# A PROTOTYPICAL APPROACH TO DEVELOPING A JUNIOR GOLF FACILITY FOR DIVERSE PARTICIPANTS USING SURVEY INSTRUMENTS AND ADVANCED COMPUTER VISUALIZATION TOOLS

by

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# A Prototypical Approach to Developing a Junior Golf Facility for Diverse Participants Using Survey Instruments and Advanced Computer Visualization Tools.

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## ABSTRACT

Can a prototypical process involving literature reviews, interviews, questionnaires, design charrettes, and advanced computer visualization tools, be applied to create golf facilities valid to the subjects involved in the process? The research attempts to create a prototypical process by exploring and applying various research schemes that attempts to solve a selected design issue.

Thus, the issue selected: How can the golf course be designed to attract, accommodate, and educate today's youth? Children should be introduced to activities at an early age to build character and self worth. The golf course acts as a place for today's youth to build relationships, test and enhance their character, and expand their education. This research is a result of these ideals. It focused on creating a prototypical process to create a junior golf facility, using data collection methods inclusive to: literature reviews, interviews, questionnaires, and design charrettes. As an addendum to this prototypical process, these methods of data collection were validated through computer visualization. These preceding methods, along with the basic ideals of youths in golf, were the main focus in researching golf course design catered to the youth.

The First Tee junior golf program was the model used to compare the conceptual golf facility prototype, because it is the leader in making golf accessible to the youth. The First Tee Program, established in 1997 by the World Golf Foundation, teaches kids of all backgrounds the game of golf, including fundamentals, etiquette, and sportsmanship: elements that are of value to our society. It also educates them on how to become a valuable member of his/her community. The goals of The First Tee are in two phases: to create one hundred golf facilities by the year 2000, and to reach 500,000 youths by the

year 2005. While the First Tee program is successful, this research attempts to improve upon junior golf facility development by addressing the youths' interest in a customized, conceptual golf facility built upon the principles of a state-of-the-art facility created by programs like The First Tee. The results of this research could potentially serve as an addendum to junior golf development, and also act as a resource for future designers, by assisting to acquire user needs and demands for buildings, interiors, landscapes, and products.

The conceptual golf facility was created from two major resources. Students in Montgomery County, Virginia, were the subject resources, while the available literature, designers, and superintendents were the professional resources. A research strategy was created to serve as a guide for better organization. As a result, the Conceptual Research Diagram was implemented to serve as the prototypical process of the research. The subjects were Montgomery County students of various ages, skills, physical dependants, and also of various cultural backgrounds. Although the subjects were randomly selected, it was necessary to have an adequate amount of subjects to each subject group for a well-formed response to the research. The subjects were given a questionnaire, asked to participate in a design charrette, and given the option to participate in the C.A.V.E. (Cave Automated Virtual Environments) experiment. The CAVE is a three-wall cell, each wall with a dimension of 10x10x9 feet in diameter, which uses a Silicon Graphics Machine, plus projection devices, to project three-dimensional computer images onto its walls and floor. As a result, life size, three-dimensional computer models are created for an experience in virtual reality. All of the data was complied to obtain requests and demands to create a custom golf facility in virtual reality. The youth input and site location was limited to the town of Blacksburg, Virginia, with an attempt of creating a prototypical process that can possibly be applied to any town or city around the world.

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# INTRODUCTION

"Children use play and the power of their imagination to establish their place in this world. Play is the best place to try out different roles, and through their imagination, kids make their play world real: They don't pretend to be a doctor; they are the doctors. This is the model you should follow when you introduce your child to golf — let them 'be the golfer'. Remember that it's play, it needs to be fun, and it needs to be artistic — something they create. Kids need to become immersed in the playing of the game, not in the swinging of the club or perfection of the shot or even the score" (*The Golf Doctor, Today's Golf, December 7, 2001*). Children should be introduced to activities at an early age to build character and self worth. The golf course acts as a place for today's youth to build relationships, test and enhance their character, and expand their education. This research is a result of these ideals. It focused on creating a prototypical process to create a junior golf facility, using data collection methods inclusive to: literature reviews, interviews, questionnaires, and design charrettes. As an addendum to this prototypical process, these methods of data collection were validated through computer visualization. These preceding methods, along with the basic ideals of youths in golf, were the main focus in researching golf course design catered to the youth.

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assisting to acquire user needs and demands for buildings, interiors, landscapes, and products.

The conceptual golf facility was morphed from two major resources. Students in Montgomery County, Virginia, were primary resources, while the available literature, designers, and superintendents were secondary resources. Developing a research strategy was another entity that had to be created thus, the Conceptual Research Diagram was implemented. This prototypical process would also serve as the guidelines of the design research. The subjects were Montgomery County students of various ages, skills, physical dependants, and also of various cultural backgrounds. They were given a questionnaire, asked to participate in a design charrette, and given the option to participate in the C.A.V.E. (Cave Automated Virtual Environments) experiment. All of the data was complied to obtain requests and demands to create a custom golf facility.

The data obtained by the preceding research methods were the guidelines for the conceptual golf course prototype. Two golf facility prototypes, conceptual versus state-of-the-art, were created in virtual reality for two subject groups to experience and comment on. Comments and results from the two subject groups were recorded, then, the data was compiled and compared to conclude if the subject groups approved the new prototype. If the prototype is not approved, there was an option in the prototypical process to loop back through the process and upgrade the conceptual prototype as needed. The prototypical process had the option to continue in this cycle until there was a better consistency between the current subject's comments and results, and the compiled data of his/her subject group.

The final portion of the research discusses the results of the visual evaluation component using the C.A.V.E. environment to provide an analysis of the prototypical process, reports advantages, disadvantages, and new findings for the researcher, and discusses recommendations and opportunities for the research.

The thesis is divided into three chapters: background, methodology, and findings and conclusions. Chapter One, the background, describes the instruments exercised to operate the prototypical process. The chapter begins with a explanation of the research goals, then gives a description of the targeted group, thereafter, discussing attempts in catering to the targeted group, thus, displaying an example of this attempt. As a result, the

chapter discusses the entities involved in the research process: the child golfer, technological advances, the First Tee program, and a state-of-the-art junior golf facility. Chapter Two, the methodology, describes the research processes of the project inclusive to the four research methods and the prototypical process. Chapter Three reports the results and findings of the research methods and summarizes these findings. It also discusses the validity of the Conceptual Research Diagram (prototypical process), compares the data results of the two golf facility prototypes used in the C.A.V.E. experiment, and briefly explores implications and further observations.

# CHAPTER 1

## BACKGROUND

**THE SITUATION:**

The following scenario is an example of what many golf course employees encounter when they consider including children on the golf course.

> John was very excited that his country club was negotiating to incorporate a policy that would allow unsupervised children to play at the golf course he was working for. Having played, as a youth, at youth-friendly golf course, and having previously worked for a golf course that allowed children to play unsupervised, John felt that he could give the most insight on the potential market and revenues it could bring. John was aware of the potential problems as well, but felt that it was nothing that could not be controlled.
>
> The other employees were in disagreement with John, siding that kids would not appreciate the time and effort spent to maintain a golf course. There was also a suggestion that this newly acquired group would beleaguer the more "mature" golfers. John disagreed, feeling that kids were being discriminated against because of a shallow stereotype. He felt that certain children knew how to conduct themselves on a golf course, and should be allowed to play unsupervised. Only those that were unaware of the course rules, and/or show signs of immaturity, would not be allowed to play without an adult. John spoke of how the golf course he used to work for handled the issue. He mentioned the use of rangers to periodically check up on things, the use of pre-play spiels, and incorporating a three-strike penalty rule.
>
> The other employees were still not convinced that including unsupervised children was a good idea. Numerous "what ifs" were brought out in casual conversations and in-group discussions. Some employees admitted that they would purposely harass some of the kids just so the kid will have a mental stigma to not misbehave. Other employees admitted that the kids, as a whole, would probably be blamed for every problem the golf course encountered from then on out.
>
> Infuriated, John remembered what it was like as a youth to play at a golf course where he felt like he was being babysitted. He remembered the mental stress and the negative impact it had on his golfing experience.

> John thought to himself, “If only kids could be at a golf course where they were appreciated, there would be more golfers and golf would be more popular.” Eventually, the policy was thrown out, and John eventually found a community golf course to work for.

This story is an example of how kids are viewed in regards to the traditional golf course, thus an alternative method should be presented. Hereafter, the many obstacles that this user group faces will be identified, and suggestions on how to increase a long-term interest in the game for them will be explored.

Of the total golfers in the United States, 17% range from ages 5 to17, constituting 6.1 million youths to play the game via The First Tee, the USGA, and the Hook-a-Kid-on-Golf program. In addition, youth golfers saw a 38.6% growth rate over a three-year span. The total number of youth golfers increased from 4.0 million in 2000, to 4.4 million in 2001, to 6.1 million in 2002. (National Golf Foundation, 2003) As the statistics show, the popularity of golf among youths is on a sharp rise.

The age-old issue of allowing young golfers to play a golf course unsupervised always raises potential obstacles. The first obstacle is the issue of safety. According to most golf course owners, children are more prone to get injured in comparison to their older counterpart. There is also the issue of potentially injuring other golfers on the golf course due to carelessness. The second obstacle is considering weather or not a child is responsible enough to follow the rules, as well as discard horseplay. A child that appears responsible might be the opposite, and vice versa. The third obstacle is the issue of course appreciation. In the eyes of the golf course owner, will a younger golfer respect the time and effort invested in maintaining a quality golf course?

As business deals are negotiated and closed by adults on the playing field called the golf course, children also promote friendships and deals, but usually on a different playing field. These activities usually occur on the playground, basketball courts, and sandlots. Since the youths’ interest in golf is increasing, there should be a custom golf-related playing field that compliment current youth golf programs. This will also allow the youths’ potential friendships and deals to blossom under the “golf umbrella”. If the golf community embraces these young businesspersons early, weather it be through facilities or programs, the popularity of golf will withstand the test of time and could possibly compete with, or surpass, other popular American sports and past time hobbies.

## THE CHILD GOLFER

The child golfer is unique because this is the only golfer group that could succeed in having its own custom golf course. With the exception of age, no other golfer groups could morally, or even economically, succeed in gaining a customized facility according to demographic traits, like race or gender. The idea of providing a youth-related golf course was approached conceptually, using four major methods to gain state-of-the-art ideas; literature reviews, interviews, questionnaires, and design charrettes. The ideas fashioned from the four research techniques were reformed and consolidated in order to create a universal concept for the entire golf facility. The concept was to stimulate the youth's intellectual, physical, and emotional values through the conceptual facility. The golf facility was developed as such in order to attract, accommodate, and educate today's youth. Throughout the junior golf experience, there were various elements to attract the mind, body, and soul of the child. This idea of mind + body + soul = the total child (See Figure 1.), which is also the design concept, is based on two sets of competencies for youth development. Having youths succeed as adults requires building sufficient attitudes, behaviors, and skills in both sets of competencies (*Definitions of Youth Development, National Youth Development Information Center*). The first set of competencies for youth development are in five basic areas: health; personal/social skills; knowledge, reasoning, and creativity; vocational awareness; and citizenship (*A New Vision: Promoting Youth Development, Testimony of Karen Johnson Pittman, Director, Center for Youth Development and Policy research, before the House Select Committee on Children, Youth and Families, September 30, 1991*). The second set of competencies for youth development target goals that youth development programs seek to build: cognitive competencies; social competencies; physical competencies; emotional competencies; and moral competencies (*Building Resiliency, pp. 11-14, National Assembly, 1994; and Position Statement on Accountability and Evaluation in Youth Development Organizations, p. 1, National Collaboration for Youth, 1996*).

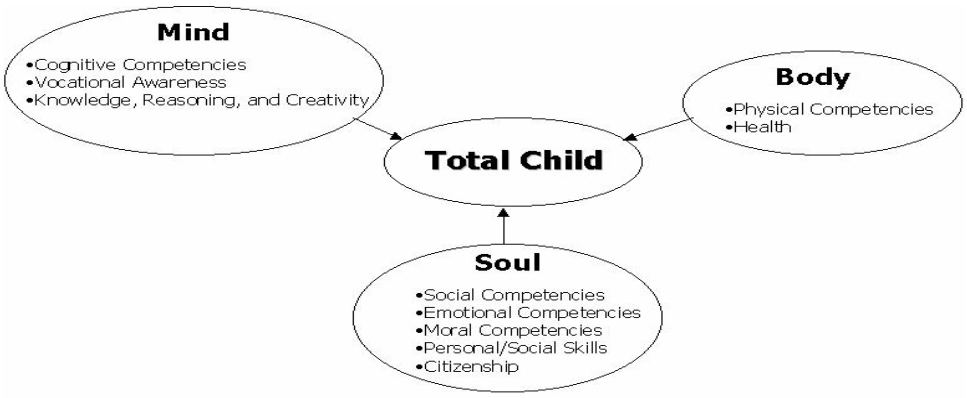



**Figure 1:** Total Child Diagram. Based on two sets of competencies for youth development, the concept of mind + body + soul = the total child was developed.

The subject of "mind" concerns the child's intellectual development as it coincides with the function of the facility. Youth development competencies that fall into this category are: cognitive competencies, vocational awareness, and knowledge, reasoning and creativity. These three elements, taken from the two sets of competencies of youth development, set the mental capacity of the child. Cognitive competencies and knowledge, reasoning, and creativity take on a broad base of knowledge with the ability to be creative. This is inclusive to learning abilities and written, oral, and problem-solving skills. Vocational awareness is inclusive to taking on a broad sense of understanding the options life has to offer, and taking the proper steps in making these life-long choices.

"Body" is the child's physical components and needs for lifelong fitness as it relates to the facility. Usability of the facility is a nice general statement for this element of the total child. Development competencies that fall into this category are health, and physical competencies. From using the facilities, to simply walking the site fulfills these competencies. Health and physical competencies are two elements that deem critical in maintaining a consistent well-being. This can be accomplished through proper nutrition intake, exercise, and awareness of the results of unhealthy practices.

"Soul", the third and final element of the total child, nurtures the emotional values and cultural depth that identifies the child's character. Development competencies that are placed in this area are personal/social skills, citizenship, moral competencies,

emotional competencies, and social competencies. Personal/social skills are divided into two areas intrapersonal skills and interpersonal skills. The intrapersonal skills are the processes of practicing self-discipline and understanding emotions, while interpersonal skills deals more with building standing relationships through friendships, negotiation, and other people skills. Citizenship and moral competencies involve grasping the functionality of systems at the community and national levels. Gaining ethical values and understanding different cultures and its history and values plays an important role as well. Emotional competencies are inclusive to giving the child a sense of personal identity and independent decision-making skills. Social competencies deal with all types of people skills, family and work, while covering the basics of communication, problem-solving, and life skills.

The three elements of the total child, mind, body, and soul, give an opportunity for many youths to have a well-rounded experience at the conceptual golf facility. Generalizing the two sets of competencies into three main areas also allows simplicity, as well as balance, to the conceptual golf facility. In addition, the facility experience can be generalized into three main areas: educational/vocational, competitive, and recreational. Nevertheless, any type of experience from the facility that achieves a good balance of the three primary elemental components, mind, body, and soul, will enhance the child's basic developmental needs. Using this approach, along with the current concepts of youth golf programs, will further strengthen youth participation and increase the popularity of golf.

## TECHNOLOGICAL ADVANCES

With the general increase of golfers, the popularity of the sport has simultaneously increased. As time progressed, pioneers in research and development have taken an "alternative" approach to the game by applying technological "upgrades", or advances, to golf's traditional stature. These advances have definitely enhanced the popularity of the sport, resulting in state-of-the-art functionality and development. Many ideas have been attempted with a percentage of them succeeding. For the purpose of the research, the ideas discussed are the current trends, categorized into one of four groups: facility upgrades, system upgrades, golf course upgrades, and program upgrades.

The facility upgrades can be best described as alternative ideas that attracted people to golf. These ideas are most likely not accepted as a USGA standard golf course, but this approach makes golf accessible to golfers who would like to perform golfing activities without playing an actual round. The decision to open a driving range independently from the golf course was the initial spark in providing accessible golf. As this trend became more popular, other alternatives were introduced. The incorporation of short courses, particularly par-3 courses, gave golfers the opportunity to play a round of golf in a short amount of time. This concept was condensed further into a pitch and putt course, and further into a putting course. For facilities that were concerned with high-maintenance courses, and the consequences of errant golf shots, the Cayman golf courses and disc golf courses were developed. Other forms of golf were also introduced as industry supplements. For those that were physically disabled, the option to play a golf course sensitive to various disabilities was made available. The incorporation of miniature golf attracted numerous participants, especially kids, and complemented golf's popularity, thus providing its own economic resource. Furthermore an approach to include children with golf further resulted in the development of youth golf facilities inclusive to golf training centers, and the incorporation of playgrounds, dog parks, electronic entertainment, and other sport facilities like tennis, swimming, ice-skating, baseball/softball, volleyball, and walking/running. Learning has been the primary state-of-the-art concept in developing these facilities, thus including any popular youth activities that could be used for learning may be a possible venture.

System upgrades are more inclusive to systematic advances that have made golf courses more efficient in functionality and development. The development of an irrigation system created the most impact on the golf industry, greatly reducing manual irrigation and creating less shot distance. Other systems assisted in increasing revenues for the industry; the incorporation of an illuminated golf course allowed golf to be played at night, sound emitting systems and visual systems better accommodated disabled golfers, energy-monitoring software assisted in energy conservation, Global Positioning Systems (GPS) for assistance with the long game and short game, and automatic ball collecting/washer/delivery systems for an accessible ball supply. These systems,

built upon the foundation of trial and error, will serve as foundations of further advanced systems yet to come.

Because of golf's growth, there have been many golf course upgrades from the twentieth century to today. These upgrades are inclusive to all inventions and technological advances that have complemented the play of the game. The two primary tools that experienced the most facelifts are the golf ball and the golf club. The typical state-of-the-art golf ball strives to gain durability and maximum distance, while the typical state-of-the-art golf clubs are lighter, more durable, and provides a more accurate shot. Other tools have been developed to complement these products. The incorporation of club fitting, computer technology, and video technology has improved many players' golf swing, while automated yardage systems have improved their short game. Computer technology also contributed to the golf industry with the incorporation of Global Positioning Systems (GPS) and virtual golf courses. Virtual golf courses require minimal space, which is a plus for smaller facilities. The concept of providing golf to areas with minimal space became popular to accessible golf. Rooftop golf was incorporated as a state-of-the-art approach, and aqua ranges were incorporated as an alternative for the use of existing bodies of water. Another state-of-the-art product that required minimum space was the limited space range. The concept behind this prototype is to reduce the range space to the size of a tennis court, surrounding it with netting. In addition, netting has contributed to the industry as well. Because of its incorporation, golf facilities can be placed in areas that were previously impossible due to errant shots. In addition to impossible locations, one current trend is to develop miniature golf courses underground. Separate entities have been tied to golf for marketability and to attract more customers as well. Some current ideas that have been incorporated are the addition of retail outlets, babysitting services, and specialty food services.

Weather conditions are a big issue in golf, as this primary element determines what type golfing experience, if any, will occur. Created as a solution to this problem, the invention of the golf dome was the gateway to accessible golf all year around. This concept especially catered to the American states in the north. Another approach to this issue was the development of weather tee stalls. Furthermore, weather tee stalls were developed to handle various weather conditions inclusive to rain, wind, extreme heat and

extreme cold. Another approach golf course weather conditions are the development and incorporation of artificial turf. This product also contributed to the durability of tees and greens. Artificial turf is still a controversial issue among course developers, resulting in an upgrade in natural turf. Continuous research is being performed to give various types of natural turf a longer life, more durability, and aesthetically pleasing characteristics. One approach to the natural maintenance of the perimeter turf of the course is to allow wildlife to maintain it through ingestion and wear-and-tear. All of these new concepts and products are built upon its predecessor, thus creates an ongoing development. What will the next state-of-the-art concept/product be? Only time will tell.

Program upgrades are approaches that the golf industry utilized to include golfers of all backgrounds. As previously discussed, the incorporation of junior golf programs have greatly contributed to youth participation. As a result, other types of programs have been developed to attract more participants. The incorporation of clinics, lessons, and golf pros has made the sport more intimate, resulting in a more inclusive environment. The incorporation of golf and art has given a twist to the sport's approach, allowing the participant to learn about a given subject as well as the game. The development of after-school leagues is another option for the youth to participate, keeping them out of trouble. Work programs are also a good option for the youth. It gives them insight, and possibly an interest, in various jobs related to the golf industry. Lastly, the incorporation of instructional golf booklets and digital instructional programs claimed its share of contribution in participation increases. These entities, inclusive to convenience and good communication, has indirectly attracted numerous golfers, and catered to their experience.

It appears that many attempts are being made to provide a more pleasurable and fulfilling experience for all types of golfers. The technology of the game is evolving more each day, thus easing the work load for all participants, from architects, to facility employees, to the players. Not only are there successful tangible advances, but successful intangible advances as well. Any type golfer, from various skill, cultural, social, or physical levels, has a program of some sort available at almost any facility, thus making golf relatable to any user group. Golf is tapping into resources now that was not approached in earlier years, resulting in a potential dynasty in favorite past time activities

among American citizens. Furthermore, at this rate of technological advances, the “drop out rate” of golf will decrease, propelling a popularity of participation among people throughout the world.

**THE FIRST TEE PROGRAM**

Golf has taken on new prominence in the minds of young Americans across the nation and around the world. The sport is seeing a surge of popularity in the inner city as well as in the suburbs. Children have trouble accessing the sport, however. The green and cart fees are often far out of the reach of the typical child. There is not always a public course nearby on which to play. Certain etiquette is expected from players, and children don't always have someone to teach them these rules. Because of this, older players often make assumptions about how youths will act and are unwilling to open the course to them. "Sometimes I don't want to go play, just because I feel like other people don't want me there. Why should I play where no one wants me? But I'm a polite player. I know the rules. But they think I'm just a kid and I'm going to act up," twelve year old Garrett Henderson said in a recent interview. One way to break the barriers to a more inclusive playing population for the youth is to create a golf course geared specifically towards the youth. Of all the golf programs that are attempting to incorporate the youth, The First Tee Program of the Professional Golfer’s Association is the leader in the field.

The First Tee of the PGA is the first initiative of the World Golf Foundation to develop and accommodate golf facilities and activities for all children, especially those who would otherwise not have the opportunity to play. Not only is The First Tee offering tangibles to the youth, but intangibles as well. These intangibles are inclusive to etiquette, respect, self-control, honesty, persistence, etc. The primary objectives are as follows:

Primary Objectives of The First Tee

- Improve the game's accessibility, making golf more available to people of all social strata, particularly children.
- Provide every child, regardless of race and economic background the opportunity to learn and play golf.
- Teach children that dedication, sound values, and education are keys to success.
- Develop in participants a greater self-esteem, civic responsibility, and confidence to broaden their goals in life.
- Create employment and advanced educational opportunities for participants.

