A Rating System For Gaelic Football Teams: Factors That Influence Success

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Abstract

AIM: The current investigation aimed to create an objective rating of Gaelic football teams and to examine factors relating to a team's rating. METHOD: A modified version of the Elo Ratings formula (Elo, 1978) was used to rate Gaelic football teams. A total of 1101 competitive senior Inter County matches from 2010-2015 were incorporated into calculations. Factors examined between teams included population, registered player numbers, previous success at adult and underage levels, financial income from the GAA, team expenses and number of clubs in a county. RESULTS: The Elo Ratings formula for Gaelic football was found to have a strong predictive ability, correctly predicting the result in 72.90% of 642 matches over a 6 year period. Strong positive correlations were observed between previous success at senior level, Under 21 level, Under 18 level and current Elo points. Moderate correlations exist between population figures and current Elo points. Moderate correlations are also evident between the number of registered players in a county and the county's Elo rating points. CONCLUSION: Gaelic football teams can be objectively rated using a modified Elo Ratings formula. In order to develop a successful senior team, counties should focus on the development of underage players, particularly up to U18 and U21 level.

KEYWORDS: GAELIC FOOTBALL, ELO RATING SYSTEM, SUCCESS, SENIOR SUCCESS, UNDERAGE SUCCESS

Introduction

Gaelic football is an amateur sport that boasts higher attendances than any other sport on the island of Ireland (Sport Ireland, 2013). Inter County level is the highest level of competition in Gaelic games. At Inter County level in Gaelic football there are two competitive competitions, the National Football League and the Senior Football Championship. The Gaelic Athletic Association (GAA) is the governing body for Gaelic games, founded in 1884. Other Gaelic

games include hurling, camogie, handball and rounders. Each of the sports are played by both sexes with the exception of hurling and camogie. Hurling is only played by males while camogie is only played by females. Both hurling and Gaelic football are played on the same size pitches, with 15 players on a team. Matches are won by the team that accumulates more points. A point is awarded for hitting the ball over the opposition's crossbar and between the two uprights. When the ball is hit underneath the crossbar and between the two uprights, a goal is awarded. In both Gaelic football and hurling a goal is equivalent to three points. Below adult (senior) level, teams compete at different age groups across each Gaelic sport. The age groups directly preceding senior level are Under 21 (U21) and Under 18 (U18). In Gaelic football and hurling, particular interest is paid to U18 level as opposed to other age groups. The reason for this is most likely due to the fact that the U18 championship is run parallel to the adult equivalent. This means that U18 games are often played directly before an adult championship game in the same stadium. At any one time a player could be playing on an U21 team for their club and county, on the senior team for club and county and on a college team. This list can grow again when other sports are taken into account.

Ireland has four provinces; Leinster, Munster, Ulster and Connacht. Each of the four provinces host their own provincial championship. Currently thirty-three teams participate in the Senior Football Championship. This figure includes representative teams from New York and London as well as teams from the 32 counties in Ireland, excluding Kilkenny. London participate in the National Football League while New York do not. Both London and New York participate in the Connacht Football Championship. The representative teams of London and New York are made up largely of Irish emigrants who live in the respective cities. No youth teams from either New York or London currently participate in any of the major competitions at youth level in Ireland.

Research to date in Gaelic games has focused on injury incidence (Blake, Murphy, Gissane, & O'Malley, 2011; Murphy, Gissane, & Blake, 2012), anthropometric profiles (Collins, Reilly, & Morton, 2014; Kelly & Collins, 2015), technical performance indicators (Bradley & O'Donoghue, 2011; Carroll, 2013), and physical demands (Collins & Doran, 2015; Malone, Solan, Collins, & Doran, 2016; Reilly, Akubat, Lyons, & Collins, 2015). While anthropometric data and performance indicators can give an insight into Gaelic football, the data can be influenced by the level and quality of the teams that are sampled. The issue of team classification was raised previously by Carroll (2013). Carroll elected to split teams into two categories; top and bottom teams, top teams being counties that reached the All Ireland Quarter Finals twice in the space of the previous three seasons and bottom teams being teams who had not achieved this criteria. The limitation of this method are that teams are being judged on a small sample of games and the method is not reproducible as the number of "top" or "bottom" teams will change depending on the years selected.

