobbyist
4. _____Pet Stores
   1. _____ A chain, or “big box” store
   2. _____ Private pet store
   3. _____ Fish only store
5. _____Koi only retail shop
6. _____Garden Center
7. _____Other Koi hobbyists acquaintances
8. _____Koi Clubs
9. _____Koi Shows/Events
10. _____ Educational Programs – workshops/conferences
11. _____ Fish Vets
12. _____ Fish Biologists
13. _____ Others (Please specify)___________________________________

14. When considering Koi health problems and challenges, which of the following sources did you or will you utilize? Please label the following sources as either:
   (R) - I use this source on a regular basis
   (O) - I occasionally use this source
   (N) - I never use this source

1. _____ Internet:
   1. _____ Documentary WEB Sources
   2. _____ Interactive Discussion Boards
2. _____ Books/magazines
3. _____ Friends and/or family, who is
   1. _____ someone in the Koi business
   2. _____ considered a “Koi” expert
   3. _____ a Koi hobbyist
4. _____ Pet Stores
   1. _____ A chain, or “big box” store
   2. _____ Private pet store
   3. _____ Fish only store
5. _____ Koi only retail shop
6. _____ Garden Center
7. _____ Other Koi hobbyists acquaintances
8. _____ Koi Clubs
9. _____ Koi Shows/Events
10. _____ Educational Programs – workshops/conferences
11. _____ Fish Vets
12. _____ Fish Biologists
13. _____ Others (Please specify)___________________________________
Part 2:

As a Koi hobbyist, please rank the following statements from strongly agree, disagree, agree, and strongly agree:

1. My experience in raising Koi is important for me to be a successful Koi hobbyist.
   ___Strongly disagree _____Disagree _____Agree _____Strongly Agree

2. Having other pets has helped me be successful with my Koi.
   ___Strongly disagree _____Disagree _____Agree _____Strongly Agree

3. What I learned in school (K-12, college) has helped me be successful with my Koi.
   ___Strongly disagree _____Disagree _____Agree _____Strongly Agree

4. My income is adequate, allowing me to participate in the Koi hobby.
   ___Strongly disagree _____Disagree _____Agree _____Strongly Agree

5. I have adequate time to spend on my Koi.
   ___Strongly disagree _____Disagree _____Agree _____Strongly Agree

6. It is important I learn something from keeping Koi.
   ___Strongly disagree _____Disagree _____Agree _____Strongly Agree

7. The degree of my success with keeping my Koi is important for me.
   ___Strongly disagree _____Disagree _____Agree _____Strongly Agree

8. I keep Koi as a way to achieve relaxation.
   ___Strongly disagree _____Disagree _____Agree _____Strongly Agree

9. I must experience financial return from keeping Koi.
   ___Strongly disagree _____Disagree _____Agree _____Strongly Agree

10. It is important that my family also enjoys my Koi.
    ___Strongly disagree _____Disagree _____Agree _____Strongly Agree
11. Being a Koi club member has helped me be a success at keeping Koi.

___Strongly disagree _____Disagree _____Agree _____Strongly Agree

12. I actively contribute to Koi club(s).

___Strongly disagree _____Disagree _____Agree _____Strongly Agree

13. Participating online with Koi discussion groups has helped me to become a successful Koi hobbyist.

___Strongly disagree _____Disagree _____Agree _____Strongly Agree

14. I actively contribute to online Koi discussion groups.

___Strongly disagree _____Disagree _____Agree _____Strongly Agree

15. I enjoy people’s admiration when showing my Koi to them.

___Strongly disagree _____Disagree _____Agree _____Strongly Agree

16. My family members are happy that I keep Koi at home.

___Strongly disagree _____Disagree _____Agree _____Strongly Agree

17. I work with other Koi hobbyists on special projects, such as building ponds or spawning Koi.

___Strongly disagree _____Disagree _____Agree _____Strongly Agree

18. I help, teach, and tutor other Koi hobbyists.

___Strongly disagree _____Disagree _____Agree _____Strongly Agree
Part 3:

Please put a check by the correct answer – there may be more than one correct answer.

1. Koi are the same species as:
   _____Goldfish   _____Common Carp   _____ Silver Carp

2. Koi are:
   _____Herbivores   _____ Carnivores   _____ Omnivores

3. Ammonia can arise both from the breakdown of food/waste from within the pond or it may come directly from the fish themselves:
   _____ True   _____ False

4. We can remove nitrate by performing water changes:
   _____ True   _____ False

5. Why quarantine?
   a. _____ True _____ False - To acclimate our Koi to new feeds, water parameters, and husbandry protocols
   b. _____ True _____ False - To prevent disease introduction to the existing Koi population
   c. 

6. Why change the water in a Koi pond? (Circle all applicable answers)
   a. Reduce levels of accumulated nitrates
   b. Boost the alkalinity
   c. Supplement minor minerals
   d. Dilute accumulated toxins
   e. Aeration

7. You have a 10,000 gallon pond; and you want to treat the pond with 1ppt salt to help reduce stress on your Koi. Approximately how much salt do you need to add to reach this concentration? Circle one
   a. 0.38 g   b. 380 g   c. 38000g

8. Koi are commonly judged based on the following criteria: (Circle all applicable answers)
   a. Body conformation
b. Color
c. Pattern
d. Breeder
e. Monetary value

9. Common components of a Koi pond **life support** system (Circle all applicable answers)
   a. Mechanical filter
   b. Settling chamber
c. Video system
d. Biological filter (Biofilter/bioconverter)
e. Aeration mechanism
f. Colored lighting system
g. UV Sterilizer
h. Skimmer box
i. Bottom *drain*

10. Which of the following are signs a Koi may be stressed or diseased? (Circle all applicable answers)
    a. Off feed
    b. Behavioral changes
c. Increased respiratory rate
d. Opercula flaring
e. Excessive mucous production
f. Reddened/ulcerated areas on the fins/body
g. Changes in color
h. Improper buoyancy
i. Scale loss

11. Identify the following varieties of Koi:
12. Koi that lack scales or have few scales are often referred to as what variety?
   a. Doitsu
   b. Mirrored
   c. Naked
   d. Gin-Rin
   e. European

Thank you for your time!

The information collected on this survey will remain anonymous/confidential. Only project researchers at Oregon State University will see the results. If you have any questions about this research project, please contact: Dr. John Falk by phone at (541) 737-3664 or by email at Falkj@science.oregonstate.edu.

If you have questions about your rights as a participant, please contact the Oregon State University Institutional Review Board (IRB) Human Protections Administrator, at (541) 737-8008 or by email at IRB@oregonstate.edu.
Appendix-B. Guiding questions for interviewing koi hobbyists.

1) Please describe how you knew about koi and why you keep koi as a hobby.

2) Before you bought your first koi, how did you prepare yourself in knowing how to keep koi?

3) Any related experience, education or training?

4) What’s your long term goal for your koi keeping and why?

5) How does your family think about your koi hobby?

6) Are you a member of koi clubs? What’s kind of club activities do you usually go? How do you think about the experience interacting with other koi hobbyists?

7) What are the common problems/ questions you encounter in koi keeping? And how did you figure out the questions and solve the problems?

8) What kind of information sources do you usually use for your koi keeping? How do you verify the reliability of the information?

9) Please describe the nitrogen cycle in your koi pond. Where did you get the idea of nitrogen cycle?