**Table 1:** Primary Objectives of The First Tee. (http://www.thefirsttee.org)

The development of The First Tee golf facilities depends on a combination of community demand and need. A majority of these facilities will be developed on underused land in urban areas, providing a location for both instruction and play. There is a fundamental concept though. Because of the limited economic resources for facility development and acquired land, the facility must be developed to according to the funds made available to the proposed facility, and accommodate to the allotted land available. Sometimes this available land is only able to accommodate a driving range, but sometimes it is able to accommodate more if the funds will allow it. (See Table 2.)

The First Tee Facility Prototypes

**3-Hole Facility:** Will include a par-3, par-4, and par-5 hole; a driving range at least 300 yards long and 180 yards wide; a practice green of at least 10,000 square feet; a maintenance building; and a clubhouse with room for a pro shop, concession area, and classroom/meeting space. The youth golf facility developed by Tom Watson and others in Kansas City is the model for this type of facility.

**Pitch-and-Putt Course:** A par-3 course, requiring 30-45 acres to accommodate a series of holes less than 100 yards long, plus a driving range, practice green, maintenance building, and clubhouse with room for a pro shop, concession are, and classroom/meeting space.

**9-Hole Facility:** An executive course, requiring perhaps 50-70 acres. This type of facility includes a driving range, practice green (and possibly a bunker and chipping green), maintenance building, and clubhouse with room for a pro shop, concession area, and classroom/meeting space.

**18-Hole Facility:** A full 18-hole course with driving range, practice green and possibly a bunker and chipping green, maintenance facility, and clubhouse with room for a pro shop, concession area, and classroom/meeting space.

**Table 2:** The First Tee Facility Prototypes. (http://www.thefirsttee.org)

The goals of The First Tee are in two phases: to create one hundred golf facilities by the year 2000, and to reach 500,000 youths by the year 2005. The first goal has been exceedingly met with the development of 129 facilities in thirty-eight states, including one in Canada. From viewing the results two years into phase two, it can be determined that the second phase is on track to exceed its preset goals as well. All three benchmarks set for 2001 and 2002 were exceeded. These figures are shown in table 7 below:

The First Tee's Phase II Objectives

Phase II Goals
- introducing 500,000 young people to The First Tee Experience
- opening 250 dedicated *The First Tee* golf learning facilities
- establishing 500 affiliate relationships

Projected Goals of 2001
- introducing 30,000 young people to The First Tee Experience
- opening 40 dedicated *The First Tee* golf learning facilities
- establishing 50 affiliate relationships

Goals of 2001
- introduced 60,000 young people to The First Tee Experience
- opened 44 dedicated *The First Tee* golf learning facilities
- established 106 affiliate relationships

Projected Goals of 2002
- introducing 60,000 young people to The First Tee Experience
- opening 40 dedicated *The First Tee* golf learning facilities
- establishing 75 affiliate relationships

Goals of 2002
- introduced 100,000 young people to The First Tee Experience
- opened 30 dedicated *The First Tee* golf learning facilities
- established 109 affiliate relationships

**Table 3:** The First Tee's Phase II Objectives. (http://www.thefirsttee.org)

Because of The First Tee's success, a life skills addendum has been incorporated with the program to complement The First Tee Experience. The facility usage component and the life skills component intervene to create a better impact on the youth, thus gaining more supporters. Furthermore, the developmental support of the United Stated Golf Association, the PGA of America, the LPGA, the PGA Tour, and the Augusta National Golf Club gives this program a strong foundation to exceed its goals, and the potential to set a new era in golf course architecture.

**BUTTON HOLE**

Research on existing junior golf facilities must be done in order to discover what has been attempted and, furthermore, succeeded or failed in the process. The background research is also performed so that a similar facility will not be duplicated in the process. In order to begin developing an adequate state-of-the-art junior golf facility, existing facilities that are successful in catering to junior golf were dissected. The First Tee program and the Minority Golf Association of America currently have a conjunction with the aim of developing programs that introduce life skills on one of four prototypical facilities: the 3-hole facility, the pitch and putt course, the 9-hole facility, and the 18-hole facility. All four facilities include a multipurpose clubhouse, maintenance building, practice green, and driving range. Chipping greens with bunkers are optional for the 18-hole facility. The tees and greens are natural, as the facility takes a more traditional aesthetic. These facilities are created on donated funds and land that range from urban areas to suburban areas in location. The programmatic aspect of the facility is a good educational concept that assists the youth in contributing his/her skills to the community. It entails hosting clinics that nurture development and growth resulting in positive life skills and career professionalism. There is also an attempt to make golf more accessible to kids of all ethnic and socioeconomic backgrounds, by providing the opportunity to learn and play.

Button Hole…short course & teaching center in Providence, Rhode Island (population 150,000+), is an excellent example of a facility of this stature, and a good model in initiating a junior golf facility. An estimation of 25,000 youths, ages seven to seventeen, reside within three miles of the facility, and the communities that reside in the

facility's proximity vary in socioeconomic status. This varied status range from low-income families in subsidized housing, to middle-class families in owner-occupied homes. Within a three-mile radius of Button Hole, the 1990 U.S. Census reported the median income of a household as being $25,619, with the poorest section of this region containing a median income of $16,857. Of the total residential property surrounding Button Hole, twenty percent was either vacant or abandoned, with fifteen percent inclusive to owner-occupied homes. These are a few significant demographics that Button Hole faced in facility development and operation longevity.

This 9-hole "short course" entails a multipurpose clubhouse, maintenance building, driving range and several putting/chipping greens that were developed in the hart of downtown Providence. The motivation originated from a visionary, Mr. Ed Mauro, to make golf accessible to those who wouldn't have the opportunity to experience the game otherwise. Some design issues to keep in mind from the development of Button Hole facility are: incorporate safety and beginner-friendly design, have a good water source and drainage on the site, have good accessibility for youths to the proposed facility, select appropriate construction materials, become aware of permitting regulations of the acquired land, select adequate green and tee size and material as it relates to the user, and become aware of the construction processes, costs, and facility staffing throughout the development.

One thing that will hurt an alternative facility is calling it a junior golf course. Older golfers will automatically assume that only kids can play the course, resulting in a loss of facility participants. A non-profit facility such as Button Hole is definitely a good outlet for the youths that reside in its area. It is also a good entry into the game of golf without all the intimidating components associated with a traditional golf course. The non-profit alternative facility can be restructured into other forms of alternative facilities as well. These are called either golf entertainment centers or golf learning centers. Assimilating all of these elements, along with a few new design and programmatic elements, can result in providing an extraordinary golf facility that caters to the development of the total child.

## A CONCLUDING OBSERVATION

There have been numerous attempts to include youths to the game of golf through programs and facility development. The popularity of golf resulted in many technological approaches to make golf more playable and appealing to its participants. These participants range from potential golfers to the most experienced of golfers. Many of these approaches are incorporated in state-of-the-art golf facilities, which emulate traditional golf in many ways. With the exception of cost, skill difficulty, and facility size, these state-of-the-art facilities appear to be functionally and aesthetically similar to its traditional counterpart. Although many milestones have been established, the concept of youth participation in golf course development could be further explored.

So what will be the next trend in golf course architecture? Will the communities of the residing golf courses serve more as the designer of the development, leaving the architect to be more confined to express the ideas of the community instead of oneself? Will communities have the option to apply their "signature" to express the character of their community? Community involvement in relation to any type of development is steadily increasing due to the technology made available for community awareness. There are numerous methods of sending and retrieving information now than ever before. What about applying golf to certain communities? Will there be accessible golf facilities to accommodate all types golfers? What about the youth? Will they have a facility that they find intriguing as well as inviting? The First Tee, along with other golf programs, is breaking barriers by creating accessible golf to children of all backgrounds. This accessibility ranges from programs to facilities. One way to further break barriers to a more inclusive playing population is to create a course geared specifically towards the youth, with input from the youth themselves. It should also be inexpensive and provide lessons in both the sport and the etiquette associated with it. Lastly, the course should be accessible to children of all ages and provide them the opportunity to explore this popular sport. All of these probing questions and suggestions are intended to spark an interest and push the envelope in golf course development, thus formulate a new era with a profound impact on golf course design and the golf industry.

# CHAPTER 2

# METHODOLOGY

## OVERVIEW

The research took place in the fall of 2001, and the spring of 2002 in Blacksburg, Virginia. The focus of the project was to select juniors of many diverse backgrounds, to gain design data for a golf facility that met their needs. This diversity is inclusive to skill, gender, culture, and physical attributes. The diversity of skill level is beginner and advanced; gender is male and female; culture is American and International; and physical attributes are able and disabled. Two hundred subjects in Blacksburg, Virginia, were selected for this research. The methods used to gain qualitative design ideas for the junior golf facility were literature reviews, interviews, questionnaires, and design charrettes. These methods were placed in a hierarchal order to enforce a positive progression of design ideas. Literature Reviews and Interviews were good for brainstorming and information gathering thus provided a good foundation. Data obtained through the subjects' questionnaires and design charrettes were gathered as guidelines. As a result, a new prototype was created.

In the final portion of the research, selected subjects compared and validated two golf facility prototypes: the conceptual youth facility, and a generic, state-of-the-art 9-hole youth facility. Once the conceptual design was created, a select group of subjects experienced a virtual model of the golf facility prototypes at the Cave Automated Virtual Environments (CAVE). The subject groups chosen for comparison and validation of the designs were from one of the four diverse groups, thus, skill level was chosen. Within the skill group, beginner and advanced golfer groups *were* chosen for the experiment.

Each of the methods of data collection played its part in the success of another method, while also providing valuable information for the project. In addition, this "snowball effect" helped to enhance and structure the project, while giving it life as well. It is important to note that beyond these structured forms of data collection, techniques were used such as general observation and informal conversations with numerous helpful individuals, including teachers, fellow students, and the children themselves.

This type of relaxed data gathering may not be noticed as much, but truly provided the backbone of this project. The youth input and site location was limited to the town of Blacksburg, VA, with an attempt of creating a prototypical process that can possibly be applied to any town or city around the world.

## RESEARCH INTENT

To develop a golf facility designed to attract, accommodate, and educate today's youth, can a prototypical process involving literature reviews, interviews, questionnaires, design charrettes, and the Cave Automated Virtual Environments lab (CAVE), be applied to create a valid solution? This research attempts to explore and apply various research schemes by attempting to solve a selected design issue. Interviews with Professionals and Literature Reviews were performed in order to evaluate any past attempts to design a junior golf facility, or anything similar. The questionnaires dissected the functionality and physical elements of a golf course, and translated each element into a form of question that was understandable to kids, especially for those who are unaware of the game of golf. This process helped to develop the particulars at the conceptual golf facility. The design charrette added to the design ideas already accumulated. By allowing the subject to design a custom golf hole, this process gave the subject more freedom to express his/her ideas, while obtaining a clearer understanding of the project goals. After the ideas from the research schemes were screened, consolidated, and applied to the new facility concept, two prototypes, old and new, were experienced at the CAVE for comparison and subject validation.

From the research, there is also an attempt to satisfy the basic needs of youth development. According to literature in youth development, they need to meet five basic needs: health; personal/social skills; knowledge, reasoning, and creativity; vocational awareness; and citizenship. Today's youth also need physical, social, cognitive, vocational, and moral competencies in order to help them become responsible and successful adults. This valuable information serves as a good foundation for progression of the research and development of the conceptual design. The design concept is based on the two sets of competencies for youth development, in which the elements of these sets will fit into one of three categories of the concept: mind, body, or soul.

After performing the research, there are recommendations to the research that are inclusive to: what new knowledge was gained in the research, what the research can possibly be used for, what areas of the research could have been approached differently, and the advantages and disadvantages of the research. Lastly, the youth input and site location developed from one area can provide an opportunity to create a universal prototypical process for a development of this stature.

## HYPOTHESIS

The four major research methods used will restructure, as well as amalgamate, many original golf development ideas, thus creating a more interesting state-of-the-art junior golf facility. Furthermore, the subjects involved in the research will be more partial to the new facility versus the old.

## CONCEPTUAL RESEARCH DIAGRAM

The research attempts to report positive results from amalgamating new and previous ideas for a given problem, and comparing them to a state-of-the-art model. The utilized formulas/diagrams were combined to formulate a conceptual research diagram. (See Figure 2.) This newly created diagram will serve as the “backbone” of the research by outlining and identifying major steps and entities of the research.

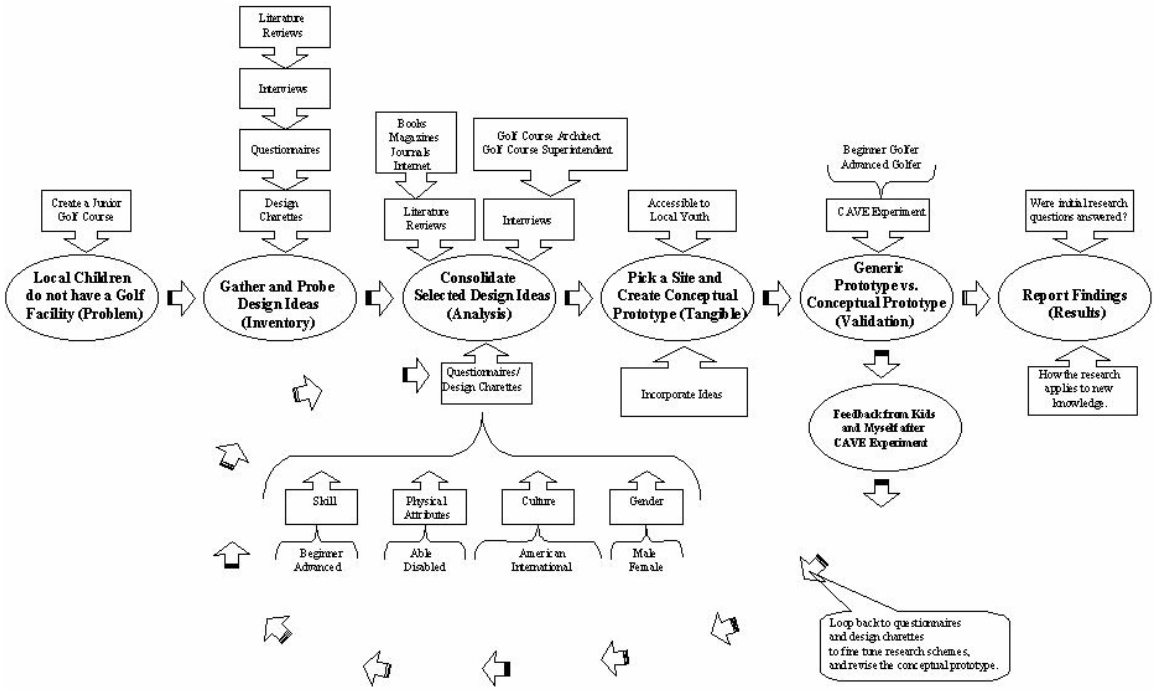



**Figure 2:** Conceptual Research Diagram. The diagram serves as the outline of the research. It identifies the roles and relationships of the major steps and entities used in the research.

The conceptual research diagram consists of a string of primary nodes supported by connecting secondary nodes. The primary nodes are placed in a progressive order, and identify the surrounding secondary nodes, with the purpose of structuring and supporting the research. The first node identifies the problem, which recognizes that children do not have a custom golf facility (Problem), and the secondary node states a possible solution, which is to create one. There is progression to the next primary node, which begins to solve this problem. Information is gathered from four secondary nodes, containing four different research schemes that begin to look at developing a custom junior golf facility (Inventory). This process leads to the next primary node, which selects and applies the information to one conceptual design (Analysis). This node also begins to identify the different sources within the research schemes, via secondary nodes, to show the depth of exploration that was achieved to collect the design ideas. Progression to the next primary node consisted of secondary node tangibles, like selecting a site accessible to the user, as well as incorporating the consolidated design ideas to the site that were created and approved by the subjects involved (Tangible). The next primary node was the validation

section of the research. It consisted of dividing an existing 9-hole junior golf course, and the conceptual junior golf course prototype, each into four virtual sequences for comparison (Validation). These eight virtual sequences were experienced by local kids belonging to one of four major demographic areas set in the conceptual research diagram. Skill level was selected as secondary nodes, resulting in the participation of two user groups: beginner and advanced. Their comments were recorded during and after the virtual experience of each facility. Depending on the level of validation, there was the option to proceed on with the obtained results (Results), or to loop back to the secondary node labeled "Questionnaires/Design Charrettes". Because of the time restraints of the research, the loop option was not selected, thus the data was directly reported. The loop option allows the research schemes to be fine-tuned, thus revising the conceptual prototype. The loop option may also be repeated until there is a high validation rate in the conceptual prototype. After achieving a high validation rate, the results are then recorded from the final primary node.

**PROBLEM**

The problem node is the first primary node of the Conceptual Research Diagram. It identifies the current problem, along with a secondary node that provides a logical answer. The progression of this document has previously identified the conceptual problem and answer, but due to the context, these issues will be repeated in the paragraphs to follow.

To develop a golf facility designed to attract, accommodate, and educate today's youth, can a prototypical process involving literature reviews, interviews, questionnaires, design charrettes, and the Cave Automated Virtual Environments lab (CAVE), be applied to create a valid solution? Today's golf courses are initially developed for the avid golfer, the older golfer, or the more mature golfer. The idea of hosting kids on a golf course is a conflict to some golf course owners and superintendents. A fear of the child's inexperience and level of responsibility always lead to the issue of property damage. In addition, a majority of youths included in the research, when asked, considered a golf course to be too monotonous. If given the opportunity, the golf course can act as a place

for today's youth to build relationships, test and enhance their character, and expand their education.

Children are sent a message by society that they are not valuable members of society until a certain age. By asking children to take an active role in the design process, and by implementing their solutions to that process, children being to understand that they can, indeed, have a voice in what happens to them. Their opinions and solutions are valid and credible, and essential to the design process of a golf course. The experience of being asked to solve a problem, and then seeing their opinions taken in serious consideration may start to counteract the feelings of invisibility that so many children experience. While designing a golf course may not make them more active citizens directly, the opportunity to see how they may influence a decision may make them more active in the long run. The lack of youth influence poses a problem for current facility development. One could argue that children should not possess power or have a say; that is what parents are for. I have chosen to take the approach that it is necessary for children to possess a balance of power so that the prototype can communicate their needs.

If stakeholders and designers that aid in developing golf facilities give the youth a voice in the development, their ideas and involvement will enhance the popularity and need of the facility. Developing a golf facility solely for the youth will have the potential to positively impact on the community as well. The disadvantaged community, in particular, will greatly benefit from this. It will provide another avenue for the youth to explore, complementing the mission of The First Tee Program. With the combined effort of programs like the First Tee, community run golf facilities, and stakeholders willing to give appropriate funds, the golf course can serve as a tool of guidance for today's youth. The golf course can also be an environment where the youth, as well as the community, can grow to love.

The First Tee Program of the PGA is a non-profit organization that currently pilots the development/provision of junior golf facilities. The First Tee was created to make golf affordable and accessible to kids of all economic and ethnic backgrounds.
These facilities cater to kids, but contain similar golf course elements as traditional Golf Course Architecture. The First Tee uses four main prototypes, with the fundamental concept to "use the available space to create a quality playing area and a true golf

experience through a variety of hole lengths, shapes, and strategies". (*The First Tee*) These four prototypes serve as excellent resources for developing the "ideal" golf course for youths, thus serving as a good starting point for the research. So what would be a good answer to the previously posed research question?

To create a universal conceptual golf course would be an ideal answer, but because of the context of the research, and limited resources in this area, an attempt to initiate a custom golf facility for a local group of kids will be a sufficient foundation. Here's a more formal answer: Create a prototypical golf facility for local youth, using various research schemes, and comparing the new product to a current junior golf facility using computer technology. Overall, the research should create another positive avenue for the youth to explore, while also creating another avenue for researchers and designers to explore.

## INVENTORY

The inventory node is the second primary node of the Conceptual Research Diagram. It gathers and probes ideas for the problem node by using various secondary nodes to gain information. These secondary nodes were inclusive to: Literature Reviews, Interviews, Questionnaires, and Design Charrettes. The literature reviews and interviews served as a foundation data for the activities to follow. The questionnaires and design charrettes allowed children to explore their creativity and participate in a worthwhile process that was geared toward their needs and desires. The relaxed data acquired from the four research schemes were systematically fostered from one to the other to create a "snowball effect", resulting in a progression of targeted research data.

### Literature Reviews

Literature reviews was the first method chosen for data collection, and served as the foundation of the project. The Literature Reviews also served as an informative base for the subjects, as well as myself, in order to grasp the concept of the project. It provided extensive information on general golf course design, designs that have been attempted before, and guidelines that explained how to work with groups, including charrettes.

The literature used for the project varied from books and articles, to information in cyberspace (Internet). As a supplement to the literature, class notes and pamphlets were also used, which reflected and expanded on the readings. Literature reviews, as a method of data collection, were key in helping to jump-start the project and set a foundation for the research.

Interviews

Interviews were the second method chosen for data collection, and served as the voice of the project. They allowed the opportunity to correspond with others more knowledgeable on the content of this project. The interviews also allowed the opportunity to meet an assortment of professionals who work in the golf development industry, while providing the opportunity to gain contacts within the golf industry. The professionals interviewed provided a plethora of information that helped lead to the development of a questionnaire, which is the next method of data collection.

Golf Course Architects interviewed were Mr. Russell Breeden of North Carolina, Mr. Steve Burns of Fernandina Beach, FL, Mr. Robert Cupp of Atlanta, GA, Mr. Ronald Fream of Santa Rosa, CA, and Mr. Roger Warner of Toledo, OH. Mr. Russell Breeden is a golf course designer that worked on projects with Mr. Tom Fazio. Mr. Breeden was a good local contact, whose position is both Architect and Contractor. Mr. Steve Burns is a golf course architect based in Northern Florida who poses extensive resources on golf for the youth. Mr. Bob Cupp is a designer who worked on numerous golf courses with Jack Nicklaus. Most of Mr. Cupp's projects are located in the Southeast, and the West. Mr. Cupp's affiliation with Mr. Jack Nicklaus and Mr. Tom Kite gives him insight to the elements of a quality golf course. Mr. Ron Fream is an international designer who has created golf courses all over the world. He had a few areas of feedback that aided in the direction of the project focus. Mr. Roger Warner is the Project Manager for Aurther Hills and Associates. One aspect of his responsibilities is the computing phase of the golf projects.