Rating systems are currently used across numerous competitions and sports to differentiate between the quality of players and teams. As of November 2010, competitions in 159 international sports are recognised by the International Olympic Committee (Stefani, 2011). Of the 159 sports, 99 have an official rating system (Stefani, 2011). Rating systems can give an objective classification of a team's quality, based on previous performance (Lasek, Szlávik, & Bhulai, 2013). Ratings can be mapped over time to give an objective reading of a team's progress. The main advantage of rating systems is their ability to aid with seeding of teams for competition draws. An evaluation of rating systems for soccer found that the Elo rating system (Elo, 1978) and a modified Elo system used for the FIFA women's world rankings had greater predictive power than other rating systems used for soccer (Lasek et al., 2013). The Elo rating system was originally developed by Arpad Elo to rate chess players but has since been tailored to other sports (Elo, 1978). The principle behind the Elo system is that both teams have a

specific start off rating. After the match the expected outcome is compared to the actual outcome, yielding a certain number of points. These points are then taken from the losing team and given to the winning team. The method means that a team's total number of points can only be affected when they play a game.

While the National Football League gives a natural ranking of teams from final league standings, rating teams off this alone would be somewhat flawed. The National Football League begins each year either in the last week in January or first week in February, just 4 weeks after the start of pre-season training. The All Ireland Football Championship on the other hand, begins in May and continues through to September, giving players more time to physically prepare for competition. If players are not near their peak fitness levels then naturally matches played so early in the season will be played at a lower intensity. Higher attendances at matches and larger television audiences is another reason why team's prioritise the All Ireland Championship over the National Football League. The larger financial incentives that come with the Championship mean that it would be illogical to prioritise the National Football League. Therefore if teams are not physically fit and fully focused, it would be unfair to base team ratings solely on league position.

The addition of a rating system to Gaelic football could have a number of benefits. Each county team is governed by a county board, a committee of people who make many decisions regarding the county's representative teams, including hiring and firing of management teams. An objective rating system would give these administrative committees another decision making tool when reviewing the progress made by their team over a period of time. The advantage for coaches and players is similar, they could set themselves targets to reach based on their rating and evaluate their progress by monitoring how their rating has changed. From an academic point of view, the ability to objectively classify the quality of teams would allow for more valid comparisons between teams in research. The aim of this investigation is to devise an appropriate rating system to rate teams in Gaelic football in terms of previous results. The secondary aim is to examine factors that may differentiate top and lower rated teams.

Methodology

Match Sample and Data Selection

Senior Inter County Gaelic football match results from 6 seasons (2010-2015) were gathered from both an online source (*Hoganstand.com*) and a Gaelic sports book (Donnegan, 2015). The criteria for selection were that games had to be within the National Football League or the All Ireland Football Championship. Match results that met the criteria (n=1101) were imported into Microsoft Excel (Microsoft Inc., Redmond, Washington). Population figures were taken for the years 1991 and 2011 from official census results. Player registration numbers were obtained directly from the GAA. Financial figures and information on the number of club teams were sourced from the Official GAA Annual Reports (Gaelic Athletic Association, 2014). Team expenses figures were obtained from each county's annual report.

Rating System

The rating system used to rate teams is a modified version of the Elo formula (Elo, 1978), similar to that of the World Elo Football Ratings (Advanced Satellite Consulting Ltd., 2015). The formula is as follows;

$$R_N = R_O + K (O - O_E)$$

$$O_E = \frac{1}{1 + c^{-((Rh+p)-Ra)/d}}$$

R_N = New Rating R_O = Original Rating   K = Constant   O = Outcome

O_E = Expected Outcome R_h = Rating of home team R_a = Rating of away team

p = home advantage points c = Constant d = Constant

Constant Values

There are three parameters in the Elo formula that need to be set, the c, d and k factors. According to Hvattum & Arntzen (2010) both the c and d factors serve only to set a scale for the ratings. They further add that alternative values of c and d give identical rating systems. For consistency, in the Elo formula for Gaelic football, the *c* factor is set at 10 and the *d* factor is set at 400 as it is in the work by Hvattum & Arntzen (2010) and in The *World Football Elo Ratings* (2015).

The k factor in the Elo formula determines how much a team's rating changes after the result of a match. The lower the k value, the lower the rate of change and the higher the k value, the faster the rate of change. In sports such as soccer and tennis where matches are frequent, a relatively low k factor is desirable. Gaelic football differs from theses sports as many teams will only play 9 competitive matches in a season. For this reason a higher k factor is desirable.

The *World Football Elo Ratings* is a well known rating system published by Eloratings.net (Advanced Satellite Consulting Ltd., 2015). The website incorporates a couple of factors into its K factor including the importance of the match as well as the margin of victory. Similar considerations were used in the Elo formula for Gaelic football. The All Ireland Championship is the major competition for which teams prioritise each year. To qualify for the All Ireland Championship, teams must progress through their Provincial Championship. If a team loses in the Provincial Championship, they are afforded a second chance to reach the All Ireland Championship through the All Ireland Qualifiers. Anecdotal evidence suggests that physical demands are much higher in the championship than in the league and that as the championship progresses, so too do the physical demands. To reflect the variation in importance and physical demands, stages of competition were afforded the following weighting;

All Ireland Championship = 100 points   Provincial Championship = 70 points

All Ireland Qualifiers = 70 points   National Football League = 50 points

Margin of victory is incorporated into the Elo formula to ensure that a greater margin of victory leads to a greater points swing in the ratings. The margin of victory multiplier was calculated as a ratio of points scored to points conceded. To ensure very large score differences do not cause a huge swing in ratings, a cap of 2.5 was applied for the margin of victory multiplier.

Start off Rating

Teams were given a start off rating according to their final league position in the year prior to the commencement of the ratings (2009 National Football League). The highest number of points (1800) was given to the team that finished top of division 1. The second highest placed team was given 20 less points and so on as far as the lowest placed team in the National Football League. Teams that were included after the end of the 2009 season were given the same start off points as the lowest rated team in the National Football League in 2009 (1160 points).

Home Advantage

The *World Football Elo Ratings* add an arbitrary 100 points to the home team's rating to account for home advantage when calculating the expected outcome (Advanced Satellite Consulting Ltd., 2015). To adjust for home advantage in Gaelic football, the results of 976 competitive Inter County Gaelic football games were analysed. The winning % of home teams was found to be 56.0 % in comparison to 37.5% for away teams. Using these figures it was possible to calculate a point advantage for home teams by ways of a weighted average formula. Home advantage was calculated to be worth 79 Elo rating points to the home team.

$$R_N = R_O + M.I \ (O - O_E)$$

R_N = New Rating R_O = Original Rating   M = Margin of victory

I = Importance of fixture   O = Outcome O_E = Expected Outcome

Outcomes: Win = 1, Draw = 0.5, Loss = 0

$$O_E = \frac{1}{1+10^{-((Rh+79)-Ra)/400}}$$

R_h = Rating of home team R_a = Rating of away team

Example using the Elo rating formula for Gaelic football

Derry versus Tyrone in the National Football League

Derry Original Rating = 1780   Tyrone Original Rating = 1720

Final Score: Derry 1-18 (21 points) - Tyrone 1-12 (15 points) – Margin = 1.4

$$R_N = R_O + M.I \ (O - O_E)$$
$$= 1780 + 1.4 \times 50 \ (1 - \frac{1}{1+10^{-((1780+79)-1720)/400}})$$
$$= 1802$$

New Rating Derry = 1802   New Rating Tyrone = 1698

Statistical Analysis

Statistical analysis was carried out in SPSS for Windows (SPSS Inc., Chicago, Il.). Spearman's ranked correlation was used to determine whether there was a relationship between team rating points and each of the other selected variables. Wins predicted by the Elo formula (where the expected result was equal to or greater than 66.6% in one team's favor) were compared to actual results to assess the predictive ability of the Elo rating formula for Gaelic football.