Developers that were interviewed were Mr. John Rosequist of Phoenix, AZ, and Dr. Chris Wilkerson of Jacksonville, FL. Mr. John Rosequist is an alumnus of the

University of Arkansas who is working for a golf course development company out West. His reply was to try to consider the care of the course by adding as little manicured tees, fairway and green as possible, just as long as it will not affect the design. Dr. Chris Wilkerson is the head developer at Dana B. Kenyon and Associates. His feedback was critical in that consideration of the location of the golf course should be in relation to the potential users. There were also multiple interviews with Mr. Brandon Johnson, PGA director of design of The First Tee Program in St. Augustine, FL, and Mr. Jay Carstens of the Jim Ager Memorial Junior Golf Course in Lincoln, NE. Mr. Johnson and Mr. Carsetns were the main two resources used in the prototypical process of the research for the development of the golf course, due to their expertise.

Questionnaires

The questionnaire was the third method chosen for data collection, and the most precise. It was a four-page-long list of questions that broke down each element of the golf course, from the tee marker to the clubhouse. It then converted the elements into the form of a design question that the children would understand. For example, one question is in regards to the driving range. It asks, "What would you do to make the driving range fun?" One child's answer was that every time you sink a hole-in-one, there should be a twenty-dollar reward. The children had many valuable ideas that would be useful in furthering the design of a golf course for juniors.

The questionnaire provided initial information on how children view golf in general. (See Table 4.) The participants in the questionnaire were broken down into five user categories and four question types. These five categories were: Age, Gender, Skill, Culture and Physical Attributes. Each category included different category types in order to gain a more thorough collection of data. The age category was created to gain comments and suggestions from youths of all ages. The second category, Gender, was also an important component in creating an appealing and accommodating golf facility to both males and females. Skill and Physical attributes were categories critical to the design of the golf facility. These were two main accommodating factors, inclusive to the beginner, intermediate, and advanced golfers, and the ADA and non-ADA golfers. The cultural category was an interesting one. This sensitive area was explored in attempt to

attain subjects diverse in cultures to link various cultures to this facility. Because of the context of the research, the culture was divided into two groups: American and International. The American group can be viewed as a domestic perspective for juniors, while the International group can be viewed as an international perspective for juniors. The four question types were: categorization, open-ended, multiple-choice, and diagrammatic. The categorization questions were needed to effectively organize the data with its appropriate user group. The open-ended questions allowed the subjects to explore original data they felt was appropriate. This method also allowed the subjects to be creative. The multiple-choice questions contained a more controlled data collection process. This method focused more on the selection count of the data provided, than any original data. The diagrammatic question was an introduction to the design charrette. This section allowed the subject to illustrate their perspective of a golf hole followed by a short explanation. The questionnaire, though somewhat personal, served as an initial source of information about children's attitudes and knowledge about golf courses and golf course design.

Questionnaire Structure

| | *Gender* | *Age* | *Nationality* | *Disabled* | *Skill Level* |
|---|---|---|---|---|---|
| •Clubhouse | | | | | |
| •Driving Range | | | | | |
| •Number of Holes | | | | | |
| •Hole Markers | | | | | |
| •Tee Boxes | | | | | |
| •Tee Markers | | | | | |
| •Fairways | | | | | |
| •Hole Lengths | | | | | |
| •Bunkers | | | | | |
| •Water Hazard | | | | | |
| •Tree Hazard | | | | | |
| •Greens | | | | | |
| •Carts | | | | | |
| •Cart Paths | | | | | |
| •Plantings/Gardens | | | | | |
| •Naturalistic Feel | | | | | |
| •Course Location | | | | | |
| •Relation to Heritage | | | | | |
| •Hole Sketch | | | | | |

**Table 4:** Questionnaire Structure. The questionnaire approached various entities of a golf facility, while targeting various user groups. The questions were presented in the form of one of four types of questions for data collection and structured the subjects into five main user groups.

Design Charrettes

The fourth method of data collection included a design charrette. It required that the children fill out the questionnaire before they could participate. This helped introduce the children to golf and had them excited about the charrette and CAVE experience that followed. The charrette had three parts, which Race and Torma identify in their book, Youth Planning Charrettes: A Manual for Planners, Teachers, and Youth Advocates (32-43). In the first part, the parts of a golf hole were identified and defined by asking the children to label the parts and come up with their own definitions. There were also discussions about how the design process progresses when designing a golf course. By performing this, the knowledge base of the children is revealed, and also working definitions of the terminology to be used will be exposed. Next, the children were separated into groups. These groups designed their own golf hole with instructions that walked them through the design, similar to the approach of a golf course architect. Finally, the entire class reassembled for each group to share their design.

Of all the classes in the Montgomery County Public Schools, eight were chosen to participate. Each class was instructed to perform the charrette separately. The charrette began with a brief welcome and introduction that gave an overview of the project and established the ground rules such as being respectful and allowing everyone to participate. The next step of the charrette was an exercise in identifying the different elements of the golf course and allowed the children to define each term in an understandable fashion. Because of the versatility of the questionnaire, all of the children were able to participate in the exercise even if they were not familiar with golf.

**Figure 3:** Design Charrette. The fourth graders shown here were participating in the development process of a golf hole.

The next part of the charrette involved dividing the class into 3 groups. Each group along with a facilitator was given a huge sheet of paper, an assortment of markers, and thirty minutes to come up with a unified design. (See Figure 3.) They were to design the hole by following the order of elements as identified in the previous exercise. The children were encouraged to discuss their ideas and give everyone an opportunity to be heard. Beyond encouragement and time management, the facilitators were instructed to allow the children to be in charge. The last part of the charrette was for each group to discuss their design and elect two members to explain it to the rest of the class. (See Figure 4.)


**Figure 4:** Charrette Presentation. The fourth graders shown here were presenting their ideas for a golf hole to the rest of the class.

The charrette experience utilized critical thinking and individual problem-solving skills for the youth, while also utilizing group problem solving skills. The charrette also involved communication skills, both verbal and non-verbal. By allowing children to voice their opinions, and see the implementation of those solutions, children began to see how they could be active participants in the decision-making processes. While many of the children were familiar with the different aspects of a golf course, the charrette allowed them to think how these elements are put together. The charrette also asked children to analyze information and apply it to the design process. This utilized problem solving and critical thinking processes, and allowed the children an opportunity to apply these skills in a group. The exercise not only provided valuable design information for the junior golf course, it also attracted more kids to golf as well as teaching them the value of teamwork.

## ANALYSIS

The analysis node is the third primary node of the Conceptual Research Diagram. It consolidates and selects the ideas established in the inventory node to develop a conceptual prototype. The secondary nodes served as research schemes with a breakdown of information resources within each scheme. The breakdown of resources was discussed in the previous section, and will be discussed in this section as well. Thus, the data obtained from both the inventory and analysis nodes will be identified and consolidated.

Literature Reviews

The findings of the literature reviews were discussed earlier in the "Technological Advances" section of the research, thus stating the tangible ideas would be repetitive. There were a few intangible entities gained from this method that should be added though. Various goals and golf programs were discovered in the literature reviews thus, should be mentioned. The First Tee Program, as mentioned earlier, exposes disadvantaged youths to the game of golf, while teaching them life-long values. Another program is the "golf-club recycling program". This program takes old golf clubs and cut them down to a youth size fit. The result is a very inexpensive, if not free, range of golf equipment. There are numerous ideas for programs that can potentially encourage youth participation in the game of golf, thus complementing the proposed facility.

The proposed facility takes the form of previous existing facilities, with the exception of pushing the concept of attracting more kids to golf. When developing the conceptual prototype, there should be a universal programmatic concept for the facility. In this case, the "Disney Concept" was used, where the youth would be seen as the guest. The Disney Concept is simply creating an environment where the youth plays the role of the adult, and the adult plays the role of the youth. All the elements chosen in the design of the golf course would be geared towards the youth, so this concept would be adequate.

Hopefully, these ideas will begin to create benchmarks, or goals, to build upon for pushing the concept even further. Most of the goals set were a result of previously accomplished goals. The more critical, reasonable goals had to be established and accomplished first in order to move up to other challenges. These included: making golf accessible to kids of all backgrounds, allowing more opportunities to learn various trades within the golf industry, familiarizing more youths with golf by enhancing their knowledge of the game, creating a permanent location for various youth-related activities and programs, creating a facility that will give its community a sense of pride, and enhancing the minds of the youth by creating an enjoyable and educational facility. Accomplishing these goals will set a positive tone for the local youths, thus setting more advanced goals: helping children find their niche in society by giving them new avenues to explore, building bridges between non-profit organizations of similar interests, and

aiding in the reduction of local crime and poverty rates, as well as other frightening youth statistics. From these foundational goals, the “snowball” data can be properly applied.

Interviews

There were various formal and informal interviews with professionals in the golf industry. Mr. Ronald Fream aided in the direction of the project focus. Mr. Fream responded that all people should experience the golf course; so do not lean so heavily on a certain ethnic or socioeconomic group. He also added that focusing on the youth would be a nice research project because it is still fairly new to the profession. Mr. Steve Burns complemented this idea of youths in golf by sending extensive articles about junior golf, and Mr. Robert Cupp supported this idea as well by providing suggestions keep the kids interested throughout the project. Mr. Roger Warner is responsible for the computing aspect of the golf projects at Aurther, Hills, and Associates. He provided a list of quality computer programs to look into that would enhance the design of the prototypes. Mr. Jay Carstens is the golf course superintendent of the Jim Ager Memorial Junior Golf Course. Because of his field experience with junior golf facilities, he was considered to be a main resource in the development of the new prototype. His advice was to try to consider the care of the course by adding as little manicured tees, fairway and green as possible, as long as it will not affect the design aesthetic. His feedback was also critical in that consideration of the location of the golf course should be in relation to the potential users. (See Table 5.) There were also multiple interviews with Mr. Brandon Johnson, design coordinator of The First Tee Program of the PGA. Mr. Johnson was also a main resource in the development of the new prototype, due to his design expertise in this area. Mr. Johnson provided extensive information on The First Tee Program, and suggestions on how to approach a custom golf facility for the youth. (See Table 5.) One of his suggestions was to talk with kids about what it is they want. This idea led to the next two steps in the analysis process, which was to interview the potential users of the golf facility through questionnaires and design charrettes.

Interview Results

- What do you think a golf course for juniors should entail?
- What are the important components of a golf course?
- What age groups should be targeted?
- How should it be different from a regular course?
- What is involved in your program?
- How does golf benefit young people?

| Mr. Brandon Johnson | Mr. Jay Carstens |
|---|---|
| •Variety of hole lengths<br>•Holes that are fun and rewarding<br>•Encourage growth in skill<br>•Life skills (honesty, integrity, respect, etc.)<br>•Professional skills<br>•Target kids between 7 and 17 years of age<br>•Make golf accessible to kids<br>•Preparation for college and life<br>•Vocational training<br>•Availability/Accessibility of courses<br>•Community Involvement<br>•Involve local Parks and golf courses<br>•Target small pieces of property<br>•Brownfields or redevelopment of old courses | •Safe and easy<br>•Whatever makes it fun<br>•Don't call it a junior golf course<br>•First hole shouldn't be long (Speed of play)<br>•Practice area and oversize putting green<br>•Etiquette<br>•Knowledge of golf terminology<br>•Knowledge of elements on the golf course<br>•Adequate amount of signage<br>•Schools, camps, families, practice short game<br>•Gives patience, and teaches respect for others<br>•Helps to build character, worth, and control<br>•Kids must complete an initial quiz to play<br>•Kids under 12 years must be supervised |

**Table 5:** Interview Results. Six common questions were asked to all resources contacted. The two subjects selected in the table provided the most extensive and pertinent answers.

Questionnaires

The survey led to some essential findings about children's participation in golf. The children that participated in the survey liked non-traditional designs and activities, like food and animals. These entities were a central theme throughout the questionnaires. Overall, the children want their experience to be fun and interesting, which was reflected in the questionnaires. It was also discovered that children maintain more interest when their efforts have the possibility of being realized. Within the questionnaires, the most common responses of all the subject groups were amalgamated and placed within each questionnaire category. They are as follows:

**Clubhouse** - Many ideas were consistently suggested, like an arcade, eating area, and the strong request to add a unique shape to the structure of the clubhouse.

**Driving Range** - There was a strong demand to include lights and batting cages in this area. There were also many requests to include an option for music in these areas.

**Practice Area** - The practice area was structured as an offset of the driving range. Again, kids referenced music to this area.

**Number of Holes** - There were more requests to play up to 9 holes of golf in comparison to other quantities.

**Hole Markers** - Tips on which club to use and how to play the hole, golf comics, hole profiles, interesting facts, records for the hole, and different artworks were the more popular choices.

**Tee Boxes** - The tee boxes kept a traditional size. Views were the most important aspect to the kids, then shape. They wanted these top two elements to be stimulating.

**Tee Markers** - There were many creative answers. Patterns, numbers, shapes, animals, color, size, and from regular golfer to pro golfer, were chosen as tee markers.

**Fairways** - There was a consistent demand to add animals to the landscape, with water playing a significant role.

**Hole Lengths** - The strongest response was to have a good distribution of both short and long golf holes.

**Bunkers** - There was a strong demand to have a visual stimulation with the bunkers. Unique shapes were chosen.

**Water Hazard** - Water was mentioned extensively in the questionnaire. The kids incorporated water in various forms. Waterfalls and fountains were chosen the most, then natural water elements.

**Tree Hazard** - Vegetation, like water, was in high demand throughout the questionnaire.

**Greens** - The most demanding greens were large, flat, and slow greens. Greens with rolling mounds were chosen from one out of every three kids.

**Carts** - This was a popular subject for the kids. There were suggestions of sports cars, airplanes, boats, and SUV's.

**Cart Paths** - The cart paths coincided with they type of golf cart suggested. For cars, roads were suggested; for boats, streams were suggested; for computer navigated carts, roller coaster rails were suggested.

**Plantings/Garden** - Gardens were in high demand on the golf course. The aesthetics of the garden were top priority, then smell. Life forms that dwell in these gardens followed, then sound thereafter.

**Naturalistic Feel** - This helped to validate the desire to have natural elements on the golf course. Many basic elements were mentioned like trees, grass, and flowers.

**Course Location** - Almost all of the participants wanted the golf course to be located outside of town.

**Relation to Heritage** - This can be viewed as a cultural perspective. Flags, music, foods, animals, and other standout-elements from various nations were stressed.

**Other Usage** - Kids had the option to consider activities other than normal golf. Some responses were miniature golf, batting practice, an arcade, and a library.

**Equipment** - As an addition to the demand for an interactive stimulator for indoor golf, some kids wanted to have the option to rent equipment from the facility. There was also a large demand for adequate signage and lighted yardage markers. In addition, the golf balls were chosen to be of various colors.

The questionnaire also provided valuable feedback on how certain subject groups viewed golf, and what their demands were. For example, within the age subject groups, the older the kids were, the higher the demand for a traditional-style golf facility. But the younger the kids were, the more outrageous and colorful the facility became.

The majority of the female subject group was more interested in the design issues associated with a golf course, while the majority of the male subject group just wanted to play. Females were more detailed and considered smell to be an important factor in a garden on the course, while males wanted targets and markers that showed how far they hit the ball. The skill groups were somewhat similar to the age groups in relation to the functionality of the facility. A majority of the more advanced subject groups strayed away from non-traditional ideas, but a majority of the beginner groups were attracted to interesting alternatives. Within the physical attributes subject groups, there was only one significant point of view that could benefit the facility development. The ADA group gave some insightful data on how to accommodate them, which can mostly be found in an ADA design standards book. Because of the controversy and high probability of placing certain cultures within certain stereotypes, the cultural subject groups were limited to two main groups: American and International. Most of the subjects in the American group possessed an attention to detail for golf cart styles, monsters, music, and carnival rides. Most of the subjects in the International group possessed an attention to detail for naturalistic elements, music, and naturalistic animals on a golf course. The questionnaire, though very personable, served as an initial source of information about children’s attitudes and knowledge of golf courses and golf course design.

Design Charrettes

One of the key findings of this charrette was that children have a real interest in the game of golf. Many of the children already had a good understanding of the game and the key aspects of a golf course. The children that had not previously been exposed to golf showed a real interest in learning the different facets of the game. All of the children were very enthusiastic about participating in this project. The children were excited that someone was actually listening to them and to their ideas. The children were proud of the fact that some of their ideas could be used in the design of a real golf course hole. Each group wanted their own golf hole design to be implemented. It seemed as though each group wanted to participate in the final outcome of the completed golf course.

The children that participated in the design charrette all had very unique ideas about the design of their golf hole. The children were very interested and excited to take part in the charrette. Even though, on some levels, the participation was forced as a classroom assignment, each child took an active role in the design of their hole. Granted, some children participated more than others. As in most group situations some people are more vocal than others are. In some of the groups, leaders emerged who guided the group through the design. In these groups, the leaders negotiated the design aspects with the rest of the group. In most instances the majority ruled when deciding on a specific aspect of the hole and that aspect of the design was implemented. Some groups took a more group-oriented approach to the design. Within this group, participants took turns facilitating decisions.

Overall, the children in each group worked very well together and took the charrette seriously. Naturally, there was some competition among the groups over who had the best design features. At the end of the charrette, members of each group expressed interest in seeing their design implemented. Generally, the children were excited about the possibility of a golf course for kids in this area. The charrette also peaked the interest of some children who had not been previously introduced to golf. The charrette charged the interest of the children and allowed them to interact with each other in positive ways.

Each of the designs that the groups came up with was very unique to that group. However, there were some central themes in the designs. First, each design included all of the essential elements of a golf course. The children had no problems identifying the parts of a golf hole and including these parts in the design. Next, each hole had a water element. Water seemed to be an essential entity for a golf course hole in the mindset of the children. Each group incorporated water to the design in some way, whether using it as a trap or as an aesthetic feature.

Each golf hole design also had a theme. One theme was Spooky Mickey-Dragon Land where a roller coaster ran through the middle of the green and ghosts paraded around the hole. (See Figure 5.) Another group had a mice theme where mice served as vendors and sold soft drinks around the course. Another group had a theme of boats. In their design, boats floated along a river that ran around the green and each boat served as the actual hole for the ball to fall in to. Each golfer would have to use precise timing to putt the ball into the moving hole. (See Figure 5.)

**Figure 5:** Charrette Results. The designs above are two of eight group designs that were created. These designs were selected to show the range of creativity from the subjects.

The children were very imaginative in their designs and centered their artwork on one central theme. All three groups also shared a love for animals. In each design real animals or animal images showed up around or in the golf course. Some of the animals were dragons, snakes, and of course, mice. In addition, the groups also had a shared interest in nature. Each group included nature themes such as trees and rolling greens. The children enjoyed a lot of movement in their golf course design. All three groups wanted to make the hole as fun as possible while including all of the essential elements. Overall, the greatest mission of the groups was to make the golf course fun and a place where they felt that they belonged.

| Charrette Findings |
| --- |
| Many of the children already had a good understanding of the game and the key aspects of a golf course. |
| The children that had not previously been exposed to golf showed a real interest in learning the different facets of the game. |
| A person or sign of some sort explains each hole. |
| Each hole has a concept. Food and animals were a central theme. |
| Water is an element that was consistently used throughout the facility. |
| Batting cages were included at the range area of the facility. |
| Exotic holes that was stimulating, yet attractive. Bunkers also had interesting shapes as well. |
| Overall, the children want their experience to be fun and interesting. |

**Table 6:** Charrette Findings. The statements above were significant findings that resulted from the charrette activity.

Children have great ideas and, through various productive activities, can communicate those ideas in an effective manner. Often adults do not ask children their opinions. Most often, children have the least power in society. However, if children are involved they can become powerful tools to affect change and enhance their surroundings. Children are great resources for participation. Children do not hesitate to give feedback when asked. Every child involved with the charrette was excited to participate in the design of the golf course. The charrette was a powerful tool in introducing group ethics and dynamics as well. One of the ground rules for the charrette was to value everyone's opinions and not humiliate one another. The children learned that each opinion was valuable and unique. In showing this, the children tried to be respectful of everyone's feelings. The design charrette not only peaked the children's interest in golf, but it allowed them to get involved and gain perspective from participation.

## TANGIBLE

The tangible node is the fourth primary node of the Conceptual Research Diagram. It selects various entities of the consolidated data, created from the previous nodes, and attempts to establish a semi-tangible environment. The secondary nodes served as complementary guidelines for this environment, thus a site location and conceptual prototype was established. The makeup of the conceptual prototype was also discussed.

Now that the ideas have been created and consolidated, the next step was to find an actual site to develop the conceptual prototype. This would make the prototype appear more realistic to the subject experiencing the facility in the validation process, thus providing better experiment feedback. Using an actual site also assists in creating a virtual computer model. In this case, the City of Blacksburg Planning Office contained pre-drawn Computer-Aided Drawings (CAD) of the site, which served as a base for the computer model. This process will be further discussed in the validation section.

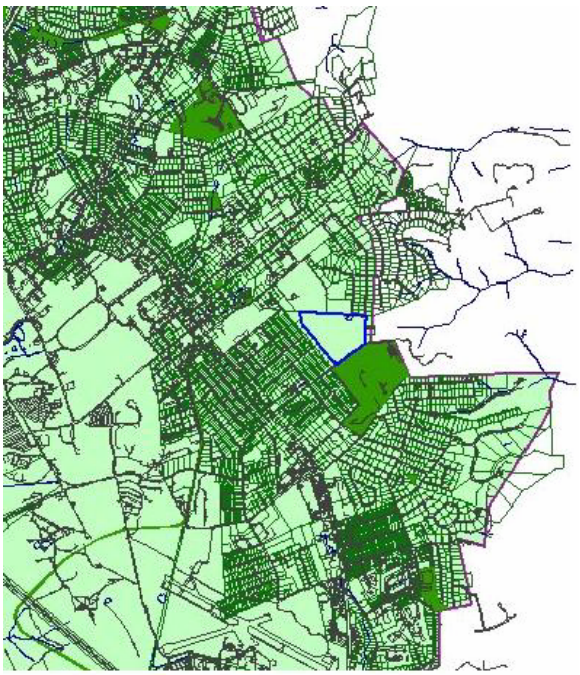


**Figure 6:** Site Location. The site location was chosen due to its accessibility to the subjects, and its accessibility to other golf courses. (http://www.blacksburg.gov)

Accessibility was the main objective in locating an adequate site for the proposed junior golf course. The chosen location sits adjacent to an existing 9-hole regulation golf course. (See Figure 6.) In addition, the proposed golf facility appears less intimidating to the beginner golfer, thus complementing the existing golf course as well as the game of golf. The finished product will result in an amalgamation of a regulation 9-hole junior course, driving range, and practice area. These guidelines are similar to the guidelines of the First Tee's 9-hole facility prototype, thus the two models will be compared.

Selected Consolidated Data

The design ideas fashioned from the four research techniques were reformed and consolidated in order to create a cohesive design concept for the entire golf facility.

The concept was to stimulate the youth's intellectual, physical, and emotional values through design. The golf facility was designed as such in order to fulfill two sets of competencies for youth development to attract, accommodate, and educate today's youth. Throughout the junior golf experience, there were various design elements to attract the mind, body, and soul of the child.

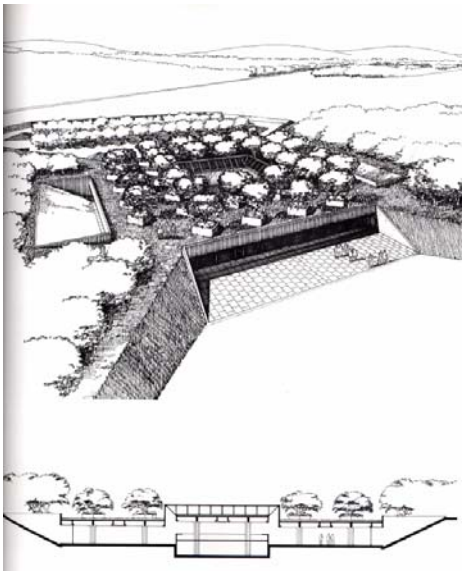


**Figure 7:** Clubhouse Precedent. The Perdue Office Building, designed by Architect, William Morgan, is a good precedent for a potential clubhouse for the youth. (Spreiregen 1987, 124)

As you enter the site, there is a sense of entry from the array of trees on both sides of the entryway. The clubhouse takes a unique form in which the design concept originated from the architecture of William Morgan: modern architect of the 1960's to late 1980's who based his architecture on prehistoric design origins. (See Figure 7.) The clubhouse has four sides, set 90 degrees adjacent to one another, that slope inward to form a shape similar to the base of a pyramid. The top of the building develops into a rectangular shape topped with a pavilion located in the center. The rooftop base sits ten feet high, while the rest of the building sits twenty-five feet high. A portion of this twenty-five foot elevation is built into the landscape. As one enters the golf facility from the parking area, there is a great sense of awe and curiosity to experience the clubhouse. From the Southwest side of the building, one can locate the overlook/reception area with a view of the driving range. Adjacent to the driving range is the location of the first golf hole. Underneath the overlook/reception area is the courtyard area that is used for eating, socializing, and making preparations to play the course. There are also a series of practice greens, paths, plantings, and bunkers for play preparation. The batting cages and driving range tees are located beyond the practice area. The courtyard area attempts to connect the clubhouse with the batting cages, practice hole, driving range, and first tee. Located on the Northwest and Southeast sides of the clubhouse are recessed windows that sit fifteen feet into the side of the building, and stretches out horizontally to end about ten feet from both corners. From these oversized windows, a view of the $9^{th}$ green, back tees of the driving range, and first tee, vehicular entry can be observed. The clubhouse is a combination of the earth and architecture that intertwine to form a very exclusive work of art. Nevertheless, this "Earthitecture" continues to take a practical form of usability, with a few added amenities that complement the overall design concept.

The maintenance facility is placed close to the clubhouse for better accessibility. (See Figure 8.) This area consists of an office, lab, and classrooms, and storage for different types of maintenance equipment. The selected equipment is very user friendly, so that youths at appropriate ages can operate it. The kids will be supervised while operating the various types of maintenance equipment, as they learn a respective trade to build character and expand their knowledge (e.g. push mowers, gardening, trash pick-up).

Thus, the maintenance area is also used for vocational classes and research related to golf course development.

**Figure 8:** Maintenance Building Precedent. The Forest House, designed by Architect, William Morgan, is a good precedent for a potential maintenance building for the facility. (Spreiregen 1987, 170)

Items, like golf training/rental equipment, classroom material/equipment, and clubhouse merchandise and foods, are stored at the clubhouse for practicality. In addition, other items, like ADA equipment, class/lab equipment, facility signage and equipment, and excess golf clubs and golf balls are retained at the maintenance facility for convenience. Overall, most of the equipment on-site is state-of-the-art, and relates to either golf or youth development. As a result, the junior golf facility can potentially be the Mecca for experimenting equipment and/or processes relating to these two areas.

The circulation is structured so that it begins and ends at the clubhouse. The circulation paths are minimal, thus, all of the main activity areas are located close to each other. Because the golf course is a walking course, there are no paved cart paths. Nevertheless, paths are created to help direct the traffic of the golf course and to accommodate the disabled. The golf course is an executive-style, 9-hole course with a par of 30. The first, middle, and last golf hole on the course are Par 4 holes, and the rest of the golf holes are par 3 holes. The following information is a narrative of the course prototype used in the validation experiment.

The first hole is a short, Par 4 hole that runs downhill. It also runs alongside a stream that flows in the same direction. At a point near the fairway, the stream flows over an area of stones that allows the water to meander into a pond. This pond has a centralized fountain that shoots streams of water up to fifteen feet in the air, and also the stream to continue its path along the golf course. The first hole introduces the golfer to

water, but the second hole is the golfer's first test with water. The three back tees sit on a hillside in which the ball has to carry over the stream, but the front tee sits close to the fairway. The third hole is a shot to the stream, while the green lie nestled in front of it. The fourth hole is a little more difficult to the right-hand golfer with a habit of slicing. A stream runs through the hole and divides the fairway. It continues to a waterfall that lands into a lake that sits to the right of the green. This waterfall can be best viewed while on the green. The fifth hole is the midway point of the course, and has been designated as a Par 4 hole. A stream that meanders from the lake at the fourth hole equally splits the set of tees. The next sets of tees have views of the sixth hole. The seventh hole consists of crossing a different stream in order to reach its tees. This hole is similar to the first in that it runs parallel to a stream, but is different in that the stream current is flowing against the direction of play. The eighth hole is golfer's first interaction with sand. The ninth hole is the last hole, thus is given the assignment to be the most fun and memorable. The only difficulty is to carry the ball over the crossing stream, onto the adjacent green. The course ends with a putt on the $9^{th}$ green.

When one experiences the clubhouse from the main entry, there is a gradual increase in height from the adjacent walls that are initially at ground level. They eventually stretch to reach fifteen feet in height. Colorful gardens are placed on both sides of the entryway to complement the main entrance and express the youthfulness of the facility. The initial space that is experienced within the clubhouse is the lobby, with the various facility offices placed around the perimeter. From the offices, the visitor can choose his/her option for play. The clubhouse is divided into three forms of experience: educational/vocational, recreational, and competition.

If the choice is educational/vocational, a great deal of the experience is located within the clubhouse. In the clubhouse, there is a museum whose theme is to preserve and enlighten the game of golf's past, present, and future. Historical facts and statistics, cultural impacts, and pictures that influenced the game of golf, are a few of the many items on display at the junior golf museum. Other areas that contribute to the educational experience are the library/computer lab for research/homework, and the mini-theater for initial class meetings, or guest speaker activities. Also located in the clubhouse are classrooms for vocational classes. The golf facility hosts various vocational activities in

which specialists come to aid in teaching kids a trade, such as turf management, horticulture, course maintenance, and golf operations. As a result, the maintenance area is placed close to the clubhouse for better accessibility. If the user extends his/her visit to play the course, there are numerous design elements that will educate him/her about the game, environment, and world. Before a first time visitor plays the course, there is a short quiz that must be completed and passed for ease of playability. This quiz entails basic rules of the game so the young golfer will not get confused while playing the course. For example, one question may state, “After sinking your ball in the hole, you prepare to tee off at the next hole. You notice that other golfers are on the green. What should you do?” Questions of this caliber will help the child better understand the game and allow faster play. When playing the 9-hole course, the hole-markers entail critical data that informs the golfer about the playability of the hole, and provides tips for one to follow. Suggestions about which club to use will be included, along with inspiring quotes from different known golfers and/or historical data.

If the choice is competition, then it is safe to assume that the user is either training, or being taught by the local golf pro. The classroom will be the most popular initial stop during the young golfer’s arrival. It is here that the individual or group would be briefed about his/her activities for the day. The next stop would either be the training room, mini-theater, or outdoor training area. The training room consists of a swing analyzer, practice nets, indoor putting green, and exercise/weight machines in order to properly train the golfer. Locker rooms and showers were also added for their extensive training. The mini-theater is used to show tapes of the trainee’s form, shots, and matches. The theater can also be used as a briefing station, or to show instructional videos and golf matches. The outdoor training area consists of the practice area, driving range, and practice hole. As a result, these training elements are placed close to the clubhouse for accessibility, and will help to refine the golfers overall skills.

If the choice is recreational, then the young golfer will have many options. The recreational aspect will possibly be the most common form of usage that pushes the design more than the others. After checking in at the front office, there will be a plethora of activities that one can choose from. The game room includes an arcade, indoor-putting green, and practice nets. There is also access to a virtual driving range and

virtual golf course for those who would rather play with no weather conditions. The pro shop entails a wide range of junior golf merchandise, from golf clubs to golf gadgets. This is the best haven to market any ideas related to junior golf. The pro shop is also the location of equipment and locker rentals. The museum, library, mini theater, and computer lab are activities available for the visitor if he/she would rather take in some golf culture, read about golf related topics, watch golf on the big screen, or surf the web. The restaurant is home to various multi-cultural entrees. Some of these foods and beverages can be served on the golf course as well. The recreational experience is also extended into the use of the facilities outside of the clubhouse. This area can be reached by passing through the restaurant area into the courtyard area. The courtyard area is located in an area that is centralized between the clubhouse, driving range, and practice area. This space is used for eating, socializing, and course preparations. Adjacent to the courtyard area is the practice area. Located a few yards away are the batting cages, and the range. To the right sits the back tees, and to the left are the front tees that edge the top perimeter of the range. To the far right is the path that leads to the practice hole, and to the far left is the path that leads to the first tee of the 9-hole course. Just playing of the course is enough to attract kids, but there is much more to experience. There are many elements that stimulate the five senses, and as a result, give the golf course a strong recreational background. Flowing water and natural sounds are a few of these recreational elements. The golf holes, from the first to the ninth, add to the experience, from its walking course status, to its great views, attractive water features, natural landscapes, and inviting wildlife.

All three purposes for visiting the facility will help to build a strong foundation of the facility's concept, as well as its success. The concept of mind, body, and soul is strongly carried through by researching, in depth, the three main visiting components. This would be educational/vocational for the mind, competition for the body, and recreation for the soul. Overall, the kids, regardless of their purpose for playing, should be placed within the same facility in order to be exposed to different environments. This will aid in expanding the depth of a child's mind and character.

## VALIDATION

The validation node is the fifth primary node of the Conceptual Research Diagram. It compares two models: an existing generic model, and a conceptual model. The data for comparison was acquired from the previous nodes; resulting in an experiment to determine which prototype the subjects would generally select. This experiment also aided in gaining further information on developing a customized product to meet the subjects' demands. The secondary nodes identified the type of experiment used, as well as the type of subjects involved. This node also has an option to loop back to the analysis node for one of two reasons, or both: if the experiment results do not meet the demands of the problem node, or to further validate the consistency of acceptance for the conceptual prototype. The loop option was not selected because of the time restraints of the research, thus the data was directly reported. The experiment procedure and loop option are the focus of discussion in this section.

The experimentation aspect was the last and most interesting method chosen for data collection. This involved using the Cave Automated Virtual Environments (CAVE) lab as a means to gain validation, as well as additional ideas/data for the development of the conceptual golf facility. (See Figure 9.) The CAVE is a three-wall cell, each wall with a dimension of 10x10x9 feet in diameter. In addition, the CAVE uses a Silicon Graphics Power Onyx with Infinite Reality Engines, plus projection devices, to project three-dimensional computer images onto its walls and floor. This device is particularly used for a three-dimensional walk-through of models. In this case, two golf facilities were loaded into the CAVE for the selected subjects to experience.

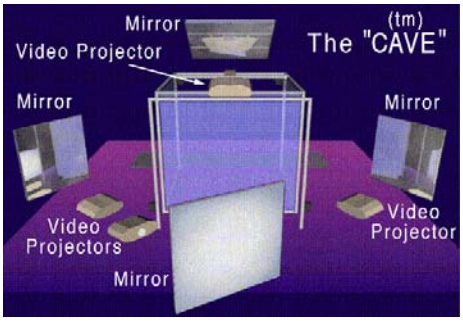



**Figure 9:** Elements of the CAVE. With the exception of the Silicon Graphics Machine, these are the main objects that allow subjects to experience 3D computer images. (http://www.cave.vt.edu)

After the golf questionnaire and design charrette, all the design ideas were consolidated, but only so many were carefully selected to fulfill the development of the conceptual design. In order to validate the conceptual prototype as well as gain additional ideas, a computer model containing the design of the existing and proposed golf facilities was created. The footprints of these two models were created in AutoCAD, and then imported into 3D Studio Viz to serve as a frame for 3D modeling. (See Figure 10.) All the 3D elements were developed in 3D Studio Viz, thus creating the models that would be observed at the CAVE. Furthermore, the 3D Studio files were imported through two other computer programs, Nugraf and Diverse, in order for the CAVE's Diverse Software to read and project the models in this virtual experiment.

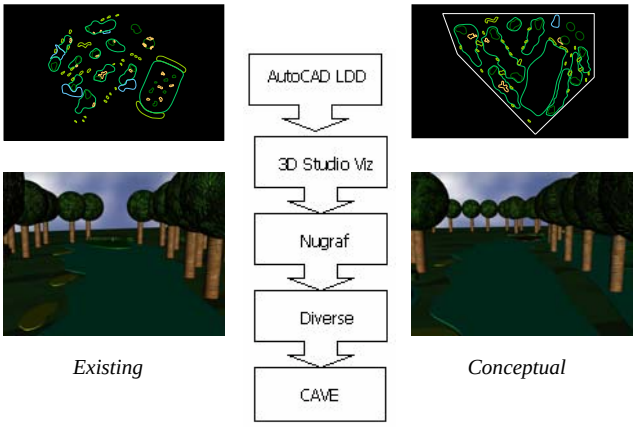



**Figure 10:** Model Importing Process. The CAD files were imported into 3D Studio Viz, and the models were in its same 3D form throughout its last two importations.

The experiment began by selecting one group from the questionnaire demographics section. For this experiment, the skill level group was selected. After having the subjects complete a consent form, they were placed in either the beginner golfer, or advanced golfer research group. Placing the subjects within one of two groups further separated this group, thus the groups were labeled accordingly. These two groups, consisting of one hundred students each, experienced a total number of eight virtual sequences. The sequences, labeled either existing or conceptual, pertained to one of the following four entities: the clubhouse, the practice area, a typical golf hole, and a typical golf course. To reduce the subjects' biased view towards either prototype, the prototypes

were labeled Model #1 and Model #2, instead of existing and conceptual. Each subject wore a set of Stereographics LCD Stereo Shutter glasses to obtain a 3D experience within the two models. In addition, some of the subjects experienced the virtual models simultaneously with as many as ten other subjects. To allow the subjects to relate to his/her group members, these "grouped" subjects were of the same demographic group.

The four sequences of the existing prototype were experienced first, and then the four sequences of the conceptual prototype were experienced. Simultaneous to the virtual walk-through, the researcher provided the subjects with identification information of the facility elements and intangible data about each prototype. This gave the subjects a better understanding of each golf facility. Also, parallel to this activity, the subjects were asked a series of questions during and/or after the virtual experience. (See Table 7.)

The subjects navigated through each sequence, and gave their validation comments. They also added additional comments that were relevant to the design of the golf course. Each subject had various ideas to add to the golf course, but there was one universal comment; that the new ideas for the conceptual golf facility were interesting and exciting.

The CAVE Experiment Table

| **Existing Model** | | **Conceptual Model** | |
|---|---|---|---|
| Explanation of each sequence is simultaneous with a controlled navigation. Subject reports his/her comments during and/or after each sequence. | | | |
| Clubhouse | Practice Area | Typical Hole | Typical Course |
| What do you like about this area?<br>What do you dislike about this area?<br>If you were the designer, what would you do to make this area better suited for kids like yourself? | | | |
| After experiencing both facilities, which one do you prefer and why? | | | |

**Table 7:** The CAVE Experiment. Two subject groups navigated through two virtual models, eight sequences total, and simultaneously answered questions posed by the researcher.

The existing prototype, or Model #1, was the first virtual model to be experienced by the subjects. It involved using a researcher-controlled navigation through four sections of the golf facility. (See Table 8.) The clubhouse area was the first area navigated. Although the subjects responded excitedly to this sequence, there is speculation that,

because this sequence was first, the subjects were more in awe of the CAVE and the virtual experience. As the subjects experienced sequence after sequence, their “true” feedback became more relevant. As a result, the responses were recorded for each sequence. There was little to no response to the researcher’s comments and questions to about the clubhouse area. Furthermore, the subjects tended to select the data stated by the researcher as answers to the research questions. The next sequence was the practice area, which navigated through the driving range and putting greens. The feedback was a little more qualitative, but still leaned on the researcher’s comments. Following this sequence was the golf hole sequence, which received immediate feedback. Immediately following this sequence was the last sequence; navigating through the entire nine holes of the golf course. The subjects that experienced this sequence began to lose interest towards the middle of the nine holes. When asked why, the responses were that the holes began to look the same. Overall, the clubhouse design was neutrally accepted, and there was a request to shorten the course. Although there was much criticism given for this prototype, there were also many ideas given that automatically led into the next prototype experience.

Existing Prototype Table

| Clubhouse | Practice Area | Typical Hole | Typical Course |
|---|---|---|---|
| •Pro Shop<br>•Eating Area<br>•Indoor Nets<br>•Classrooms<br>•Library<br>  | •Driving Range<br>•Target Greens<br>•Chipping Green<br>•Putting Green<br>  | •Open Fairway<br>•Large Undulating Green<br>•Easy Shots<br>•Natural Targets<br>  | •Par 3 Course<br>•9-Hole Course<br>•Lots of bunkers<br>•Water as a Hazard<br>  |
| •Eating area and study area<br>•Library<br>•Add more interesting things | •Great place to practice skills<br>•Not very interesting<br>•Add more to it | •Large fairways and greens<br>•Water<br>•Less water | •Short course<br>•Only a par 3 course<br>•Longer holes |
| •Pro shop and eating area<br>•Classrooms<br>•Add a rest area | •Practice putting and driving<br>•Too much sand<br>•More shaded areas | •Large greens<br>•Too many hazards<br>•Remove some hazards | •Short course<br>•Not enough variety for Par<br>•Vary the holes |

**Table 8:** Existing Prototype. The subject groups experienced the existing prototype in the form of four sequences. The top list of data contains the researcher's comments, the bottom list of data contains what the beginning golfer subjects generally liked, disliked, and would change about the area, and the last list of data is what the advanced golfer subjects generally liked, disliked, and would change about the area. The four animations give a similar idea to what the subjects experienced.

The conceptual model, or Model #2, immediately followed the first four sequences. (See Table 9.) It consisted of the same type of sequences, with the exception of incorporating selected consolidated data acquired from the four research schemes. From the initial experience of the first sequence, the attitudes and attention of the subjects positively changed. This could be due to the subjects' means of using the first group of model sequences as a reference of comparison to the second group of model sequences. As a result, there were more creative suggestions and requests to explore various parts of the second model. The first sequence was inclusive to the clubhouse area. There was immediate feedback to the formation of the clubhouse, and comments about its functionality were provided thereafter. The second sequence involved the practice area. The subjects were more partial to the driving range area, which led to the demand for other sports-related activities. The third sequence involved navigating through

a golf hole. This hole was favored more than the previous model due to the range of elements provided for the hole, not to mention its ease of play. The last sequence walked the golfers through the 9-hole golf course. Most of the subjects did not seem to be as uninterested as they were in the first model. This could be due to their enthusiasm for the ideas presented in this model, complemented by shortened golf holes and added gardens.

Conceptual Prototype Table

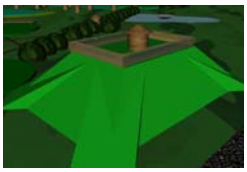
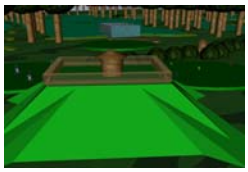
| Clubhouse | Practice Area | Typical Hole | Typical Course |
|---|---|---|---|
| •Pro Shop<br>•Museum<br>•Arcade<br>•Eating Area<br>•Miniature Golf<br>•Indoor Training Area<br>•Classrooms/Labs<br>•Library | •Illuminated Driving Range<br>•Target Greens<br>•Batting Cage<br>•Chipping Green<br>•Putting Green<br>•Waterfall and Fountain | •Kids Tees<br>•Open Fairway<br>•Easy Shots<br>•Natural Targets<br>•Large Green<br>•Undulating Green<br>•Aid for Shots to the Green | •9-Hole Course<br>•Adjusted Tees<br>•Each Hole has a Theme<br>•Walking Course<br>•Less Bunkers<br>•No Water<br>•Ball Assortments |
|  |  |  |  |
| •Many things to do<br>•Potentially high attendance<br>•Add more things to do | •Driving range/batting cage<br>•Limited activities<br>•Add other rec. facilities | •Large Greens<br>•Holes too close together<br>•Make it larger overall | •Golf hole and gardens<br>•Walking course<br>•Add golf carts |
| •Mini-golf, arcade, eating<br>•Landscaping<br>•Add more vegetation | •Illuminated driving range<br>•Too much space in between<br>•Place for basic golf skills | •Less hazards<br>•Kid tees and back stop<br>•Have less structures | •Variety with the holes<br>•Too many non-golf items<br>•Keep it strictly golf |

**Table 9:** Conceptual Prototype. The subject groups experienced the existing prototype in the form of four sequences. The top list of data contains the researcher's comments, the bottom list of data contains what the beginning golfer subjects generally liked, disliked, and would change about the area, and the last list of data is what the advanced golfer subjects generally liked, disliked, and would change about the area. The four animations give a similar idea to what the subjects experienced.