Results

In order to assess the predictive ability of the Elo rating system for Gaelic football predicted wins were measured against actual match results. For every match, the Elo rating formula gives a number between 0 and 1 which signifies the 'expected result'. The closer the number is to 1, the more likely a team will win the match according to the formula. With this in mind, in matches where teams had an expected result greater than 0.666 (66.6%), they team were deemed likely by the Elo Rating formula to win that match.Wins predicted by the Elo Ratings formula for Gaelic football were compared to actual results (Table 1).

Table 1 – Predicted wins based on Elo formula versus actual wins

Year	Number of wins predicted by Elo formula	Wins correctly predicted by Elo formula	Correct %
2010	81	59	72.84%
2011	106	81	76.42%
2012	118	83	70.34%
2013	103	75	72.82%
2014	115	84	73.04%
2015	119	86	72.27%
Total	642	468	72.90%

Table of ratings (2015)

All 1101 games were run through the Elo formula from the previous 6 seasons, yielding an up to date rating for the end of 2015. The table below (table 2) represents the standing of teams following the 2015 season. Dublin, the reigning All Ireland Championship and National Football League champions top the table. The lowest rated team is Kilkenny, who no longer participate in the two major Gaelic football tournaments.

Table 2 - A rating of teams as of the end of 2015, based on the Elo formula for Gaelic football

Rating	County	Points	Rating	County	Points
1	Dublin	2194	18	Cavan	1470
2	Kerry	2054	19	Westmeath	1423
3	Mayo	2004	20	Laois	1416
4	Donegal	1876	21	Longford	1376
5	Tyrone	1871	22	Wexford	1345
6	Monaghan	1846	23	Clare	1330
7	Cork	1827	24	Limerick	1307
8	Kildare	1718	25	Offaly	1300
9	Galway	1696	26	Louth	1260
10	Derry	1654	27	Antrim	1249
11	Fermanagh	1614	28	Leitrim	1184
12	Roscommon	1613	29	Wicklow	1063
13	Meath	1599	30	Carlow	1034
14	Armagh	1591	31	New York	1005
15	Down	1498	32	Waterford	951
16	Sligo	1497	33	London	940
17	Tipperary	1486	34	Kilkenny	*709*

Population

Population was examined from the 5 most recent census in Ireland. Census details from New York and London were examined for the years 1991 and 2011. It is important to note that the population of New York and London surpass the entire population of Ireland. Some moderate correlations exist between current rating points and population figures (Table 3).

Table 3 – Spearman's correlation coefficient between current Elo rating points, population, player registrations and Gaelic club figures.

Population and Player Registrations	ρ	GAA Club Figures	ρ
Total Population in 1991	.397*	Number of youth hurling clubs in a county	-.101
Total Population in 1996	.454*	Number of youth football clubs in a county	.523**
Total Population in 2002	.449*	Ratio of youth football to hurling clubs in a county	.412*
Total Population in 2006	.428*	Number of adult hurling clubs in a county	-.090
Total Population in 2011	.382*	Number of adult football clubs in a county	.631**
Percentage change in population from 1991 to 2011	-.135	Ratio of Adult football to hurling clubs in a county	.368*
Male Population in 2006	.430*	Number of U21 hurling clubs in a county	-.089
Male Population in 2011	.382*	Number of U21 football clubs in a county	.499**
Registered GAA Players in 2015	.466**	Percentage of GAA youth teams that are football in a county	.412*
Registered GAA Players in 2014	.490**	Percentage of U21 GAA teams that are football in a county	.312
Registered GAA Players in 2013	.516**	Percentage of adult GAA teams that are football in a county	.368*
Registered GAA Players in 2012	.512**		
Registered GAA Players in 2011	.477**		

ρ = Spearman's correlation coefficient
* Correlation is significant at the 0.05 level (2-tailed)
**. Correlation is significant at the 0.01 level (2-tailed)