In comparing the two subject groups' virtual experiences with both models, it became evident that the beginner golfers wanted a stimulating golf facility that was easy to play. On the other hand, the advanced golfers wanted a golf facility that was more challenging, without so many youth-related entities. Within both of these subject groups, a medium model must be established. Also, many of the subject's initial ideas/comments were in the category of golf programs rather than golf course designs. For example, one

subject wanted to have competitions with other golfers at his level. Another subject wanted to have a virtual Tiger Woods to either play against or to serve as a caddy. There were other comments given, and findings that served as great ideas for future references. (See Table 10.) Elevated tees, easy play, large greens, and a multiuse clubhouse were ideas that remained most consistent in the subjects' comments. Some of the subjects were excited that requests could be given for a design element, and that their input could be created for their viewing. The only data relevant to how many holes to add were to add an adequate number parallel to the subjects' attention span. Consequently, this data does not factor in fatigue, weather elements, etc. One subject wanted to add a golf hole that floated in the air so you could fly to it. This may be because of the way the subject navigated through the model. Although this suggestion was not applicable to the current experiment, the idea could possibly be applied to the virtual golf component of the conceptual facility. There was also a comments pertaining to the clubhouse, like teeing off from the rooftop and also using the clubhouse as a shot target. This was a result of navigating through mostly golf holes. Overall, the results of the CAVE experiences were successful in that the subjects were excited to see that some of their ideas will be incorporated in an actual 3D model. It gave them the feeling of having a voice in the development of the golf course.

CAVE Key Findings Table

•Virtual immersion aided greatly in understanding the design by communicating qualitative data clearly between the researcher and the subject.

•It was necessary for the researcher to explain the design during the virtual experience so the subject would understand the functionality of the design properly.

•A Comparison of the two user groups rendered quality data for the designs. Now, the current feedback can be used, via the loop option, to develop a new prototype for a more concrete validation from the same user groups, or a more diverse validation from different user groups.

•The feedback from the first model was mostly functional comments, and there were less dislikes and desires to change elements in the second model.

•The design of second model almost coincided with the comments from the first model.

•There was a real desire to implement the conceptual model.

**Table 10:** CAVE Key Findings. The data stated above are significant findings from the CAVE experiment.

Loop Option

After the subjects experienced the virtual golf course, their feedback was reported to the next and final node. There is, though, the option to loop back to the secondary node of the third primary node. This is the questionnaire/design charrette node in which the subjects' initial ideas were consolidated and selected. This process is repeated, along with the remainder of the Conceptual Research Diagram from that point, in order to achieve a more consistent model validation. The loop option also allows two of the four main research schemes to be fine-tuned for a more qualitative feedback. As a result, the new questionnaire and design charrette results should serve as an addition to the already attained results from the first run-through, congregating the conceptual prototype from the loop option with the original conceptual prototype for comparison. This should aid in achieving a better prototype validation rate from the subject groups involved. In order to decrease a biased validation, a new group of subjects from the same research groups are

to be chosen to participate in the questionnaires and design charrettes. They also are to experience the model from the loop option, and the original conceptual model in order to gain a consistent compilation of design elements. When the researcher feels the two models in comparison are somewhat similar, or that the validation rate from the new model is prominent enough, the option to proceed to the results node with the obtained results is selected.

**RESULTS**

The results node is the sixth and final primary node of the Conceptual Research Diagram. It serves as the report section of the validation, as well as the overall research. The Results section also has secondary nodes that approach two topics: answering the original hypothesis to meet the conditions of the first primary node, and discovering any additions to new knowledge. After the subjects experienced the validity node, the loop option was bypassed, and the subjects' feedback was reported. As stated earlier in regards to the loop option, when the researcher feels the two models in comparison are somewhat similar, or that the validation rate from the new model is prominent enough, the option to proceed on with the obtained results is selected.

The CAVE research added feedback and design ideas for the strategy of the golf course. Elements like educational, and new age ideas were discovered from the CAVE experience. From the tees, subjects wanted to be able to see the entire hole played. There was an interest in viewing various shapes of bunkers. Upon the fairway all subjects still liked the idea of being able to see the entire play of the hole. They didn't like the idea of having hazards after discovering the amount of skill it would take to master it (water, sand, trees, etc.). There was a unanimous vote to design the greens large to create a better attempt to putt the ball. The clubhouse received the most ideas. There were comments to have a place to eat, an arcade, a place to do homework, and even a virtual course to play if they didn't want to play the real course.

The conceptual prototype validates the original hypothesis by catering to many forms of usage. The primary form of usage involves young golfers of all backgrounds having a place to grow in golf, the community, and life. Kids need to be entertained in order to retain their attention, but should be educated in the process as well. This

education can be in the form of life learning skills, interpersonal skills, the natural sciences, golf course management, etiquette, respect for one another and, of course, the game of golf. Although the subjects varied in skill, they were also the same in that they had great energy and were very inquisitive, which led to some great ideas from all the subjects. Golf camps and competitions, and special programs sponsored by the Professional Golfer's Association (PGA) and its golfers, would have the potential to encourage a permanent home at this facility. In addition, a state-of-the art facility of this stature would have the option to offer a permanent location to various community programs; vocational classes that relate to the golf industry can be held, YMCA and other nonprofit organizations can shuttle kids to and from the facility, after school activities and field trips can be coordinated, and juvenile programs in which the main objective is to maintain the upkeep on the facility can be held. To ensure that all kids have the opportunity to experience the facility, ADA accessibility is also incorporated. Although all of the programs and possible partnerships have the potential to enrich lives and leave a positive impact on the youth, the facility is not just limited to the usage of youths. Adults are considered as well by providing back tees on the golf course. The back tees contain an average yardage that sits between the average men's tees (usually the white tees on a regular course) and the women's tees. As a result, family rounds can be played and older, more advanced golfers can come to work on their short game. Sharing the versatility of the junior golf facility simply demonstrates a plethora of endless possibilities with golf and youth development.

The conceptual prototype takes a step away from traditional golf course architecture; yet preserves the integrity of the game by offering many tangible and intangible advantages. Some tangible advantages are: a shorter course that will result in faster play, a multipurpose clubhouse, a safe and inviting habitat for wildlife, and other substantial elements that assemble an entertaining and educational golf facility. Being that a facility of such stature is also low maintenance, less water and little to no pesticides will be needed, which will reduce the amount of contamination to the land. Lastly, the facility creates an aesthetically pleasing visual, which increases property values to the surrounding properties. While tangible advantages create a positive impact on the youth, an extensive amount of intangible advantages will create a greater long-term impact.

There is potential to significantly attract youths of all ages, cultures, and skill levels, especially non-golfers. The facility is also capable of attracting and exposing kids to golf at an early age, thus resulting in the development of many personal relationships that will broaden a child's world. By accomplishing this, negative stigmas that have been placed upon golf courses in relation to children will eventually fade out.

From an environmental point of view, the potential impact of the conceptual prototype is minimal. In fact, the facility invites local wildlife and vegetation the opportunity to come live and grow. The facility also has little impact on land use. A majority of the landscaping would be native, which reduces costs in upkeep. Also, smaller facilities mean less landscape maintenance, including water and pesticides. Due to the demand for a maintained landscape, the golf course would add a great visual for adjacent property, providing an aesthetically pleasing element to the community. As a result, the conceptual thirty-acre prototype composes a great natural screen, and would be an immense addition to urban areas as well as rural and suburban areas. Brownfield, Greenfield**,** redevelopment of existing parks and golf courses, Native-American reservations, and Appalachia areas can be included as a potential site for better accessibility to various kids. The research questionnaires of kids in Blacksburg, VA, showed that kids of various skills levels supported the concept of a junior golf course. The prototypical process developed to create the junior golf facility in Blacksburg, VA, can be applied to different regions with hopes of containing a customized facility. Will kids in any environment/location support the concept? Only further research and experimentation of different subject areas will begin to give more valid answers.

In conclusion, the conceptual prototype adds to new knowledge by serving as a great tool for education, as well as entertainment for the youth. This state-of-the-art concept can possibly bridge many political, social, and economic gaps, but the primary responsibility is to bridge the gap between children and golf. From the point of view of the overall research, new knowledge was attained through the development of the Conceptual Research Diagram. Within its structure, the various sub-nodes, or secondary nodes, complimented the primary nodes with the functionality and progression process of the data involved. This prototypical process served as a good outline for the current research and thus could be a good precedent for similar future research.

# CHAPTER 3

# FINDINGS AND CONCLUSIONS

## OVERVIEW

The research attempted to reveal significant data and validate results in three areas: selecting a design issue to research and use in the initiation of a prototypical process, initiating the development of a universal prototypical process for design, and using state-of-the-art methods and technology in the process. This Chapter is divided into five sections, the first of which discusses the implications acquired from the three main areas of the research. The second section discusses the validity of the Conceptual Research Diagram, which is the prototypical process. The third section approaches the weaknesses of, or problems with, the research. The fourth section reveals further observations of the research, while the fifth section explores opportunities for further research.

## IMPLICATIONS

There were many implications revealed from the research. (See Table 11.) The main implication involved validating if a prototypical process involving literature reviews, interviews, questionnaires, design charrettes, and the Cave Automated Virtual Environments lab (CAVE), can be applied to create design solutions valid to the subjects involved in the process. There were also implications involving the design topic used in the Conceptual Research Diagram. After completing the initial steps of a potential golf facility for youths, several implications come to mind. These implications include aspects concerning the process of the project and also ideas that should be taken into account when continuing beyond this initial step of development. Time was an essential element needed to properly conduct a project such as this. The time spent with the children, although very productive, should have been lengthened to harness their creativity and allow them to have more influence over the process and outcome.

Implications Table

| Now what do I know? | What can this research be used for? | What could have been done differently? | What were the advantages/ disadvantages of the research? |
|---|---|---|---|
| •The process to create a design for a junior golf facility was successful, concluding a validity for a prototypical process that can be applied to other towns and cities.<br>•Local junior golfers, from beginner to advanced, would use the conceptual prototype, thus giving a validation to the design.<br>•Some user groups created a greater impact than other user groups.<br>•New elements and ideas to attract kids to golf were discovered.<br>•The conceptual prototype was chosen more than the existing prototype due to its unique ideas. | •The research can serve as an example of how to collaborate the ideas of research subjects, local professionals, and educational professionals within the university.<br>•The research can be a guide for students who would like to find ways of developing new ideas, and gaining support for it in the academia setting.<br>•The content of the research is an addition to new knowledge, therefore serves as a new resource.<br>•The research can be used as a basis to actually develop a facility of this stature. | •More children could have been chosen to participate in the questionnaire, charette, and CAVE research, resulting in a more supported result.<br>•In relation to the First Tee Program, a more urban setting could have been chosen, thus the possibility of targeting a junior golf program would have been high.<br>•Proper scheduling of my research sources would have allowed more time to focus on the research.<br>•A different user group could have been selected to gain a different perspective on user demands. | •There was a limitation to resources pertaining to the subject area.<br>•The availability of more research schemes resulted in more design ideas, which in turn created a more customized junior golf facility.<br>•Limited resources to kids in local junior golf programs made the research progression more difficult.<br>•The opportunity to use the same kids for the CAVE research that completed the questionnaires and charrettes helped to validate the conceptual prototype.<br>•The opportunity to use state-of-the-art technology had a positive impact on communicating ideas between the subject and the researcher. |

**Table 11:** Implications. The information listed provides a collection of implications acquired throughout the research.

In addition, subjects should be included in the process at a much earlier stage. They were the reason for the project and should be allowed to shape it from the start and be involved in every additional step. Something learned about employing a questionnaire was that it should be administered to a test group in order to detect any flaws and avoid problems when used in the actual project. In addition to allowing more time on the charrette, conducting numerous charrettes would have provided more ideas and concepts from the subject groups. Such a small sample of subjects obviously does not represent the entire population or even one segment. Data from the subjects' parents should also be considered to gain parental feedback. The parents can provide a wealth of information, but it is important that they are not allowed to influence their children's decision within the process. Involving children may take additional time and be a tedious endeavor, however, the insight they possess is endless.

Nevertheless, the two subject groups involved in the CAVE experiment generally approved of the conceptual prototype over the existing, thus validating the prototype and the functionality of the Conceptual Research Diagram. In comparing the two subject groups' virtual experiences with both models, it became evident that the beginner golfers

wanted a stimulating golf facility that was easy to play. On the other hand, the advanced golfers wanted a golf facility that was more challenging, without so many youth-related entities. Within both of these subject groups, there was still a common ground, acceptance of the conceptual prototype. Overall, the results of the CAVE experiences were successful in that the subjects were excited to see that some of their ideas will be incorporated in an actual 3D model. It gave them the feeling of having a voice in the development of the golf course. Not only does the research create new resources through the incorporation of various research schemes, it creates new research within the current research by probing for elucidations to the original research topic. This series of elucidations can serve as a tangible basis for facility development. For example, the processes used, and all elements needed to construct the Conceptual Research Diagram would serve as the current research, and the compilation data, that was retrieved from the Conceptual Research Diagram and used to create a junior golf facility, would serve as new research within the current research.

## VALIDITY OF THE CONCEPTUAL RESEARCH DIAGRAM

Various research methods and state-of-the-art technology was amalgamated to form the Conceptual Research Diagram. This conceptual diagram was beneficial in data collecting, experimentation, and continuity. The methods used to collect the various data had its individual advantages, and as a whole, they provided additional information that served as a good resource. (See Table 12.) The literature reviews gave data on what has been attempted and accomplished, and the interviews gave professional advice and additional comments on the subject area. The questionnaires gave more detailed responses, as well as answers to basic golf facility elements. The charrettes showed a visual of the subjects' ideas, thus giving numerous ideas and designs of golf holes. Furthermore, these ideas could be clearly interpreted which led to better communication between the researcher and the subject. In the CAVE research, the communication between the researcher and the subject was great, which gave an even clearer visual of ideas and interpretations. It also helped the designer communicate the ideas more clearly and helped the subjects understand the design. The process took longer to accomplish, but gave the clearest visual of ideas and concepts due to its life-scale models from the

virtual immersion. Because the design topic chosen had little background information available, this particular approach was appropriate. It used five methods of massive information gathering, consisting of literature reviews, interviews, questionnaires, charrettes, and virtual experiments, which provided additional information that enhanced the background information made available. Also, dividing the Conceptual Research Diagram into major steps and sub-steps, or primary and secondary nodes, aided in conducting a more structured process. This helped to give each idea and concept meaning by having them progress from simple ideas and to concepts to more complex ideas and concepts. In addition, each research method served as a basis for its following method, creating a filtered and well-supported group of ideas and concepts. This was due to a unanimous acceptance of the ideas and concepts from each method.

Conceptual Research Diagram Advantages Table

| Literature Review / Interviews | Questionnaires | Charrettes | CAVE Research |
|---|---|---|---|
| •Gave data on what has been attempted and accomplished.<br>•Gave professional advice and additional comments on the subject area. | •Gave responses to real needs as compared to literature research.<br>•More detailed responses<br>•Gave answers to basic design elements of the facility. | •Showed a visual of the subject's ideas, thus giving numerous ideas and designs of various holes.<br>•Ideas could be clearly interpreted.<br>•Better communication between the researcher and the subject. | •Gave an even clearer visual of ideas and interpretations.<br>•Communication is excellent.<br>•The process took a little longer to accomplish, but affects the data dramatically.<br>•Immersion created almost an onsite experience.<br>•Good for gaining detailed information.<br>•Helped the designer better communicate ideas and helped users to better understand the design. |

**Table 12:** Conceptual Research Diagram Advantages. The information listed provides the advantages of using various design-related, data-collecting methods.

The experimentation aspect of the Conceptual Research diagram was beneficial in that the existing model could be tangibly compared to the proposed model at a life-size scale. Virtual immersion aided greatly in understanding the design by communicating qualitative data clearly between the researcher and the subject. It was necessary for the researcher to explain the design during the virtual experience so the subject would understand the functionality of the design properly. As a result, a comparison of the two user groups rendered quality data for the designs. Now, the current feedback can be used,

via the loop option, to develop a new prototype for a more concrete validation from the same user groups, or a more diverse validation from different user groups. It was beneficial to have the option to loop back through the diagram as many times as needed for validity and/or consistency. The technology component definitely enhanced the medium of experimentation by creating a life-size virtual environment that could be navigated and experienced. This enhancement was also inclusive to providing the option of using virtual environments for comparing prototypes, and collecting its data. As a result, this approach can serve as a tool for researchers and designers from all types of disciplines.

The continuity aspect of the Conceptual Research Diagram could serve as the most important component. Because without structure, the diagram is nothing but a mere plethora of various ideas muddled together. The diagram ran smoothly from one primary and/or secondary node to the next. Even if the researcher chose to loop back through the diagram, the nodes were developed to be universal to that respect. The three major aspects were revealed numerously throughout various parts of the diagram, and were orchestrated by the design topic selected for the research. In other words, the examples of the diagram aspects were thoroughly revealed within the Conceptual Research Diagram by the design topic selected to pervade the Conceptual Research Diagram.

## WEAKNESS OF THE RESEARCH

The research, like other pieces of research, had its areas that could be improved. Some of these areas were mentioned in the previous section. (See Table 16.) The first element that somewhat appeared as a “weakness” was the amount of subjects selected to participate. Although the subject base was diverse in representation, it only represented a portion of the town’s youth population. Location of the research could have been improved also. A location that encompassed a more urban environment would have possibly revealed a better probability of acquiring access to a First Tee golf facility, as well as a greater number of youths that regularly play the game. Because there was limited research done on golf course design for the youth, finding tangible resources became limited. The overwhelming sum of intangibles from professionals across the country, as well as the youth input from the various research schemes, made things

somewhat difficult for one researcher to organize at times. One last area that could have been adjusted or changed was the selection of subject groups. What if the subject chosen to participate in the CAVE experiment were based on age, sex, or physical handicaps? Would the conceptual prototype remain incredibly similar, or would it drastically change?

**FURTHER OBSERVATIONS**

The booming popularity of golf has attracted many people of many different backgrounds. The original interest of golf in the past included a smaller number of youths compared to today. With the success of golfers such as Tiger Woods, youth participation is greatly impacting the game. The golf course can serve as an environment for many things: education, self-respect, trust, hard work, and love for nature. Most values of a positive lifestyle that can be incorporated through the development of the golf course are made possible through various youth golf programs. The other values such as self-improvement, respect, etiquette, and the love for nature have the opportunity to be conveyed through everyday play. As this group has impacted the golfing population, it will also impact the development of the golf facilities. This impact must be recognized and honored, as traditional development have been honored in the past.

The conceptual facility takes the form of previous existing facilities, with the exception of pushing the concept of attracting more kids to golf. Hopefully, these ideas will begin to create benchmarks, or goals, to build upon for pushing the concept even further. Most of the goals set were a result of previously accomplished goals. The more critical, fundamental goals had to be established and accomplished first in order to move up to secondary goals. The fundamental goals were inclusive to: making golf accessible to kids of all backgrounds, providing opportunities to learn various trades within the golf industry, familiarizing more youths with golf by enhancing their knowledge of the game, creating a permanent location for various youth related activities and programs, creating a facility that will give its community a sense of pride, and enhancing the minds of the youth by creating a enjoyable and educational facility. Accomplishing these goals will set a societal benefits for the local youths, thus setting more advanced, or secondary, goals: helping children find their niche in society by giving them new avenues to explore,

building bridges between non-profit organizations of similar interests, and aiding in the reduction of local crime and poverty rates, as well as other frightening youth statistics. The two groups of goals are important in that they are needed to obtain the overall goals: to create a new area of research and employment in the golf course design profession, which will create more jobs, and to set a prototypical process that can be used globally within any setting.

## OPPORTUNITIES FOR FURTHER RESEARCH

Establishing research of this stature creates the potential to generate many possibilities for further research. First, the Conceptual Research Diagram could be refined to provide a more robust output. Manipulating the subject groups would be the most influential step. For example, instead of using age, skill, gender, physical attributes, and sex, the researcher may decide to use socioeconomic status, behavior type, grade level, favorite hobbies, etc. The researcher may also decide to use grouped demographic information instead of individual demographic information. For example, the researcher may chose subjects whose residence sits within the area of little developmental growth, instead of choosing subjects that are low-income, at-risk, or of an ethnic status.

Within the Conceptual Research Diagram, the topic chosen has the potential to generate many possibilities as well. A golf facility that caters to the youth is still fairly new to the Golf Course Design profession, thus could house many forms of research. The topic currently used could be further tested to see if subjects in Stockton, California, have similar views as the subjects used in this experiment. What about subjects in Lincoln, Nebraska, or Sanford, Florida? How does subjects from towns and cities of various populations, crime rates, and other demographic information compare and contrast in experimental data? Will there eventually be a universal golf facility that sets the standard for youth facility development? Eventually, there could be a process of validation from the Conceptual Research Diagram that compares on-site feedback from existing golf courses to on-site feedback from golf courses designed and built by the method created from the research. Nevertheless, further research and experimentation of this caliber would begin to answer these questions.

## SUMMARY

To develop a golf facility designed to attract, accommodate, and educate today's youth, can a prototypical process involving literature reviews, interviews, questionnaires, design charrettes, and the Cave Automated Virtual Environments lab (CAVE), be applied to create a valid solution? This research attempts to explore and apply various research schemes by attempting to solve a selected design issue. There was an attempt to create a prototypical process that incorporated various methods and technology, and there was an attempt to develop a golf facility for juniors. A thesis dealing with these two entities could have taken two forms. It could have been peremptorily written and leave little imagination to the reader, or it could have been unrestrictedly written and use the fundamentals and principals of design as a basis. As for this research, the latter of the two forms was chosen, leaving potential avenues for future research in numerous areas. Many of these areas were inclusive to: community participation, youth participation in the development process, golf course design for the youth, and establishing a state-of-the-art prototypical processes that incorporate state-of-the-art methods and technologies.

The groups that could benefit mostly from the research are organizations that introduce youths to golf. The First Tee of the Professional Golfer's Association, initiative of the World Golf Foundation to develop and accommodate golf facilities and activities for all children, could benefit from this research by using it as a foundation to develop new avenues that introduce golf to young Americans across the nation and around the world. The sport is seeing a surge of popularity in the inner city as well as in the suburbs. Children have trouble accessing the sport, however. The green and cart fees are often far out of the reach of the typical child. There is not always a public course nearby on which to play. Certain etiquette is expected from players, and children don't always have someone to teach them these rules. Because of this, older players often make assumptions about how youths will act and are unwilling to open the course to them. The methodology that the research took in approaching this issue was to create a golf course geared specifically towards the youth.

Because of the technology incorporated in the research, and the design topic chosen, using an unrestricted approach begins to plant seeds of inquiry for future researchers interested in any of the areas covered in the research. Incorporating the use of

virtual environments adds resource variety to be used at the researcher's disposal, which allows a tangible pre-developed environment for potential users. As a result, this will allow the researcher to incorporate diverse methods of data collection. Using golf course design as a topic influences the development style of the thesis in that this particular type of Architecture is predicated upon random arrangement and infinite variety, requiring an unrestricted thought process. As a result, future researchers/ designers can use the basic design fundamentals and processes as guidelines, not advanced ideals established in a given area of design. In this case, the two entities could bring about new and unique approaches to golf course development.

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# APPENDIX A

## A BRIEF OVERVIEW OF GOLF

Golf is a great game that can be simultaneously enjoying and frustrating. The requirements involve a playing field, equipment, and a great amount of patience. The playing field is called a golf course, and the equipment used is a set of golf clubs and a golf ball. The play of golf is usually in sets of nine-hole intervals that range from 2,400 yards to 3,600 yards. The most common interval sets on a golf course are two: the front nine, which consists of the beginning nine holes, and the back nine, which consists of the last nine holes. Golf courses are known to have as many as thirty-six holes, and a little as five holes.

Each golf course has a par, which is the number of strokes a golfer is given to advance their ball from the "tee point", to the golf hole. A course contains three types of holes: a par 3, a par 4, and a par 5. For example, on a par 4 hole, the golfer is given one stroke to advance their ball from the tee to the landing area, another stroke to advance from the landing area to the green, and two strokes to putt. The par amount of the course depends on the number of holes the golf course contains. Many courses have a par of 72, which are usually four par 3's, four par 5's, and ten par 4's. A par 3 or par 5 hole usually follows approximately after a par 4 hole has been played. The following table gives a good visual of par in relation to the player:

U.S.G.A. Yardages for Guidance

| Par | Men | Women |
|---|---|---|
| 3 | up to 250 yds. | up to 210 yds. |
| 4 | 251 to 470 yds. | 211 to 400 yds. |
| 5 | 471 yds. And over | 401 to 575 yds. |
| 6 | (no par 6 for men) | 576 yds. and over |

Source: 2000-01 U.S.G.A. Rules of Golf

**Table 13:** Par Yardages for Men and Women.

At a minimum, a player needs a set of golf clubs and a golf ball to play the game. The typical range of golf clubs used consists of the driver, fairway woods, fairway irons, sand wedge, and putter. The United States Golf Association will only permit a maximum of fourteen golf clubs per player's golf bag, but there is no limit on the minimum number of golf clubs a player can use. The driver is used to tee off on holes in which the green cannot be reached in one shot. These holes are usually par 4 and par 5 holes. The driver should theoretically be the club that the player gains the most distance with the golf ball. Fairway woods are similar in shape, but possess a shorter shaft. These clubs are used for distances of one hundred fifty to two hundred yards. The fairway irons are used for distances of eighty to one hundred eighty yards. The specialty clubs, consisting of the sand wedge and pitching wedges, are used to play the ball out of hazards and for short shots onto the green. The putter is used on the green to tap and roll, or "putt", the ball into the hole.

To play the game of golf, there are two main objectives: to make par, and to achieve the lowest score possible. Depending on a golfer's handicap, which is a system that allows golfers of all skill levels to reach a certain level of equivalency among one another, the goals set by the golfer will vary. The golfer with a high handicap (25+) may aspire to attain a lower handicap, to not lose so many golf balls, to actually enjoy the game, etc. The golfer with the low handicap may aspire to play golf competitively, to become a scratch golfer (no handicap), to win more bets with his/her golfing buddies, etc. The scratch golfer, or no handicap golfer, may possibly be playing golf competitively or teaching the game to others. The aspirations of this type of golfer may be limited to goals that are player related, or competition related.

# APPENDIX B

## ELEMENTS OF GOLF COURSE DESIGN

The basic elements of golf courses are simplistic in its functionality. A golf hole consists of three basic elements: the tee, the fairway, and the green. The tee is the beginning point of a golf hole. This element is significant in that it can determine the character, difficulty, and initial strategy of its hole. The fairway is the area of the golf hole that sits between the tee and the green. This area is usually comprised of landing areas for the par 4 holes and up. The green is the end point of the golf hole. This element consists of the flag and cup, and is usually placed at a lower elevation than the tee. Further strategy is added to the golf holes by way of hazards. These hazards are inclusive to sand or grass bunkers, berms, water features such as ponds and brooks, plant materials, and other natural elements. Figure 11 is an example of the elements comprising a par 4 golf hole:


**Figure 11:** Example Par Four Golf Hole. This cartoon illustrates and outlines the basic golf elements of a golf hole. This hole in particular comprises of a par four. (Manning 1954, 74)

The tee area is the starting point of the golf hole. The appearance is usually takes a rectangular formation, resulting in a series of “tee boxes”. This series of “tee boxes” is due to the multiple number of “tee points” for various golfing levels. When considering the placement of tees, precedence should be given to the topography. Thus, the series of tees should take a similar formation. This formation may take an irregular shape, or the individual tees may form an irregular shape to fit the topography. The “tee points” are placed in different locations within the constraints of the “tee box”, usually on a daily basis. Some “tee boxes” contain two “tee points”, and some “tee points” may be assimilated to the same “tee point”. (See Figure 12.) The tee location is a critical factor in how the golfer plays the hole. Golfers like to see their shot from an elevated area. Consideration must be given to avoid blind shots and improper drainage. One rule to remember when deciding on a tee location is to allow the golfer to see the first landing area, or the green if it is a par 3, from the proposed tee location.

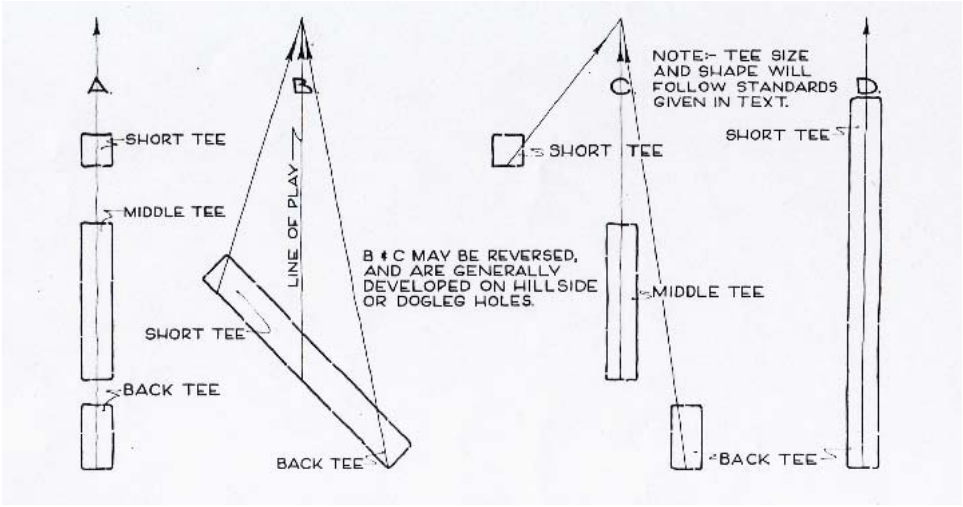



**Figure 12:** Tee Alignment. (Ferlow 1959, 113)

The hole’s character is usually the deciding factor on the types of tees to implement. Regardless of the tee selection, the slope must be sufficient for adequate maintenance. The current maintenance of tees are implemented by the use of power mowers, thus the slopes should, at the most, be set to 1:4 or less. The longevity of the tees will vary with each golf hole. One common rule is the larger the “tee box”, the longer the

life of the tee. The table below was created to determine the minimum size of a common tee according to the number of golfers per day and types of golf clubs used:

Average Tee Area

| Type of Golf Clubs Used | 50 players per day | 150 players per day | 300 players per day |
|---|---|---|---|
| Wood | 1500 sq. ft. | 2500 sq. ft. | 4500 sq. ft. |
| Iron | 1750 sq. ft. | 3000 sq. ft. | 5500 sq. ft. |

**Table 14:** Average Tee Area. The suggested minimum size allocated for a golf tee. (Ferlow 1959, 114)

Another thing to remember is to attempt to equal the total tee size to the size of the green. This will give an adequate amount of tee space. Depending on the size and location of a tee, the yardage of the corresponding golf hole can be either increased or decreased. The ideal tee is to have one massive “tee box”. This would allow the golfer more “tee point” opportunities. If the tees are to be divided, then a fraction, in eights, should be distributed accordingly. The middle tee should have five-eighths of the total teeing area, the back tee should have two-eighths, and the front tee should have one-eighths of the total teeing area.

The fairway is the middle area of the golf hole. This larger area is usually considered as half of the total golf hole. Referred to as “through-the-green” (Ferlow 1959, 116), this area is inclusive to all the land that lies between the tee and the green within the boundary of the corresponding golf hole. The “through-the-green” can be divided into two parts: the other natural elements, and the fine-mowed playing surface. The other natural elements are usually along the border of the fine-mowed playing surface, and require little to no maintenance. This area is also referred to as the “rough”, which is inclusive to trees, sand, tall grasses, etc. The rough also serves as a strategic element for play, and a buffer between other golf holes. The fine-mowed playing surface sits in the middle of the golf hole usually, and follows the contours of the land. One common character of the fairway is for it to be “rolling”, which adds an interest to the golf hole. The pattern of the fairway allows it to be easily located, thus is a good guide from the tee to the green. The width of the fairway is approximately seventy yards, and

fluctuates as the golf hole progresses. The width, though, should be widened as needed to meet the traffic demands of the course. The length will vary as well according to the character of the golf hole. The ideal length is to reach out from the back tee to catch any unusual tee shots, to the back of the green to catch any long shots.

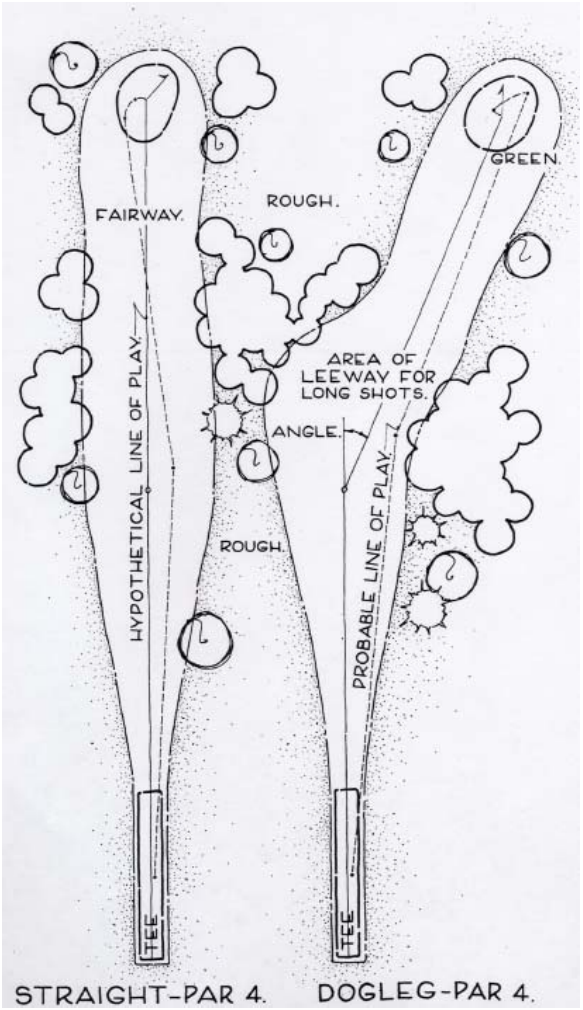



**Figure 13:** Fairway Alignment. (Ferlow 1959, 120)

A fairway appears in two forms: straight and dogleg. (See Figure 13.) The straight fairway can be simplistic in that the path from the tee to the green is in one direction. The dogleg, on the other hand, forces the golfer to change directions, or turn. In most cases, the green cannot be seen from the tee, which adds more strategy to the golf hole. The first landing area, though, should be seen. This area is placed two hundred-fifty yards from the back of all the tees, and usually turns the line of play at an obtuse angle between ninety

and one hundred-eighty degrees. The second landing area generally sits between four hundred-fifty and five hundred yards from the back of all the tees. The landing areas are usually set wider via fairway, to avoid overplaying or underplaying the shot. There is also another type of landing area called, island fairways. These elements can be used on both straight, and dogleg golf holes. These areas are appealing to the golfer and can be rewarding if played correctly. The island fairway is also surrounded by other natural elements, or the "rough", that will make the golfer's next shot more difficult.

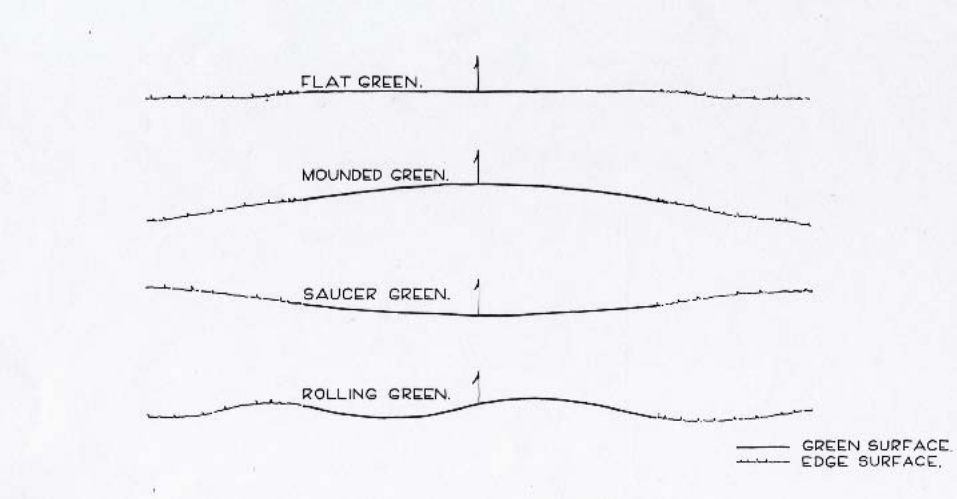



**Figure 14:** Green Topography-Profiles. (Ferlow 1959, 123)

The green area is the end point of the golf hole. This area is critical in that the golfer must leave the golf hole feeling fulfilled, and wanting to return. Depending on the character of the golf hole and the topography of the green area, there is the opportunity for the green to take many forms. (See Figure 14.) Green size, undulation, and placement is vital in retaining a golfer's interest, meaning that a green should not be as difficult if the golf hole is semi-challenging, and vice versa. The size of the green should be adequate to the character of the golf hole. A variation in pin placement should be considered to give the green longevity and variety in approach shots. Usually about three-fourths of a green's surface should be made available for pin placement. The slope of the green should be sensitive to drainage and blind shots, thus a green should not hold drainage, or slope away from the line of play. As an addendum to green drainage, any drainage outside of the green should be directed to flow around the green. There are

usually three types of green placements: a valley green, a hillside green, and a hilltop green. They are shown in figure 15 below:

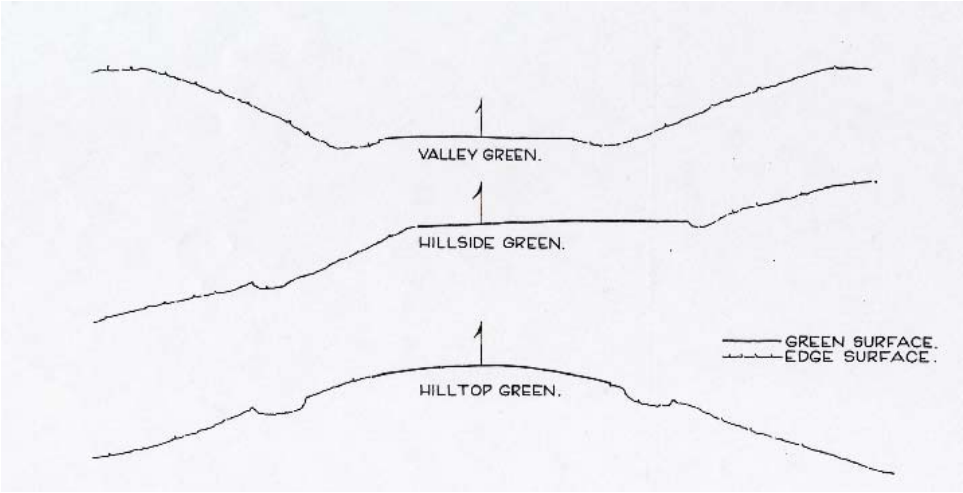



**Figure 15:** Green Types-Profiles. (Ferlow 1959, 124)

These green placements are critical in determining the type of approach shot to play. Thus, another factor in determining what type of green to select is discovering what type of approach shot the corresponding golf hole will demand. The following table gives suggestions for green size and dimensions in relation to shot lengths:

Green Size and Shape

| Shot | Minimum Green Size | Desired Green Size | Average Desired Green Dimensions Length | Width |
|---|---|---|---|---|
| Wedge | 4400 sq. ft. | 6200 sq. ft. | 74 ft. | 84 ft. |
| 9-iron | 4700 sq. ft. | 6500 sq. ft. | 76.5 ft. | 85 ft. |
| 8-iron | 5000 sq. ft. | 6800 sq. ft. | 79 ft. | 86 ft. |
| 7-iron | 5300 sq. ft. | 7100 sq. ft. | 81 ft. | 87 ft. |
| 6-iron | 5600 sq. ft. | 7400 sq. ft. | 84 ft. | 88 ft. |
| 5-iron | 5900 sq. ft. | 7700 sq. ft. | 87 ft. | 89 ft. |
| 4-iron | 6200 sq. ft. | 8000 sq. ft. | 90 ft. | 90 ft. |
| 3-iron | 6500 sq. ft. | 8300 sq. ft. | 93 ft. | 90 ft. |
| 2-iron | 6600 sq. ft. | 8600 sq. ft. | 96 ft. | 90 ft. |
| 5-wood | 6800 sq. ft. | 8600 sq. ft. | 96 ft. | 90 ft. |
| 4-wood | 7100 sq. ft. | 8900 sq. ft. | 99 ft. | 90 ft. |
| 3-wood | 7400 sq. ft. | 9200 sq. ft. | 102 ft. | 90 ft. |
| 2-wood | 7700 sq. ft. | 9500 sq. ft. | 105 ft. | 90 ft. |

**Table 15:** Green Size and Shape. The suggested green size and shape for various shot lengths. (Ferlow 1959, 131)

There are generally four types of approach shots to the green: the lob shot, the running shot, the bump and run shot, and the pitch shot. The entrance to the green is the deciding factor to determine the type of approach shot to take. This entrance is usually the narrowest end of the fairway that connects itself to the green. The fairway can attach itself to the green in relation to the left, right, or center of the line of play. Though the entrance to the green can assist the golfer if used correctly, the green of some golf holes have no entrance at all and is completely surrounded by hazards. These greens are called island greens.

The obstacles that add strategy and interest to the golf holes, typically called hazards, appear in two forms: natural and man-made. The natural hazards are just as such, being they are derived from native elements and material that have been strategically manicured to cater to the character of the golf hole. The man-made hazards increase the challenge of the golf hole. They generally appear in the form of bunkers, sand traps, ponds, and landforms, like drop-offs or pits. The bunker and sand trap are the most popular form of man-made hazards. (See Figure 16.) These sand contained elements differ via its adjacent landform obstacle. The mound, or “cop” (Ferlow 1959, 140) is the

bunker's adjacent obstacle, and the "overhanging lip" (Ferlow 1959, 140) is the sand trap's adjacent obstacle. The placement of the hazards should be considered initially when contemplating the placement of the tee and green, thus a hazard is just as significant.

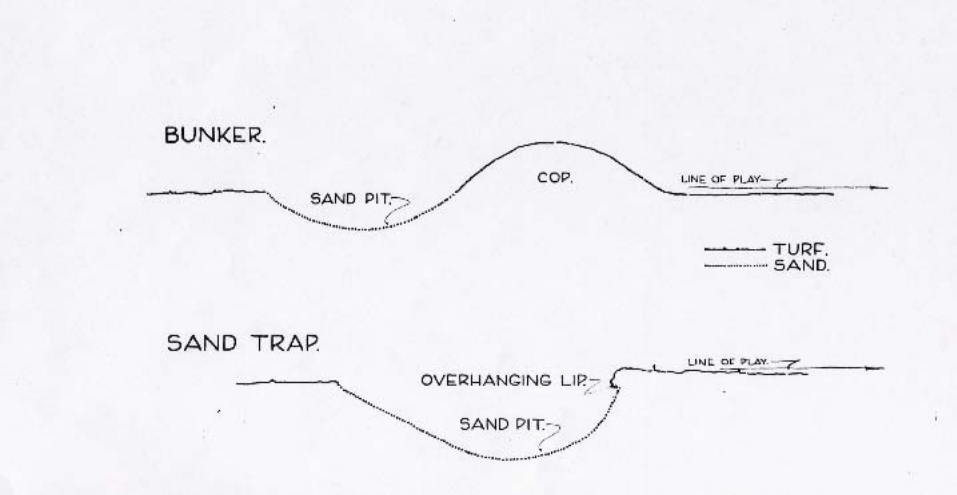



**Figure 16:** Bunker Types-Profiles. (Ferlow 1959, 140)

Generally, there is two types hazards: the fairway hazard and the green hazard. The fairway hazards usually begin at approximately two hundred and fifty yards from the back of the tees. If the fairway hazard is a man-made bunker, the pit is usually shallow in depth, but the closer the bunker is to the green, the deeper the pit of the bunkers. The green hazards are usually inclusive to sand. These hazards are developed accordingly so that a golf ball does not pass through it, thus constructing a green hazard that does not fulfill its purpose would result in a useless hazard. There are four general types of green hazards that are selected according to the character of the golf hole. (See Figure 17.) These green hazards are one of many elements that assist in determining the types of approach shots to be taken. All hazards have a responsibility to punish the low handicap golfer without equally punishing the high handicap golfer. They also have a responsibility to serve as a safety for awkward shots, and as a buffer to other golf holes and other design features.