Player Registrations

Registered GAA players per county were examined over a 5 year period (2011-2015). Number of player registrations increased on average by $20.5 \pm 13.9\%$ over the 5 year period. In 2015, the average number of player registrations in the top 10 counties was $17,598 \pm 10,909$. The large standard deviation is reflective of the fact that 41.5% of the registered players in the top 10 rated counties come from just two counties (Dublin and Cork). The average number of player registrations in counties rated 11 to 34 was much lower at $8,805 \pm 3,385$. A moderate

relationship exists between number of registered players and team rating points (Table 3).

Percentage of Football Teams

Between 2010 and 2014 there was a 5.7% increase in the number of GAA clubs in Ireland, however at the same time there was a 5.7% decrease in the number of adult football clubs. A strong correlation exists between the number of adult football teams in a county and Elo rating points ($\rho = 0.631$, p < .001) The ratio of adult football teams in comparison to adult hurling teams in the top 5 rated counties (4.9 ± 1.9 football teams for every hurling team) is much higher than in the bottom 5 rated counties (1.5 ± 1.66 football teams for every hurling team). Cavan had the highest ratio of adult football teams to adult hurling teams (30:1) whilst Kilkenny had the lowest (0.38:1). The average ratio of adult football teams to adult hurling teams (1.83:1) is greater than the average ratio of youth football teams to youth adult teams (1.72:1).

Previous Success

Previous success is compared for both the last 15 years and the last 30 years. A similar pattern is evident through both periods, with the current top teams outperforming the lower rated teams in terms of historical success at senior level, U21 level, U18 level and at schools level (Table 4).

Financial Income from GAA

Each year the Gaelic Athletic Association provides each county with funding. Likewise, the Irish Sports Council provides additional funding which is dispersed at the discretion of the Gaelic Athletic Association. According to the GAA, categories for funding include; rent, commercial distribution, competition distribution, team expenses, administration and other grants, games development and capital grants. The top 5 teams received on average €5.10m ± €1.83m compared to €3.36 ± €0.56m received by teams rated 6 to 10. Teams rated 11 to 34 received on average just €2.50m ± €1.00m. Over the five year period, the GAA allocated €15.6m for Game Development across the country. Of the 15 plus million invested in game development, 48.13% of this money was allocated to the top rated county.

Team Expenses

Financial expenditure in the form of team expenses was analysed for 7 years (2009-2015). Team expenses include, and are not limited to, travel expenses, team holidays, training equipment, kits and employment of staff. The figures reported are spread between both football and hurling, senior and underage county squads. On average the top 5 teams spent €6.07 ± 2.69m in comparison to the €5.52 ± 2.96m spent by teams rated 6 to 10. The average team expenses for teams rated 11 to 34 were considerably lower at €3.64 ± 1.28m. Spearman's rank correlations between team expenses and Elo rating points are outlined below (Table 5).

Table **4** – Spearman's correlation coefficient between current Elo rating points and previous success parameters.

Senior Level	ρ	U21 Level	ρ	U18 Level	ρ	Schools Level	ρ
Senior All Ireland Finals won since 2001	.608**	U21 All Ireland Finals won since 2001	.603**	U18 All Ireland Finals won since 2001	.561**	School All Ireland Finals won since 2001	.256
Senior All Ireland Finals reached since 2001	.700**	U21 All Ireland Finals reached since 2001	.696**	U18 All Ireland Finals reached since 2001	.718**	School All Ireland Finals reached since 2001	.335
Senior Provincial Finals won since 2001	.761**	U21 Provincial Finals won since 2001	.649**	U18 Provincial Finals won since 2001	.795**	School Provincial Finals won since 2001	.507**
Senior Provincial Finals reached since 2001	.844**	U21 Provincial Finals reached since 2001	.800**	U18 Provincial Finals reached since 2001	.791**	School Provincial Finals reached since 2001	.578**
Senior All Ireland Finals won since 1986	.642**	U21 All Ireland Finals won since 1986	.649**	U18 All Ireland Finals won since 1986	.592**		
Senior All Ireland Finals reached since 1986	.755**	U21 All Ireland Finals reached since 1986	.713**	U18 All Ireland Finals reached since 1986	.689**		
Senior Provincial Finals won since 1986	.844**	U21 Provincial Finals won since 1986	.765**	U18 Provincial Finals won since 1986	.802**		
Senior Provincial Finals reached since 1986	.879**	U21 Provincial Finals reached since 1986	.805**	U18 Provincial Finals reached since 1986	.832**		