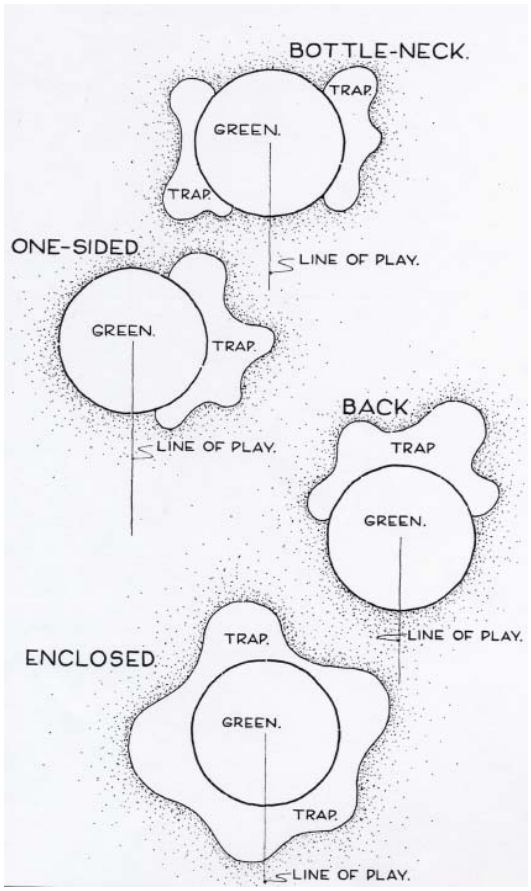



**Figure 17:** Trap Alignment Around Greens. (Ferlow 1959, 137)

Plant materials on a golf course appear in three main forms: trees, shrubs, and turf. The trees and shrubs have a capacity to enhance the visual quality of a golf course. When possible, the existing vegetation should be preserved to connect the golf course with its residing landscape. These elements not only have an important aesthetic quality, but an equally important functional quality as well. They serve as a buffer to prevent shots from leaving, or entering, a golf hole. In most cases, a massive group of trees and shrubs are strategically placed near the landing areas and greens. (See Figure 13.) For dogleg golf holes, these elements are placed along the outer area of the line of play's obtuse angle to obstruct long shots. For the inner obtuse, these elements are strategically placed to constrain the golfer from cutting corners and playing the golf hole correctly. The trees and shrubs also add an appealing nature to the architectural elements on the golf course, while simultaneously serving as hazards. The role of these natural elements may vary depending on the golfer.

Turf is the other form of plant material. It is safe to say that this element is possibly the backbone of the golf course. If not for good turf, a golfer's playing experience could suffer tremendous changes. Initially, it is the heights of the turf that allow the golfer to perform his/her variety of shots. The consequence of poor turf would result in having little to no control over a golf shot. The types of grasses used for the golf course will vary, but most golf courses will choose a species that is traditionally used in its local area. "The northern courses generally use a bent grass green area and a mixture of bent, fescue, and Kentucky blue grass for the tees and fairways. The southern and western courses add to these grasses their own hardy species of Bermuda, centipede, blue couch, and Manila grass, though bent grasses are still utilized for the greens." (Ferlow 1959, 142)

The layout of the golf course should be a stigmatic art form to the landscape, but a few basic rules should be met. Golf courses may vary in its total number of golf holes, but a few elements that are consistent. The patterns for a series golf holes are the linear, the single loop, and the double loop, or figure "8". The linear golf holes travel from one point, back to the original point, with the initial trail of golf holes parallel to the returning trail. The single loop travels out into the landscape usually forming a semi-circular pattern. The double loop, or figure "8", pattern usually applies to an 18-hole golf course, but can be applied to a nine-hole course as well. The first golf hole should advance to the west, and the last golf hole should advance to the east (usually at an 18-hole golf course), thus the golfers should not face the rising and setting sun for majority of the day. The first golf hole should also be an easier and fairly long par four. This will reduce congestion around the starter area, and allow golfers the opportunity to play a course sooner. Within a set of nine holes, there are usually two par 3's, two par 5', and five par 4's. The golf holes are distributed evenly within a set; thus, the average par of a set of golf holes is 36 with an average yardage of 3,100 to 3,400 yards. The table below outlines the formality of a set of golf holes, along with the par, average yardage, and character:

Average Course Layout

| Hole | Yardage | Par | Character and Purpose |
|---|---|---|---|
| 1 | 370 | 4 | Fairly long, straight or nearly so, not too difficult; to get players away more quickly. |
| 2 | 490 | 5 | Same object, but more difficult; three good shots. |
| 3 | 380 | 4 | Same object; difficult; green well guarded. |
| 4 | 190 | 3 | Test of 2-iron or 3-iron play. |
| 5 | 350 | 4 | Test of short iron play, difficult near green. |
| 6 | 500-550 | 5 | Test of short iron play, difficult near green. |
| 7 | 380 | 4 | Hard two shot hole, difficult near green. |
| 8 | 145-183 | 3 | Test of 5-iron or 6-iron play. |
| 9 | 360 | 4 | Difficult hole to finish out nine. |

Total yardage: 3165 yards to 3253 yards.

**Table 16:** Average Course Layout. Outline for an average 9-hole set of golf holes. (Ferlow 1959, 137)

A golf hole can be categorized into one of four types of design concepts: heroic, strategic, freeway, and penalistic. (See Figure 18.) These four basic concepts are the building blocks of a well-designed golf course. All of these concepts should be incorporated into a design to stimulate an interest and provide a variety of play. Thus, a course with only one or two of these concepts in its entire course would result in a dry, redundant golf course.

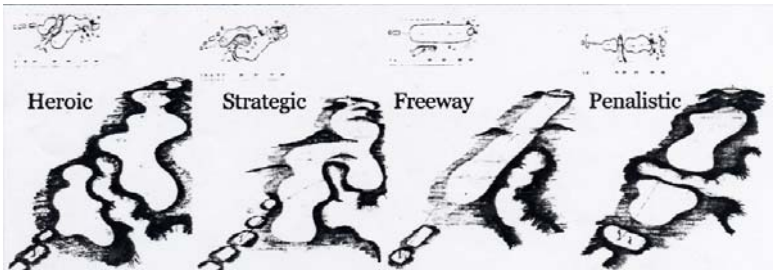



**Figure 18:** The Four Basic Design Concepts. (Hurdzan 1996, 131-134)

In the make-up of a “heroic” golf hole, achieving the high-risk shot will allow a high reward for the golfer, usually offering an easy shot to the green. On the other hand, choosing to take the low-risk shot, will lead to a low reward for the golfer. These “risks” are usually inclusive to a large body of water, sand, or some aggressive hazard to increase the par of a golfer’s score. The “rewards” are distributed in the form of shortened distance and difficulty to the green. The heroic golf holes are usually played in the latter part of the round, and take longer to play.

The “strategic” golf hole is similar to the heroic golf hole, in that a decision is initially determined on how to play the hole. There are multiple routes to the green, two at a minimum, thus more land is required for this golf hole. The first hazard is usually the most aggressive, thus forcing the golfer to make a decision from the tee. The hazards that follow are less severe, usually serving as guides to the green. The ideal strategy to play this hole is to get the ball as closes as possible to the first hazard, thus allowing a closer shot to the green.

The “freeway” label of a golf hole can be accredited to Dr. Michael Hurdzan, who calls these golf holes simplistic in design and play. These golf holes are usually found on municipal courses, designed by individuals or groups that have little to no comprehension of golf course architecture. The primary function of this type of golf hole is to satisfy demand.

The last type of golf hole is the “penalistic” golf hole. This hole is inclusive to strategically placed hazards, demanding the golfer to use a distinct strategy. The purpose behind this golf hole is to contain the shots of poor golfers, and penalize the poor shots of exceptional golfers. The elements of this golf hole are narrow in form, which are inclusive to fairways and distance between hazards. By and large, little room for mistakes are a common trait for a penalistic design.

## APPENDIX C

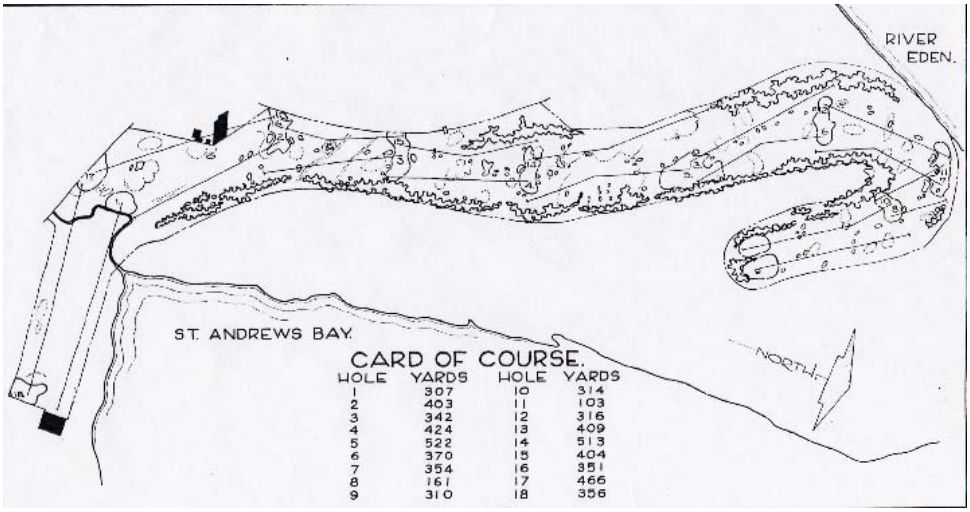
### THE EVOLUTION OF GOLF COURSES AND ARCHITECTS

The golf course, when designed correctly, can be an eloquent and piece of natural art with a great functionality. This natural art includes natural elements as a part of the strategy of the game, thus creating an immersed relationship between the golfer and nature. The functionality is inclusive to technical course operations, and accommodating golfers of all skill levels. The art and functionality of golf courses, as well as the architects, developed as the popularity of the game increased. Nevertheless, in the beginning, nature served as the primary architect.

Golf Course Architecture dates back to the early fifteenth century, during the reign of Queen Mary of Scots. “Old” Tom Morris, the first known golf course architect, began to morph laying out golf holes into a form of architecture. The earliest golf course to date is St. Andrews of Scotland. (See Figure 19.) This golf course serves as the “cradle” of golf, in which the basic visual and functional values of all golf courses originated from St. Andrews. Elements like the use of eighteen golf holes, the use of hole-routing loops, and the use of sand bunkers, are just a few elements form St. Andrews. The profession of golf course architecture began as a teacher-apprentice relationship that branched throughout England, and later into the United States. Harry S. Colt, an enthusiastic designer, and apprentice of “Old” Tom Morris. Colt played a critical part in the history of

design, because he branched out from St. Andrews to other golf course architect apprentices that impacted the evolution of golf courses. Colt later created a golf school for players; few developed into designers that impacted he profession. Two architects in particular gave important additional facets to golf course design. The two architects that branched out from Colt were Dr. Alister MacKenzie and Mr. Donald Ross. These two exceptional designers also had contrasting approaches to golf course design. Dr. Alister MacKenzie was a functional designer who considered many possible aspects golf course design. MacKenzie would make an element on the golf hole also serve a functional purpose. For example, he made numerous mounds serve as a hazard zone, but also causing it to serve as a means for drainage. Mr. Donald Ross on the other hand, was an

enemy of the golfer, whose approach to design was artistic; to become more intimate with the land. For example, Ross designed different surprise traps, like hidden bunkers and low backdrops behind the greens. Both approaches to golf course architecture, as well as other architects and ideas, took the profession and the sport through various phases, thus dividing the total evolution of golf course architecture into “Eras”.




| HOLE | YARDS | HOLE | YARDS |
|---|---|---|---|
| 1 | 307 | 10 | 314 |
| 2 | 403 | 11 | 103 |
| 3 | 342 | 12 | 316 |
| 4 | 424 | 13 | 409 |
| 5 | 522 | 14 | 513 |
| 6 | 370 | 15 | 404 |
| 7 | 354 | 16 | 351 |
| 8 | 161 | 17 | 466 |
| 9 | 310 | 18 | 356 |

**Figure 19:** The Golf Course at St. Andrews. The routing is more linear with parallel golf holes and shared greens. (Ferlow 1959, 42)

The first era, from 1414 to the mid-1700s, is the earliest known version of golf and golf course design. The location of land resided on the coast of Scotland, in which nature was designing a primitive form of “golf links”. “Links” were described as an accumulation of sandy deposits along the coast left by the tides of the ocean. There were no tees, fairways, or greens. Instead, there was a location to start a golf hole, and, according to legend, a rabbit hole that ended the golf hole. The land in between was natural and unaltered by man, which dictated where the golf hole would be located. The land was open space and the hazards were natural as well. These hazards and did not include trees, ponds, or lakes. Instead, these hazards were inclusive to natural roughs, and pits created by wildlife and elements of the weather. The length of the course ranged from five golf holes to twenty-five golf holes, in which eventually the golf course at St. Andrews set the guideline for a standard number of golf holes; eighteen. From the course at St. Andrews, man began to alter the playing field of the golf course in order to create a more challenging and aesthetically appealing golf course.

The second era, from the mid-1700s to 1850, can be summarized and represented by two elements; publicized golf matches and the “Gutter-Percha” golf ball. These elements began to popularize the sport and introduce it to the European world. The development of the British railway system brought visitors from various locations to attend golfing events, and the golf ball added an interest to the game. Made from the gutter-percha tree, this golf ball upgrade was more durable, could travel further, and was inexpensive.

The third era, from 1850 to 1900, began to introduce golf to the rest of the world. This era also upgraded the golf course St. Andrews and reared the first golf course designer. As the game increased in popularity, the demand to request golf course designers to lay out new golf courses also increased in popularity. The services of the early golf course designer were entirely on-site, and were completed in less than a week. These services were inclusive to routing the golf holes, selecting putting green locations, and upgrading existing golf courses. These courses required little construction, as these early golf courses complemented the contours of the natural landscape. The attempt to produce golf courses inland resulted in poor quality with the exception of golf courses built on natural linksland. This result was due to poor soil quality and limited work on the designer’s part. The greens were flat, the fairway bunkers were rectangular, and the turf was difficult to care for. These qualities deemed the inland golf courses boring with little architectural value.

The fourth and fifth eras, which began to increase the architectural value of golf courses, occurred around the same time but in different locations. The fourth era, from 1900 to 1914, was coined as the “Heathland” era. The locations of these golf courses in this era were fifty miles south and fifty miles east of London, England. With the exception of heavy vegetation, the heathlands were similar in natural characteristics to the linksland courses. The pioneers in developing this new form of successful golf course architecture were inclusive to Willie Park Jr., J.F. Abercromby, H.S. Colt, and W. Herbert Fowler. For the first time, golf course architecture was approached as a profession and not a hobby. These courses were successful because more time and research were put into the development. The architects also became more sensitive to render golf courses as a natural art form, and not just a basic playing field.

The fifth era, from 1888 to 1905, was the introduction of golf to the United States. These golf courses were developed to fulfill the popular demand, thus deemed limited in design quality. Nevertheless, there were, four golf courses that influenced other golf courses to follow. These four golf courses were inclusive to good design principles and philosophies: Long Island's Shinnecock Hills, National Golf Links, and Garden City; and Boston's Myopia.

Era six, 1905 to 1945 (Golden Age in Golf Course Architecture in America), and era seven, 1945 to present, addresses the more modern approach in golf course architecture in the United States. Because of the content of the research, these two eras were amalgamated and divided by important events and golf course architects that impacted the development of golf course architecture in the United States.

The Golden Age of Golf Course Design is coined with Dr. Alistar MacKenzie's vision to continue the tradition of St. Andrews. His motive in the United States was to stray away from penalistic design, and return to the strategic alternative routes harbored by St. Andrews. (See Figure 20.) Dr. MacKenzie's publications in 1920 and 1933 addressed the issues of penalistic design and returning to the approach of St. Andrews. Hazards were also an issue of Dr. MacKenzie. He loathed the fact of penal bunkers used in municipalities, resulting in a frantic round of golf. Dr. MacKenzie reiterated the fact of providing as many alternate routes to the green as possible. He felt that a true golf hole could be played with only a putter.

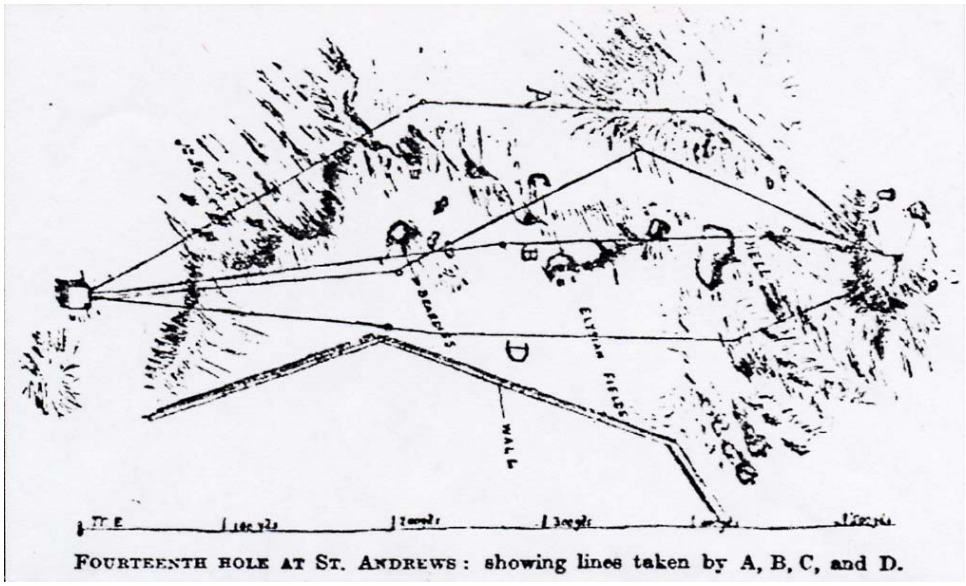



**Figure 20:** The Fourteenth Hole at St. Andrews. This design offers multiple routes to the green. (MacKenzie 1920, 107)

Another golf course architect with a similar vision to create multiple routes to the green was Mr. George C. Thomas. His work was mostly on the West Coast of the United States. Although Mr. Thomas published *Golf Architecture in America* in 1927, his is main contribution to the profession was coined with site planning. Dr. Mackenzie was coined with having the clubhouse serve as a beginning and returning point for nine holes of golf. Mr. Thomas upgraded this concept by placing the clubhouse area from the highest point on the site, if not the center, to the center of the site. This would allow more beginning golf holes to be played away from the rising sun, and finishing holes away from the setting sun. Mr. Thomas also proposed incorporating a practice area and parking lot near the clubhouse area.

On the contrary, Mr. Donald Ross was a manufacturer of penal golf course design. His courses were inclusive to great elevation changes, domed greens, drop offs in elevation from behind greens, uphill golf holes, and penal hazards. Mr. Ross' motive was to make the golfer severely pay for a mistake on the golf course. The Great Depression took a great toll on Mr. Ross' courses, as the maintenance costs were too high to maintain course upkeep. As a result, many bunkers and other hazard were removed, thus later coined the name "freeway golf" by Dr. Michael J. Hurdzan (1996).

The Great Depression and World War II took a great toll on the golf course design profession, placing many golf course architects out of business. Two architects

that managed to survive through this period and temporarily carry the profession were Mr. Robert Trent Jones Sr. and Mr. Donald Ross. The work possessed by these two architects was at a minimum, but the end of the war brought on a new change. As a result, golf course architecture from the 1930's to the early 1970's provided improved construction techniques and construction equipment, as well as technology trends in the golfing industry. Nevertheless, the trend of golf course architecture began to increase along with the construction boom. Many other development professionals attempted to construct standard golf courses to fulfill the demand, thus the freeway method of design became a popular and convenient method for producing golf courses. Many of these courses today are either military or municipal golf courses, and serve as a home to the beginner golfer. Another cause for the freeway style of golf courses was the short budgets provided to develop these courses. As a result, creating a golf course with minimal maintenance was apprehended. The mid-point of this time frame, close to the late sixties to be exact, harbored a distinct aesthetic of golf courses; long tees, wide fairways, large greens, and bunkers that were insignificant to the strategy of play. As this time frame came to a close, Mr. Robert Trent Jones Sr. guided the golf course development industry with his own distinct style; heroic in concept, long tees, wide fairways, large greens, and bunkers to challenge the long hitters. Mr. Jones eventually developed nearly 500 golf courses during his professional career.

Mr. Robert Trent Jones Sr. continued to heavily influence golf course architecture in the 1970's and 1980's. Many architects imitated Mr. Jones' style, but other architects shied away from catering to the long hitter. Mr. Pete Dye is one of these architects. Inspired by the old Scottish courses, Mr. Dye incorporated the penalistic approach to his golf courses. Some common traits of Mr. Dye's courses were to intimidate the golfer with exaggerated hazards, like railroad ties and massive bunkers, creating the "Stadium Golf" concept (with former PGA Tour Commissioner Dean Beman). Mr. Dye's success began to earn imitators of his work. Mr. Jack Nicklaus' early courses closely imitated Mr. Dye's courses with the exception of incorporating a longer course and an easy approach shot to the green (for a right-handed fade shot).

As far as contemporary golf course architecture is concerned, this may be a transition period between eras due to the advancement of computer technology. Where

one era is about to end (developing golf courses using the traditional methods), one era is about to begin (computerized golf course architecture). Designers of today are placed in one of two major categories; to use computers in their design processes or not to use them. Designers of today continue to seek strategic inspiration from architects of the Golden Age of Golf Course Design, but are searching for more efficient and productive methods to upgrade the profession as well. The works of Dr. Alister Mackenzie and Mr. Donald Ross are two popular strategic resources for the modern golf course architect, while the publications of Dr. Michael Hurdzan (*Golf Course Architecture: Design, Construction, and Restoration*), and Mr. Geoffrey Cornish and Mr. Robert Muir Graves (*Golf Course Design*) serve as good modern technological resources. The quality of golf course development have been exceptional in the past couple of decades, possibly due to combinations of knowledgeable clients, advanced technology in the profession, funded research to advance the profession, and architects educated on various aspects of the profession. As the computer age blossoms into its full potential, there will be more trends of integrations of this newly acquired technology into the profession. The Internet is an exceptional resource to seek information on the golf course design profession, and the incorporation of computer-aided design programs (CAD) reduces the work time of the architect to create drawings. The incorporation of virtual reality is a good method to show clients their development before it is even built, thus golfing in virtual reality could possibly be the replacement of traditional golf as well.

One current trend that is being approached and treated is the incorporation of children on golf courses near urban centers. Currently and in the past, the incorporation of expensive daily green fees are set at these golf courses. The golf courses are exceptional in aesthetics and functionality, thus charge at a high rate to cover the development and maintenance costs. Unfortunately, these charges are too high for the youth, which leads them to find alternative methods to play the game. Some organizations that are attempting to approach this problem are the Hook-a-Kid-on-Golf Program, the Jack Nicklaus sponsored Drive, Pitch, and Putt competition, various camps sponsored by other professional golfers, and The First Tee Program of the Professional Golfer's Association. These entities not only offer programs for the youth, but also attempt to provide facilities for this increasing trend of golfers.