ρ = Spearman's correlation coefficient
* Correlation is significant at the 0.05 level (2-tailed)
**. Correlation is significant at the 0.01 level (2-tailed)

Table **5** – Spearman's correlation coefficient between current Elo rating points and financial figures.

Income from GAA	ρ	Expenditure	ρ
Total Rent	.385*	2015 Team Expenses	.358*
Total Commercial	.545**	2014 Team Expenses	.431*
Total Competition Distribution	.385*	2013 Team Expenses	.434*
Total Team Expenses	.471**	2012 Team Expenses	.460*
Total Games Development	.015	2011 Team Expenses	.286
Total Income since GAA	.370*	2010 Team Expenses	.334
Games Development Income per population	-.250	2009 Team Expenses	.393*
Total Income per population	-.300	Total Team Expenses (2009-2015)	.391*
Games Development Income per registered player	-.373*		

ρ = Spearman's correlation coefficient
* Correlation is significant at the 0.05 level (2-tailed)
**. Correlation is significant at the 0.01 level (2-tailed)

Discussion

There is currently no objective system for classifying Gaelic football teams other than looking at final league and championship standings. The primary aim of this study was to adapt a recognised rating system to Gaelic football as a method for classifying teams. The secondary aim was to examine factors that may have influence on the success of senior Inter County teams. A rating table of teams from 1 to 34 was successfully created. Dublin proved to be the highest rated team in the sport at the end of 2015. Success at senior level as well as at U18 and U21 level was found to have strong correlations to current senior ratings. There are moderate correlations between population and current ratings and between participation levels and current ratings.

To assess the accuracy of the Elo ratings formula for Gaelic football, expected results were compared to actual results. Matches where one team was expected to have a 66.6% chance or greater of winning according to the formula were examined. A total of 642 games fell into this criteria, with the Elo rating formula predicting the correct result 72.9% of the time. The high percentage of correct results means the Elo ratings formula for Gaelic football is an accurate model. In the Elo formula, the expected result is taken away from the actual result to calculate the change in rating of the teams. To keep the formula consistent, arbitrary values of 1 for a win, 0.5 for a draw and 0 for a loss are used for the actual result in the Elo formula. To accommodate for matches that are more one-sided than others, the margin of victory is multiplied by the difference in the actual outcome minus the expected outcome.

The most up to date ratings as of the end of the 2015 season can be seen in table 2. Weak to moderate correlations were found between population figures and Elo rating points (table 3). The larger the population that's in a county, the more people there are to choose from for selecting a county team. The correlation between population and ranking points was not strong however, which is similar to the findings of Bernard & Busse (2004) where population was not

an adequate predictor of the number of Olympic medals won by a country over a 36 year time period.

Moderate correlations were observed between number of registered GAA players in a county and Elo rating points (Table 3). The primary explanation for the increase in player registrations from 2011 to 2015 would be the fact that the population of Ireland has grown in each of the last 5 census. For example, the percentage increase of registered players in Carlow (51.0%) from 2011 to 2015 may be explained by the fact that the population of the county increased by 31% from 1996 to 2011. Success of the senior team may also influence participation levels in a county. In 2011, Donegal won their first Ulster Championship in almost two decades. From 2011 to 2012, there was a 10.67% increase in player registrations in Donegal. In 2012, Donegal won their first All Ireland Championship for 20 years. From 2012 to 2013, there was a further 11.67% increase in registration numbers. A similar effect was seen in Monaghan when they won their first Ulster title in over 20 years in 2013. From these figures it seems that success has a positive impact on player registrations.