The future of golf course architecture appears to be very interesting and exciting for both the architect and the player. The technology trends of golf are becoming better, and there are more attempts to include and attract all types of golfers to the sport. The days of charging high architectural fees will soon diminish due to the ease of accessibility to golf course development information. This will allow the client to be more knowledgeable about the profession, thus aware of various phases of the development process. The largest impact on the golf industry will be incorporation of computer technology to the profession, weather it be design related or facility related. Although the initial design process may continue to resort to ink and mylar, the potential impact of tomorrow's trends will popularize the golf industry like never before. Including the youth to the golf industry is tapping into an economic resource ready to blossom. Children of today have economic resources that were unheard of decades ago, thus many business are profiting from this newly acquired resource. Children are always seeking trendy activities in which they can spend their currency and fun. The success of Tiger Woods with his love for, as well as connection to, the youth have amended the popularity of youth participation in golf as well. Furthermore, golf course architecture for the youth may be popular enough to reign as the next "era" of golf course development.

# APPENDIX D

## COMMUNITY PARTICIPATION

Why do we need people to participate in gaining ideas to develop the community? This question alone should be enough to attract participants. “Participatory research is emerging as a self-conscious way of empowering people to take effective action toward improving conditions in their lives.” (Park 2001, 1) The potential of developing a junior golf facility affects a wide range of individuals, as well as the economic and political structure. A golf facility of this type would create more jobs for the community and also create a sense of pride for these communities. This development could potentially become a bridge between the major stakeholder and the community. The community will have a sense of ownership knowing that they can make a difference by directly consulting with the major stakeholder. The major stakeholder will also benefit by being directly informed of community activities as it relates to their development, thus increasing the value of the development. The way to persuade a community into adopting a project is to involve them. This can be done through numerous ways, like surveys, forums, and town meetings, but the most effective procedure is a design charrette.

The charrette gains the ideas of the participants and quickly integrates them into the form of a design. This is a good tool in discovering what others want to experience. The best example of gaining participation is in the article “Citizen Participation in Brunswick, Maine”. The state of Maine put into effect its largest planning law ever. As a result, each of Maine’s four hundred-plus towns had to create a plan based on their rate of growth, and the citizens took over most of the plan making decisions. The City of Brunswick residents made citizen participation history for their community by hosting the most successful citizen charrette the state ever had. As a result, the plan was implemented with great public support and one hundred percent citizen input. The charrette was definitely a model to be used for other communities.

Pride, self-respect, and courtesy are elements that allow a community to function, and prosper. These elements are also enhanced when a community displays an interest, thus taking part in a development that will benefit them. For example, roadside maintenance, courtesy of the community’s juvenile delinquent program, is a good way to

keep the community looking clean and respectful. The life of a development usually depends on the amount of care the community has for it. Community involvement is closely related to, if not overlaps, participatory research in that it takes the creativity and enthusiasm of the potential user in order for ideas to become a reality. Although a community may enthusiastically want to become involved in the planning processes, there are some lessons to be learned that should be highly considered in order to achieve a productive charrette. The researcher must have plenty of food for the participants; use a variety of methods to gain input; document, verify, and ask for feedback; do not assume results; have faith in the public; and remember to have a good time.

Community involvement for the golf course prototype will prosper through various programs to keep the course functioning. Various volunteer programs and community activities will give the potential golf course many years of enjoyment. For example, one way is to increase the children's involvement along with incorporating significant recommendations overlooked in the initial steps. Once the ideas and data have been collected, they should be compiled and presented to the children for feedback. After the children have agreed on an acceptable design, the implementation process should begin. They should also be involved in the details and light work involved in building the course when applicable. When the golf course is implemented, various youth programs should be included in the formula. For example, some of the golf course jobs can be performed by responsible youths, like clubhouse duties, course starter, and maintenance duties.

## APPENDIX E

**The First Tee Interview**
*Contact:* Brandon Johnson, Design Coordinator
(904) 285-3700
Ponte Vedra Beach, FL
13 Feb 2001

1. ***How was this program first conceived?*** In November 1997, the major golf organizations met in New York City and launched a nationwide youth golf initiative. This program would help kids that have not been exposed to the game of golf gain better access and affordability to the game.

2. ***What are the benefits for teaching golf to kids?*** The overall benefit is the life skills component. Kids can learn honesty, integrity, respect, etc. from playing golf. These skills can be transferred into everyday life.

3. ***What are some of the special design features of these golf courses?*** What must be present to attract kids? The facilities need to be fun and rewarding. Also, the facilities need to encourage growth. Some courses have two or three courses in one, with short and long golf holes. There are holes with different difficulty levels so that the kids can grow and develop as they get older.

4. ***About how many golf courses does The First Tee have?*** As of January 24, 2001, there are 49 operating facilities.

5. ***What age range do you serve?*** Ages 7 to 17.

6. ***One objective of The First Tee was to develop 100 affordable and accessible golf facilities by the end of the year 2000. Did you reach that goal?*** Yes, the goal was met and surpassed. Now, the phase two plan objective has been put into place. New contact for objectives: Amy Caruso.

7. ***Now that there are First Tee facilities all over the U.S., has the original purpose of providing affordable golf facilities to kids of all different races and economic backgrounds been fulfilled?*** Yes, the purpose has been fulfilled. The goals and objectives are continuing to be refined. Still, continuing to serve kids that do not have access to golf. They will be able to see the effects later down the road when the seven-year-olds in the program are seventeen, and are faced with major life decisions such as college.

8. ***Could you tell me more about the curriculum and certification process?*** New contact: Diedrich Holmes

**Jim Ager Memorial Junior Golf Course Interview**
*Contact:* Jay Carstens, Superintendent
(402) 483-7785
Lincoln, NE
08 Oct 2000

1. ***What do you think a junior golf course should entail?*** Safety, ease of play, and whatever makes it fun for the golfer. Also, don't call it a junior golf course. Non-junior golfers will misinterpret this title as a golf course built exclusively for kids.

2. ***How should it be different from a regular course?*** In order to speed up play, the first golf hole should not be long. There should also be a practice area and an oversize putting green.

3. ***What are the important components of a golf course?*** Etiquette, knowledge of the elements on a golf course, knowledge of the course terminology, and an adequate amount of signage.

4. ***What programs and user groups mostly use the facility?*** Schools, seniors, people who work on their short game, camps, and families.

5. ***How does golf benefit young people?*** It gives them patience, helps to build self-character, self-worth, and control. It also teaches respect for others.

6. ***What would be the best age focus for the design charrette?*** Kids start as early as three years of age, so any age between three and eighteen. The charrette should be structured differently though. The basic parts of a golf course should be explained to them first. Then their ideas will make more sense.

## APPENDIX F

## Golf Questionnaire

Thank you for agreeing to participate in our survey about golf! In this questionnaire, you will be acting as a designer by giving your personal opinions about different areas of golf course design. Please answer as many questions as you can. If you don't understand a certain question, you may skip it.

*Please help us to group your information accordingly by answering the following questions:

Gender (circle one): Male Female

Age: _____

Nationality (circle one): American International
If International, what origin: _____

Are you disabled? (circle one) Yes No

How well do you know the game of golf?
(circle an area on the line below that best measures your knowledge):

•----------•----------•----------•----------•----------•

not well at all not very well somewhat well fairly well very well

Do you play golf? (circle one) Yes No

If yes, how would you rank your skill level? (circle one)

beginner intermediate advanced

*The next series of questions will explain the different elements of a golf course and will ask for your personal opinions:

What sort of things would you like to see in a clubhouse? (Example: Arcade, Candy Shop, etc.)

_____

The “tee marker” is a system that calculates “par” by setting the yardage of each golf hole to your skill level. “Par” is the average strokes it takes for you to get the ball in the hole. Tee markers are usually divides by colors. Can you think of any other way to divide them up?
(Example: Cartoon Characters, Animals, Countries, etc.)

_____

What type of golf cart models (if any) would you like to see on a golf course?
(Example: Sports Car, Airplane, Boat, etc.)

_____

How would you make the driving range fun to play?

_____

The “hole marker” is usually a sign that shows how the golf hole looks. It also includes yardage, the golf course logo, and the hole number. What else could be added to attract your attention?

_____

After you are done playing on the golf course, how do you feel?

_____

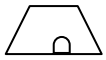
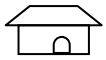
What do you think could make the golf course look and feel more natural?

_____

If you could add or change something to a golf course to reflect your heritage, what would you do?

_____

Which building shapes do you like best? (circle one)

The “tee” is the spot where you begin to play a golf hole. In the spaces below, please rank the elements of the golf tee that you feel can make the game fun.
(1 being the best, and 3 being the least)

___Views ___Size ___Shape

The “green” is the area where you try to put the ball in the hole. In each pair below, please check the space of the “green” element you like best.

___Flat ___Fast (Ball Speed) ___Large
___Rolling Mounds ___Slow (Ball Speed) ___Small

The “bunker” is the area filled with sand that tries to stop the golf ball from reaching the green. The shapes of the bunker also add to the beauty of the golf course. If you were playing a golf hole, which bunker patterns would you like to see? (please rank)

___  ___  ___  ___ 

The “water hazard” serves the same purpose as the bunker. Please choose your favorite water feature by ranking the elements below.

___Fountain ___Stream ___Waterfall ___River ___Pond/Lake

How much water would you like to see on a golf course? (circle one)

none a little somewhat a lot

I would like for a golf hole to be: (check one)

___surrounded by trees so I can only see the golf hole I’m playing.

___open so I can see other golf holes as well as other views.

How much do you like to walk on a golf course? (circle one)

none a little somewhat a lot

What is your favorite feature of a garden? (please rank)

___Smell ___Looks ___Sounds ___Life Forms ___Interaction

On an average visit, how many golf holes would you play? (circle one)

1-5 6-9 10-14 15-18

How long do you think the 18 golf holes should be? (circle one):

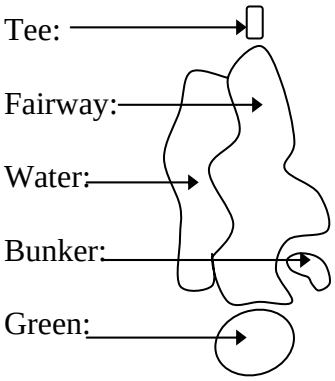
all short (up to 250 yards) all long (250+ yards) some short and some long

If you had a choice to play golf anywhere you wanted all the time, where would you play? (circle one)

downtown outside of town (countryside) neighborhood park

From the blank space on the right, draw your favorite ultimate golf hole using a tee, fairway, bunkers, water, and a green. When you're done, please give a short reason for your design.

Example:




Explain) I like water and sand.

Thank you for completing our questionnaire. It was very much appreciated. You have helped us take one step closer to creating a golf course just for you!

## APPENDIX G

Group #_____

## Design Charrette

**AGENDA**

**9:35** **Welcome and Introduction**

Project overview

Ground rules and reminders-

*Every contribution is worthwhile

*Be respectful

*Allow everyone a chance to participate

*Stay on track and follow instructions

*This is for you, so make it the way you want

**9:45** **Identify Elements and Define Terms**

Refer to pictures and diagram-

1. Tee
2. Green
3. Fairway
4. Rough
5. Bunker
6. Water
7. Other fun elements

**10:00** **Break in to Groups**

**10:05** **Design Hole**

You will design one hole of a golf course

Draw the elements in order from the list above

Be creative and imaginative

Remember the ground rules.

**10:35** **Discussion Within Groups**

What are three cool and unique things about your design?

1.

2.

3.

Choose one or two people from your group to discuss your design with the class.

**10:45** **Group Presentations and Reflection**

Present your designs

Reflect on the charrette

## APPENDIX H

## CAVE Questionnaire

Thank you for agreeing to participate in a virtual experiment about golf! In this experiment, you will be acting as a designer by giving your personal opinions about different areas the golf course. Please answer the initial questions as well as you can. The questions on the second page will be answered during the experiment.

*Please help us to group your information accordingly by answering the following questions:

Gender (circle one): Male Female

Age: _____

Nationality (circle one): American International
If International, which nation: _____

Are you disabled? (circle one) Yes No

How well do you know the game of golf?
(circle an area on the line below that best measures your knowledge):

•----------•----------•----------•----------•----------•

not well at all not very well somewhat well fairly well very well

Do you play golf? (circle one) Yes No

If yes, how would you rank your skill level? (circle one)

beginner intermediate advanced

*The next three questions will ask for your personal opinions on the four different sequences of two types of golf courses: a traditional junior golf course and a proposed junior golf course. The functionality of the sequences will be initially explained before the virtual walkthrough for a better understanding of what to comment on. You may include more than one answer in your comments. Please write your answers on the line next to the number of the sequence you just experienced (Ex. Line 2 for sequence #2).

Sequence # 1: Clubhouse
Sequence # 2: Practice Facility
Sequence # 3: Hole Structure
Sequence # 4: The Course

Course #1:

What do you like about this area?

1)_____

2)_____

3)_____

4)_____

What do you dislike about this area?

1)_____

2)_____

3)_____

4)_____

If you were the designer, what would you do to make this area better suited for kids like yourself?

1)_____

2)_____

3)_____

4)_____

Course #2:

What do you like about this area?

1)_____

2)_____

3)_____

4)_____

What do you dislike about this area?

1)_____

2)_____

3)_____

4)_____

If you were the designer, what would you do to make this area better suited for kids like yourself?

1)_____

2)_____

3)_____

4)_____

After experiencing both golf facilities, which one do you prefer? Why?

_____

Thank you participating in the virtual experiment. It was very much appreciated. You have helped us take one step closer to creating a golf course just for you!

# APPENDIX I

## Outline of Protocol for IRB Request for Exemption

## "Virtual Golf Course for Junior Golfers"

**Justification of Project**

There will be a selection of junior golfers of various age, skill, and social levels, and also of various ethnic backgrounds. They will be interviewed to obtain requests and demands for their custom golf course. A golf course will be designed to fulfill their demands, and a computer model will be created in virtual reality. The design will then be experienced either through a head-mounted display (HMD) or in the CAVE, using a combination of design guidelines given in research literature, and the subject's interview. Comments and results from each golfer will be recorded, then, pre-/post-data will be compiled and used to create an upgraded golf course in virtual environments.

**Procedures**

For each experiment, approximately 200 student subjects will be recruited. There will be four prerouted walk-through sequences. Taking one child from each background to represent his/her ethnic, skill, social, or age group will use the "sampling model of experimentation". A survey will be taken after each sequence to record comments and suggestions. Subjects between the ages of 5 and 18, and subjects of different genders will be accepted into the study.

Each experiment will have a slightly different length, but the basic procedures will be the same. Subjects will attend one session of approximately 1 hour in length. The session will include:

1. Read and sign informed consent form.
2. Fill out questionnaire on computer use, background, and experience with golf. (enclosed)
3. Read a set of instructions for the main experiment.
4. View the golf facility using virtual environment technology.

The specific technology used in the main experiment will be either the HMD or the CAVE. Subjects will be standing, and using 3D input devices to view the golf facility. For example, the first sequence will involve progressing from the entry of the golf facility, to inside of the clubhouse. The subject would see the facility as if he/she was coming to play a round. The second sequence involves progressing through the practice facility. Subjects will see some of the classrooms in the clubhouse, the driving range, and the putting green. The third sequence involves progressing through the front 9 of the golf holes that are designed to accommodate them. The fourth sequence involves progressing through the back of the 9 golf holes. The back 9 holes will have a different design concept form the front 9 holes. In all cases, subjects will be moving only in ways similar to real world movements; that is, turning the head, moving the arms, or taking a few steps in a given direction.

**Risks and Benefits**
There are possibilities of mild dizziness or nausea when using virtual environments. In previous studies, these have affected less than 10 percent of subjects, and effects have been minimal. Subjects will at no time use the VE equipment for more than 20 minutes continuously. They will be allowed to take breaks during the experiment and to quit the experiment if they feel dizzy or nauseous. See enclosed Informed Consent form for more information.

**Confidentiality/Anonymity**
Only the investigator will have access to the data. Number only on data forms and reports will identify each subject. When reporting data, only aggregate information and statistical analysis of the whole group of subjects will be published. See enclosed Informed Consent form for more information.

## Informed Consent

### Informed Consent for Participant of Investigative Project

Virginia Polytechnic Institute and State University

Title of Project: Virtual Golf Course for Juniors

Principal Investigator: Antonio D. Marshall

## I. THE PURPOSE OF THIS RESEARCH/PROJECT

You are invited to participate in a study of interaction in virtual environments. This research studies the design of a golf facility, and how various participants think it should be designed. This study involves experimentation for the purpose of evaluating and improving the design of junior golf courses.

## II. PROCEDURES

You will be asked to view a set of walk-through sequences using a virtual environment system. These sequences consist of progressing through a 3D environment. You will either wear a head-mounted display (HMD) or use the CAVE™. Your role in these tests is that of evaluator of the design. We are not evaluating you or your performance in any way; you are helping us to evaluate our design of the golf course. All information that you help us attain will remain anonymous. The time you take to do each sequence and other aspects of your interaction with the system will not be measured. You may be asked questions during and after the evaluation, in order to clarify our understanding of your evaluation.

You may also be asked to fill out a questionnaire relating to your background with such systems, and to take a short test of spatial ability.

The session will last about one hour. The sequences are not very tiring, but you are welcome to take rest breaks as needed. One scheduled rest break will be given to you about half-way through the experiment. You may also terminate your participation at any time, for any reason.

You will be given full instructions before every sequence. Because the sequences are only visual, attention through observation is a key factor. It is important that you understand the instructions before beginning each sequence. If anything is unclear, be sure to ask us questions.

## III. RISKS

The proposed experiments are straightforward tests of performance using standard virtual environments displays, trackers, and input devices. Participation involves standing on an enclosed platform (while wearing the head-mounted display) or on the floor (while using the CAVE or Workbench) and performing simple tasks. The physical components of these tasks are not stressful, and include head and body turning and pointing. All light and sound intensities are well within normal ranges. The only foreseeable physical risks are slight eye strain, dizziness, or mild nausea. There are no known mental risks.

If you experience any eye strain, dizziness, or nausea during a session, then between tasks please remove the HMD or step away from the CAVE or Workbench and take a rest break. The experimenter will explain when you can take such rest breaks. If you are having trouble with any task, please tell us. If dizziness or nausea becomes uncomfortable, you will be allowed to leave with no penalty.

## IV. BENEFITS OF THIS PROJECT

Your participation in this project will provide information that may be used to improve the design of junior golf courses for kids of all ages. No guarantee of benefits has been made to encourage you to participate. You may receive a synopsis summarizing this research when completed. Please leave a self-addressed envelope with the experimenter and a copy of the results will be sent to you.

You are requested to refrain from discussing the evaluation with other people who might be in the candidate pool from which other participants might be drawn.

## V. EXTENT OF ANONYMITY AND CONFIDENTIALITY

The results of this study will be kept strictly confidential. Your written consent is required for the researchers to release any data identified with you as an individual to anyone other than personnel working on the project. The information you provide will have your name removed and only a subject number will identify you during analyses and any written reports of the research.

The experiment may be videotaped. If it is taped, the tapes will be stored securely, viewed only by the experimenter (Antonio Marshall), and erased after 3 months. If the experimenters wish to use a portion of your videotape for any other purpose, they will get your written permission before using it. Your signature on this form does not give them permission to show your videotape to anyone else.

## VI. COMPENSATION

Your participation is voluntary and unpaid.

## VII. FREEDOM TO WITHDRAW

You are free to withdraw from this study at any time for any reason.

## VIII. APPROVAL OF RESEARCH

This research has been approved, as required, by the Institutional Review Board for projects involving human subjects at Virginia Polytechnic Institute and State University, and by the Department of Architecture.

## IX. SUBJECT'S RESPONSIBILITIES AND PERMISSION

I voluntarily agree to participate in this study, and I know of no reason I cannot participate. I have read and understand the informed consent and conditions of this project. I have had all my questions answered. I hereby acknowledge the above and give my voluntary consent for participation in this project. If I participate, I may withdraw at any time without penalty. I agree to abide by the rules of this project.

Signature _____ Date _____

Name (please print) _____ Contact: phone or address or

email address (OPTIONAL) _____

Should I have any questions about this research or its conduct, I may contact:

| | | |
|---|---|---|
| Investigator: | Antonio D. Marshall<br>Student, Architecture Department<br>email: anmarsh4@vt.edu | Phone (540) 951-2564<br>(540) 231-6386 |
| IRB Chair: | David M. Moore | Phone (540) 232-4991 |
| Advisors: | Dennis Jones (Arch.), Robert Schubert (Arch.), Dean Bork (Landscape Arch.) | |

cc: the participant, Antonio Marshall

**Biographical Sketch**
**Antonio D. Marshall**

**(702) 630-3715**

Biographical Sketch for the IRB

Antonio D. Marshall is a Graduate Student in Architecture and Technology Education at Virginia Tech, in Blacksburg, VA, where he has been enrolled since Fall 2000, and where he is a student of the Master of Science Programs. He currently holds two degrees from the University of Arkansas in Landscape Architecture and Computer Science.

His current research areas include gathering design ideas and concepts using various research tools inclusive to surveys, charettes, literature reviews, and interviews. He is currently using resources in Education, Architecture, Landscape Architecture, and Computer Science to gain valuable research for his thesis. He also plans to conduct experiments to gain design ideas from subjects' comments in immersive virtual worlds.

Mr. Marshall has traveled around the world studying Landscape Architecture, and has a wide range of knowledge about computing. In May of 2001, Mr. Marshall presented his research at an International Conference on Virtuality in Landscape Architecture, at Anhalt University, in Bernberg, Germany. Mr. Marshall is also an active member of his community. He serves as a Basketball Coach in Blacksburg, Virginia, and always gives some of his time to a local recreation center during his breaks.

# VITA

Antonio Devon Marshall
260 Henley Drive
Christiansburg, VA 24073
DOB: 1/21/1976

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## EDUCATION

**University of Arkansas** — **Fayetteville, AR**
Bachelor of Landscape Architecture — Spring 2000

**University of Arkansas** — **Fayetteville, AR**
Minor in Computer Science — Spring 2000

**Virginia Tech** — **Blacksburg, VA**
Master of Science in Architecture — Fall 2003

## EXPERIENCE

**Diverse Horizons, LLC** — 4/2003 - Current
President and CEO — Christiansburg, Virginia

**Piedmont Landscapes Inc.** — 9/2002 - 4/2003
Landscape Supervisor — Atlanta, Georgia

**Gill Miller Inc., Golf Course Architects** — 5/2002 - 9/2002
Intern — River Falls, Wisconsin

**Community Design Assistance Center** — 7/2000 - 5/2002
Graduate Assistant — Blacksburg, Virginia

**Disney's Eagle Pines Golf Course** — 1/2000 - 7/2000
Landscape Maintenance — Lake Buena Vista, Florida