A strong positive correlation was observed between the number of adult Gaelic football clubs in a county and Elo rating points ($\rho = 0.631$, $p < 0.001$) while a negative correlation was observed between the number of adult hurling clubs in a county and Elo rating points ($\rho = -.09$, $p = 0.625$). The dominance of hurling in the bottom rated teams is perhaps a major reason why they don't fare well at Inter County football. The most obvious case of the conflict between Gaelic football and hurling is Kilkenny. Kilkenny are rated as the lowest Gaelic football team in Ireland, yet they are the most successful county in terms of inter county hurling success. The dominance of hurling over football in Kilkenny is so great that they no longer participate in the National Football League or the All Ireland Championship. Future research may focus on a similar investigation of success in hurling.

A possible limitation of the Elo system is that Elo rating cannot change when a team does not play. In the instance of Kilkenny, their rating has not changed since they stopped participating in the two major adult competitions. With this in mind, teams who play more often are more likely to see a change in their rating, whether this change is positive or negative.

It was important to look back further than one generation to assess whether previous success is similar across multiple generations of players. For this reason, success was broken down into the previous 15 years and the previous 30 years. A very strong correlation was observed between the number of senior provincial finals won since 1986 and Elo rating points ($\rho = 0.844$, $p < 0.001$). Similar strong correlations between previous senior success and Elo rating points are presented in Table 4. A possible reason for the top team's continued success is the 'winning culture' created by this previous success. Success can lead to an increase in self-efficacy and if a person has greater self efficacy, then they are more likely to complete a future task (Bandura, 1986). The same theory could be applied to athletes and sports teams, where they grow in self efficacy and self confidence following success.

It has previously been suggested that success at underage level may lead to further success at senior level (Considine, 2012). Strong and very strong correlations were observed respectively between the number of U21 provincial finals won since 1986 and Elo points ($\rho = 0.765$, $p < 0.001$) and number of U18 provincial finals won since 1986 and Elo points ($\rho = 0.802$, $p < 0.001$). At secondary school level there are moderate correlations between the number of provincial finals won and Elo points ($\rho = 0.507$, $p=0.002$) and provincial finals reached and Elo points ($\rho = 0.578$, $p < 0.001$). This tells us that success at U18 and U21 level is a better predictor of future senior success than success at secondary school level.

Each year, money is allocated by the GAA and the Irish Sports Council for Gaelic games development. When analysing money received per registered GAA player, the Games Development money received from Dublin was greater by far than any other county (€274.67 per registered player). In comparison, the Games Development money received per registered player by the other top 10 counties combined was less than what Dublin received (€231 per registered player). Moderate correlations were observed between total commercial income from the GAA and Elo points (ρ =0.545, p = 0.001) as well as total team expenses from the GAA and Elo points (ρ = 0.471, p = 0.005). These correlations are expected as naturally the further a team progresses in a competition, the more team expenses they will run up and the more commercial opportunities that will arise to them.Team expenditure in the form of team expenses are outlined in table 5. Weak to moderate correlations exist between team expenses and Elo points. A possible reason for this modest relationship is the fact that counties do not distinguish between how much expenses are incurred by each team in their annual reports, instead only total figures are given.

Further examinations into the links between previous youth success and current senior success are necessary in understanding the relationship between the two. Future research may look at technical and physical variations between top and bottom teams as rated by the Elo Rating System for Gaelic football. This may give an insight into how such a sizable gap exists between the top teams and lower rated teams.

Conclusion

The Elo ratings formula for Gaelic football is an objective method for rating Gaelic football teams. The formula removes bias from the equation, allowing coaches and practitioners to compare teams in terms of previous results and predict future results with a fair degree of accuracy. Given that the results show that there is a link between underage success and current senior success, lower rated counties may decide to put greater emphasis on achieving success at underage level, particularly at U18 and U21 age grades. There must be caution however when pursing success at underage level where the primary aim should be the development of players.

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